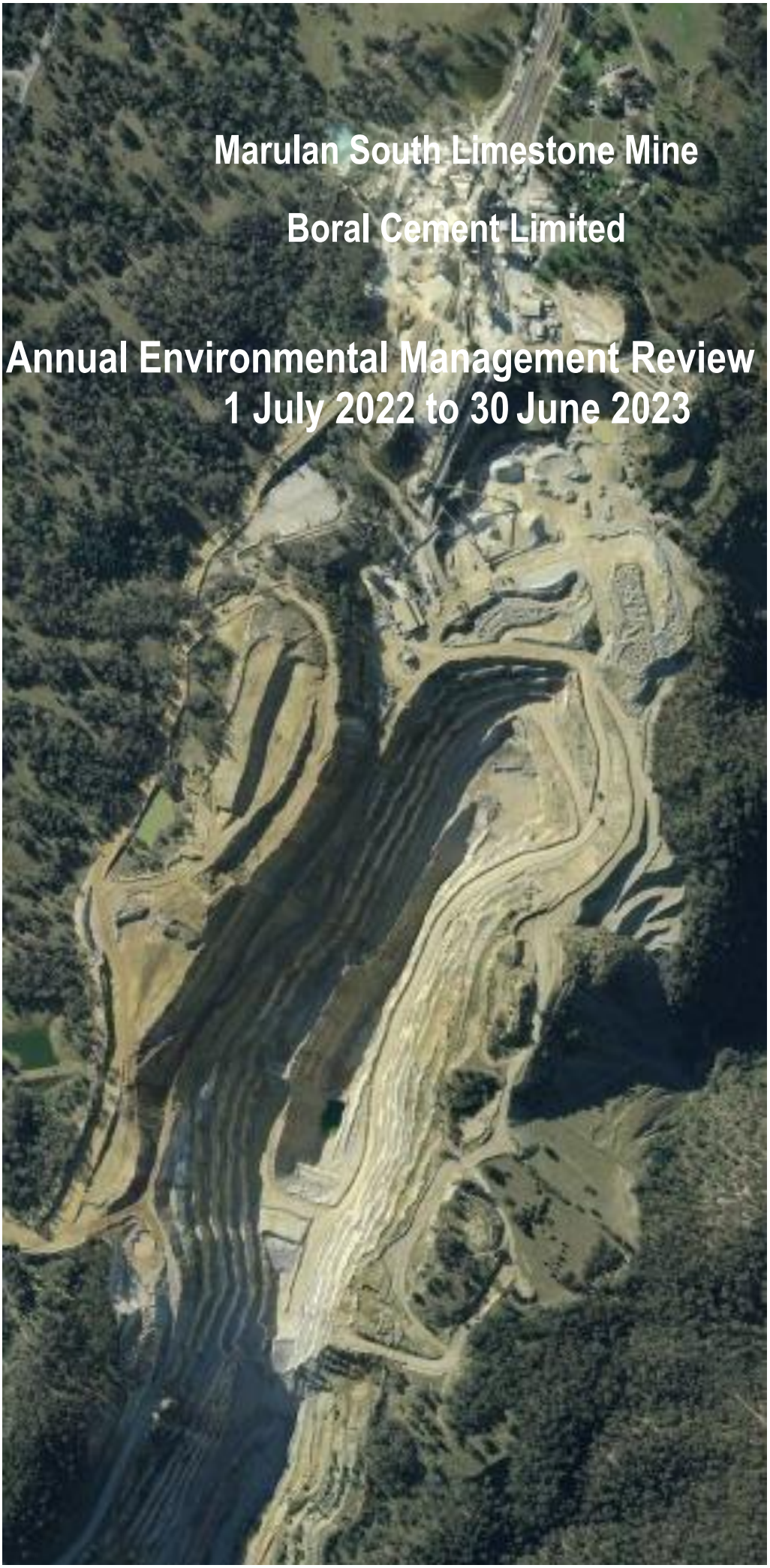

Marulan South Limestone Mine

Boral Cement Limited

Annual Environmental Management Review
1 July 2022 to 30 June 2023

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ANNUAL REVIEW INFORMATION

Annual Review Authorisation

Name of Operation	Marulan South Limestone Mine
Name of Operator	Boral Limited
Development Consent No.	SSD 7009
Name of holder of development consents	Boral Cement Limited
Mining Lease	CML16, ML1857
Name of Holder of Mining Lease	Boral Cement Limited
Water Licence	WAL25207, WAL25373, WAL25352, WAL24697, WAL41976
Name of Holder of Water Licence	Boral Cement Limited
RMP	Currently under review
Annual Review start date	01 Jul 2022
Annual Review end date	30 Jun 2023

I, Greg Johnson, certify that this audit report is a true and accurate record of the compliance status of the Marulan South Limestone Mine for the period 1 Jul 2022 to 30 June 2023 and that I am authorised to make this statement on behalf of Boral Cement Limited.

Note.

a) The Annual Review is an 'environmental audit' for the purposes of section 122B(2) of the Environmental Planning and Assessment Act 1979. Section 122E provides that a person must not include false or misleading information (or provide information for inclusion in) an audit report produced to the Minister in connection with an environmental audit if the person knows that the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, $1 million and for an individual $250,000.

b) The Crimes Act 1900 contains other offences relating to false and misleading information: section 192G (intention to defraud by false or misleading statement – maximum penalty 5 years imprisonment); sections 307A, 307B and 307C (False or misleading applications/ information/ documents – maximum penalty 2 years imprisonment of $22,000, or both).

Name of authorised reporting officer	Greg Johnson
Title of authorising reporting officer	Senior Environmental Business Partner NSW/ACT
Signature of authorised reporting officer	
Date	30 September 2023

1. STATEMENT OF COMPLIANCE

This Annual Review (AR) summarises compliance with State Significant Development Approval (SSD) 7009 which was granted by the NSW Department of Planning, Industry and Environment on 19 August 2021. Mining operations commenced under this consent on 1st January 2023. The following Mining Authorisations, Mining Operations Plan and EPL are also applicable to the Marulan South Limestone Mine:

- ML1716 (relinquished 14/7/2023);
- CML16;
- ML1857 (granted 14/7/2023)
- Marulan South Limestone Mine 2018-2023 Mining Operations Plan; and
- Environment Protection Licence 944.

This report has been prepared in accordance with the *Post-approval requirements for State significant mining developments Annual Review Guideline* (2015) (the Guideline). Tables 1.1 to 1.3 detail the compliance status of Marulan South Limestone Mine during the 2022 to 2023 reporting period.

Table 1.1 – Compliance Summary 2022/2023

Were condition of the relevant approval(s) complied with?	
SSD 7009	Conditions satisfied
ML 1716	Conditions satisfied
ML1857	Conditions satisfied
CML 16	Conditions satisfied
MOP 2018-2023	Conditions satisfied
EPL 944	Conditions satisfied

Table 1.2 – Non-Compliance

Approval	Condition	Description	Compliance Status	Comment	Where addressed
SSD 7009	N/A	N/A	N/A	N/A	N/A

Table 1.3 Compliance Status Key

Risk Level	Code	Description
High	Non-compliant	Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence.
Medium	Non-compliant	Non-compliance with: ❒ potential for serious environmental consequences, but is unlikely to occur; or ❒ potential for moderate environmental consequences but is likely to occur.
Low	Non-compliant	Non-compliance with: ❒ potential for moderate environmental consequences, but is unlikely to occur; or ❒ potential for low environmental consequences but is likely to occur.

Administrative non-compliance	Non-compliant	Only to be applied where the non-compliance does not result in any risk of environmental harm (eg submitting a report to government later than required under approval conditions).

Pre-commencement conditions associated with SSD 7009 were satisfied in the 2022 reporting period allowing commencement of the new approval on 1st January 2023. This Annual Review has therefore been prepared in accordance with Clause D11 of SSD 7009.

2. INTRODUCTION

2.1 Overview

Boral's Marulan South Limestone Mine has been operational since the 1860s, consisting of a limestone mine and processing plant (Figure 1). It is located directly to the north of Bungonia Gorge and approximately 35km east of Goulburn NSW, with lands covering 650 hectares of a significant limestone and granodiorite deposit (Figure 2). Resources over a total of 616.5 hectares of land are to be extracted under SSD 7009 (Figure 3).

The mine produces a range of limestone products for the cement and steel industry as well as the construction, agricultural and industrial markets across the state. Limestone is an essential ingredient in cement and steel manufacture while a component is further processed on site to produce Calcium Oxide and Hydrated Lime for various applications such as water purification, mining, asphalt production and soil stabilisation. Crushed Limestone is transported by rail direct to the Boral Cement Works at Berrima and Maldon, or to Bluescope Steel at Port Kembla. Limestone supplied to the Peppertree Quarry forms a key part of manufactured sand for concrete and Limestone and fine limestone are also widely used in the agricultural industry for neutralising soils and for animal feed. Lime products are distributed typically by road tanker to destinations throughout NSW or by container to Queensland and Victoria. A component of the mine production including clay shale and aggregates is transported directly by truck where rail facilities are not available. Marulan South Limestone Mine operates 24 hours per day, 7 days per week and employs approximately 95 full time personnel.

Boral received approval for the Marulan South Limestone Mine Continued Operations State Significant Development Application (SSDA) on the 19th August 2021 which came into force on 1st January 2023 with the completion of various pre-conditions including the approval of various management plans for the operation. The approval provides a modern planning consent consistent with current legislative requirements which covers a 30 year mine plan representing 120 Mt of limestone at an extraction rate of 4 Mtpa. Clay shale will also be extracted at a rate of up to 200,000 tpa. The new mine plan seeks to incorporate rehabilitation and final landform initiatives with overburden emplacement.

The continued operations of the mine will provide an uninterrupted supply of construction materials to local and regional industries and state projects with an optimal use of regionally significant resources. The mining project is expected to provide economic benefits to the local community through the purchase of goods, local expenditure, and continued employment of almost 200 people, both directly and indirectly associated with the mining operations.

This Annual Review has been prepared in accordance with Condition D11 of SSD 7009 and covers the operation over the 2022-2023 period. This review has been structured in accordance with the Department of Planning and Environment guidelines for the preparation of Annual Reviews.

2.2 Key Personnel

Details of the management personnel at Marulan South Limestone are provided in Table 2.1 below. Additional specialist advice is provided as required by a range of environmental consultants.

Table 2.1 –Mine Contacts

Role	Name	Contact
Marulan Limestone Statutory Quarry Manager	Jamie Whittaker	Ph: 0401 895 212 Email: jamie.whittaker1@boral.com.au
Mine Technical Manager	Garth Nagle	Ph: (02) 4820 3048 Email: garth.nagle@boral.com.au
Senior Environmental Business Partner	Greg Johnson	Ph: (02) 9033 4916 Email: greg.johnson@boral.com.au
Environmental and Stakeholder Advisor	Therese Thomas	Ph: (02) 4820 3007 Email: therese.thomas@boral.com.au

3. APPROVALS

This chapter describes the approval platform for the Marulan South Limestone Mine along with other mining and statutory approvals relevant to the ongoing operation.

3.1 Planning Consent

The Marulan South Limestone Mine operates under SSD 7009 which overrides the previous five development consents issued by Goulburn Mulwarree Council (Appendix B). The current approval was the subject of an Environmental Impact Statement and State Significant Development Application covering all existing and future operations for a 30 year period until 31 August 2051. The approval allows for the extraction of up to 4 million tonnes per annum (tpa) of limestone, extraction of up to 200,000 tpa of clay shale and the processing of the lime products (hydrated lime and quick lime) limestone aggregates and sand.

The mine footprint focuses on an expansion of the pit westwards to mine the Middle Limestone and to mine deeper into the Eastern Limestone. As the Middle Limestone lies approximately 70-150 m west of the Eastern Limestone, the 30-year mine plan avoids mining where practical the interburden between these two limestone units thereby creating a smaller second, north-south oriented west pit with a ridge remaining between. The north pit will also be expanded southwards, encompassing part of the south pit, leaving the remainder of the south pit for overburden emplacement and a visual barrier. The approval allows for accessing approximately 120 Mt of limestone down to a depth of 335m.

3.2 Mining Approvals

3.2.1 Consolidated Mining Lease No. 16

Consolidated Mining Lease No. 16 (CML16) was granted on the 23 April 2004 for the purpose of prospecting and mining for agricultural lime, clay/shale, iron minerals, limestone, marble, and structural clay. CML16 is the consolidation of 66 leases that allows mining operations at Marulan South Limestone Mine until 26 February 2023. An application was made to extend the expiration date to cover the period until the new mining lease was approved, which is currently pending. It is anticipated that CML16 will be relinquished in the coming reporting period.

3.2.2 Mining Lease 1716

ML1716 was granted on the 4 September 2015 to remove a depth restriction on 12.04 hectares on the Eastern Batters within CML16. The lease was granted for a period of 21 years for mining clay/shale, iron minerals, limestone, marble, and structural clay. ML1716 was cancelled on 14th July 2023 when the new ML1857 was granted for the mining operations as the new lease covers the proposed mining disturbance area including all of the previous ML1716 area.

3.2.3 Mining Lease 1857

During the previous reporting period, an application for a new mining lease was lodged with Department of Regional NSW - Resource Operations, Mining, Exploration and Geoscience

which was granted on 14th July 2023 for a term of 21 years. This ML1857 covers the new mining and associated ancillary activity areas as covered by SSD7009 for the Continued Operations Project that were not already covered by CML16. The finalisation of the remnant areas of CML 16 outside of ML 1857 is currently underway.

3.2.4 Mining Operations Plan / Rehabilitation Management Plan

The current Mining Operation Plan (MOP) covers the period 1 April 2018 to 26 February 2023. A new Rehabilitation Management Plan (RMP) is being prepared following receipt of the new mining lease. The RMP will replace the MOP and will be prepared under the new regulatory framework established by the Mining Amendment (Standard Conditions of Mining Leases – Rehabilitation) Regulation 2021 which came into force on 1 July 2022.

3.3 Environmental Protection Licence (EPL) 944

Boral Cement Limited holds EPL 944 for the "Marulan South Limestone Mine and Lime Plant" (Appendix A). The EPL allow for between 100,000 and 250,000 tpa of cement or lime production and between 2 and 5 million tpa of minerals production by mining.

Commencement of development under of the SSD7009 consent triggered a revision and variation of the EPL in order to align new consent conditions placed on the operation with those in the EPL. This update occurred in March 2023. As part of this review an additional dust deposition gauge was added to the licence as well as the requirement for a weather station within the premises.

3.4 Other Licences

In addition to SSD7009, mining leases and EPA licence, the following activities and items are licenced:

Table 3.1 - Site Licences

Description	Licence No	Licence Authority	Renewal
Explosive Licence to Import	11-100005-004	Safe Work NSW	15/06/2024
Acknowledgement of Notification of Dangerous Goods on Premises	35/008099	Safe Work NSW	N/A
Revised Apparatus Licence	1203917 1958988 & 1958989 9922223	A.C.M.A.	21/07/2024 23/01/2024 22/02/2024
Radiation Management Licence	5061123	NSW EPA	21/08/2023
Motor Vehicles Repairers Licence	MVRL 36381	NSW Fair Trading	02/01/2024
Refrigerant Trading Authorisation Certificate	AU 04450	ARC	10/03/2024
Certificate of Plant Item Registration	MC 6-82896/05/0	Safe Work NSW	16/10/2024
Bore Licences (2 x Production Bores) Converted to Certificate W3M9-WS-6FLQ	(WAL24697) 12 ML 10WA116142 10AL116141	NSW Department of Primary Industries Office of Water	10 Aug 2024

Description	Licence No	Licence Authority	Renewal
Ground water bore	(WAL41976) 838ML/units 10AL122346 10CA122907 (for road construction /dust suppression)		3 Dec 2028
Water Supply Works – two bores	10CA123795	NRAR	08 Apr 2030
Monitoring Bore Licences	10BL605442 10BL605443 10BL605444 10BL605445 10BL605449 10BL605450	NSW Department of Primary Industries Office of Water	Licence 10AL116141D Perpetuity
Surface Water Licence (1 x Overshot Dam & 2 Pumps)	Water supply works 10WA102352 pump to overshot dam (Shoalhaven River water source) Pumps 10AL102350 - WAL 25352 Stock and domestic (1ML Barbers Ck MGMT Zone) 10AL102351 - WAL25207 unregulated river (76ML Barbers Ck MGMT Zone)	NSW Department of Primary Industries Office of Water	30/06/2024
Surface Water Licence (1 x 38mm Centrifugal Pump)	10WA102377 10AL102376 WAL 25373	NSW Department of Primary Industries Office of Water	25/04/2026
Local Land Services ACT 2013 - Rate Notice	Ref: 110324316	NSW Government Office of Local Land Services	Feb/March 2024

4. OPERATIONS SUMMARY

This chapter summarises the production and processing operations during the 2022-23 reporting period. Historic production levels are also provided for completeness.

4.1 Mining

Table 4.1 provides a summary of production during the reporting period. Production is described as annual tonnages of Limestone, clay/shale and overburden/waste.

Table 4.1 - Mine Production

Material	Limestone (Tonnes)	Clay/shale (Tonnes)	Overburden (tonnes)
2022/2023	2,705,200	46,709	4,938,300

Overburden removal of 4.9 million tonnes occurred during the 2022/2023 period. Total production of limestone and clay/shale was well within the approved limit of 4 million and 200 thousand tonnes per annum respectively.

Limestone and (overburden as required) is mined using drilling and blasting methods while clay shale is mined by excavator or front-end loader. Limestone, clay shale and overburden are transported to the primary crusher, stockpile areas and overburden emplacement areas using the load and haul fleet of front end loaders and trucks on site.

Additional mobile crushing and screening plant is hired as required to meet and trial special product specifications and during plant breakdown and maintenance periods. Limestone is selected from particular areas within the mine and blended together with shale when required at the face, within stockpiles and during the crushing and screening process. Limestone quality is monitored using laboratory analysis of drill hole cuttings and online using Geoscan technology.

Limestone extraction has focused on the northern end of North Pit over the previous three years, requiring the prior removal of previously dumped overburden as well as in-situ shale and granite as the pit has developed. Stripping on the eastern side of North Pit and further development on the northwest side was undertaken during the reporting period to relocate the haul road to enable resource extraction. In-pit overburden emplacement continued in South Pit.

4.2 Mineral Processing

During the 2022/2023 reporting period the lime manufacturing plant produced the following tonnages of Quicklime, Hydrated Lime and Waste Lime. (Table 4.2).

Table 4.2 – Mineral Production

Material	Quicklime (Tonnes)	Hydrated Lime (Tonnes)	Waste Lime (tonnes)
2022/2023	77,014	48,820	3,038

Mineral production varies according to market demand and the current reporting period production levels are in line with recent years. There are no individual limits on mineral

production however these are used in combination with total production and transport of products from the site.

4.3 Traffic and Transportation

The approved transportation limits compared to the actual tonnages is provided in Table 4.3.

Table 4.3 Transportation Compliance

Condition	Details	Transported Tonnage 2023
A9	A maximum of 1 million tonnes of manufactured sand may be transported to Peppertree Quarry in any financial year	462,205
A10	A maximum of 150,000 tonnes of quarry products may be transported from Peppertree Quarry to the shared road sales stockpiling area in any financial year	33,448
A11	A maximum of 720,000 tonnes of limestone, clay/shale and quarry products (combined) may be transported from the site by road in any financial year	331,768

As shown in Table 4.3, total product transported by road complies with limits provided by Conditions A9 to A11. Additional limits are provided on 24-hour intervals by Conditions A12 and A13. Condition A12 provides for a maximum of 133 laden trucks to be dispatched from the site in any 24-hour period while Condition A13 provides for a maximum of six laden trains leaving the site in any 24-hour period. Details of 24-hour movements are provided in Table 4.4 along with monthly movements to show typical variations over the reporting period.

Table 4.4 – Monthly Truck and Train Movements (Total and Maximum per 24hrs)

	TRUCK		TRAIN	
	Monthly Movements	Maximum movements/24h	Monthly Movements	Maximum movements/24h
Jul-22	222	19	97	5
Aug-22	934	72	105	5
Sep-22	930	68	61	4
Oct-22	1015	89	92	5
Nov-22	796	50	88	5
Dec-22	690	63	90	5
Jan-23	781	71	39	4
Feb-23	902	64	75	5
Mar-23	920	59	94	5
Apr-23	632	50	66	5
May-23	927	55	86	5
Jun-23	870	65	63	5

As required by section 7.11 of the EP&A Act, an annual financial contribution will be paid to Council to be put toward the maintenance of Marulan South Road used for haulage of mining and quarry products. The contribution will be calculated in accordance with the Goulburn Mulwaree Section 94 Development Contributions Plan 2009. The contribution will be paid annually with the first payment period ending 31/12/2023.

4.4 Waste Management

Domestic and light industrial waste continues to be deposited in large dumpsters which are collected weekly by a licensed waste removal contractor.

All runoff from the workshop is channelled through an oil and grease separator. Recovered grease and oil material is collected and stored for removal by a licensed recycling contractor. Similarly, grease drums and oil filters are stored until collected and disposed of for recycling by a licensed contractor.

Reject lime continues to be placed in the designated area of the Middle Gully waste emplacement and investigations continue for reuse of this material to minimise on-site disposal.

4.5 Limestone and Lime Product Stockpiles

Since the removal of the larger stockpiling area, the stockpiling capabilities have been reduced to 50,000t for primary and secondary crushed/screened stone and 35,000t for finished goods stockpiles, giving a total stockpiling capability of 85,000t. The limestone bin capacity for rail dispatch is approximately 11,500 tonnes. Lime product storage capacity is 1,600 tonnes of quicklime and 700 tonnes of hydrated lime.

4.6 Hazardous Material Management

There are multiple hazardous chemical facilities at the mine with two diesel, two LPG, one compressed gas, and one distillate depot which are maintained in accordance with the Work Safe NSW Acknowledgement of Notification of Dangerous Goods on Premises Licence 35/008099. Explosives used for blasting are supplied by the contractor as necessary and not stored on site.

As required, all enclosures to fuel facilities are bunded to meet AS 1940 Storage and Handling of Flammable and Combustible Liquids, 2017 and hazardous materials and chemicals facilities are inspected at least annually by an external accredited inspector.

4.7 Exploration

The Annual Exploration report for CML16 was prepared by GeoRes and submitted to EROL in September 2023. Exploration during the reporting period continued at the northern end of the current pit with the Phase 6 and Phase 7 drilling programs. The Phase 6 drilling program extended over a period form late 2020 until early 2022, with a focus on shallow blasthole drilling over the Eastern Limestone in the extreme northwest of the North Pit. P6 consisted of 55 blastholes for a total of 1,408m, most holes were 30m long at 60°.

The Phase 7 drilling program in late 2022 aimed to infill existing drilling and provide closer spaced chemistry data on the western side of the pit around the Primary Crusher. The Eastern Limestone in the North Pit was originally explored to map the contacts of the limestone with the adjacent waste rock. During this process, large spaces between drill holes

of up to 400m wide were present. The Phase 7 program aimed to reduce drilling space to a length of 125m or less by targeting areas with wider gaps, to better explore the chemistry of the Eastern Limestone in the North Pit and provide greater confidence of near term mining. A series of 6 drill holes for 918m were drilled in November/December 2022. A planned 7th hole was deferred to later in 2023 to be drilled as a water monitoring bore.

Further geological surface mapping was undertaken during the reporting period to add to the previous mapping. This represented refinements to existing mapping, particularly in the areas drilled.

Proposed exploration during the next reporting period includes an envisaged Phase 8 (P8) drilling program. The aim of P8 will be to provide information which could not be obtained during P7, or became notable because of P7, involving a small RC exploration program of up to 5 drill holes. P8 will also include two vertical water monitoring bores. One of which is on the south rim of the South Pit (WM08), and the other near the Mine's access road on the west (WM09). These bores requirements form part of the commitments of the Water Management Plan.

4.8 Reserve and Resource Status

The Marulan South limestone resource is significant, with current estimates in the order of 640 million tonnes. SSD7009 has secured 120 million tonnes which will be extracted over a 30 year period.

4.9 Estimated Mine Life

Current studies undertaken as part of the SSD demonstrated that the limestone resource is extensive and can support at least a 30 year mine plan at an extraction rate of 4 Mtpa. The resource will not be exhausted at this time and depending on market conditions at the time, further approvals may be sought to continue extraction.

4.10 Land Preparation

No new ground disturbance or land preparation occurred in the reporting period. Within the future disturbed area (Figure 4), approximately 215,510 m^3 of good quality topsoil has been identified for stripping for future use in rehabilitation activities. The depth of stripping has been identified however it will be necessary to develop alternative topdressing material in order to cater for all future rehabilitation needs.

4.11 Construction

Minor construction projects are currently in progress or planned for the coming reporting period. These projects are required to support the ongoing operation include:

- Establishment of water control structures in association with surface water management plans;

- Ongoing replacement/upgrade of dust control systems; and
- General maintenance of processing facilities.

SSD 7009 provides approval on the construction of a new in-stream water supply dam on Marulan Creek to supplement the water supply and will include associated infrastructure such as an overland pipeline and pump station. The commencement date on this construction project is yet to be determined and will be reported in coming Annual Reviews.

Other future construction projects will include the relocation of the stockpile reclaim area and relocation of the high voltage transmission line. These will be constructed as required in coming reporting periods.

5. ACTIONS REQUIRED FROM PREVIOUS AR

The NSW Government has introduced new standard rehabilitation and reporting conditions on mining leases to set clear, achievable and enforceable requirements for rehabilitation across mine sites in NSW. The changes introduce regulatory tools and set clear requirements for rehabilitation throughout a mine's life, from the mine design stage through to closure.

New standard mining lease conditions for rehabilitation have now replaced rehabilitation conditions on existing mining leases and have been included in the new ML1857 (granted 14/7/2023). These require progressive rehabilitation, rehabilitation risk assessment, annual reporting and detailed rehabilitation management planning.

An additional change was the replacement of the previously required Annual Environmental Management Review with an Annual Rehabilitation Report and the replacement of the Mining Operations Plan with a Rehabilitation Management Plan. These documents will be prepared separately using the online Resources Regulator Portal and Rehabilitation Portal.

This document represents the first Annual Review prepared under Condition D11 of SSD7009 which will be submitted to the Department of Planning and Environment and Council. As such there are no specific actions required from previous Annual Review reporting however it is noted that no specific actions were required by the Resources Regulator following submission of the 2021/2022 AEMR.

6. ENVIRONMENTAL PERFORMANCE

This Chapter provides details of the environmental outcomes that were intended for the reporting period and whether these were achieved. This section identifies the requirements of any specific management plan other than water management and rehabilitation which are dealt with under Chapter 7 and 8 respectively.

6.1 Environmental Management Plans

Under SSD7009, the following management plans have been prepared and approved by DPE:

- Noise Management Plan.
- Air Quality and Greenhouse Gas Management Plan.
- Aboriginal and Cultural Heritage Management Plan.
- Traffic Management Plan.
- Biodiversity Management Plan.

The performance of the operation against the requirements of these plans, including any specific monitoring data or inspections required, are discussed in the following sections. In addition to these management plans, the operation also operates under a Water Management Plan which is discussed in Chapter 7 and a Rehabilitation Strategy which is discussed in Chapter 8.

6.2 Meteorological Monitoring

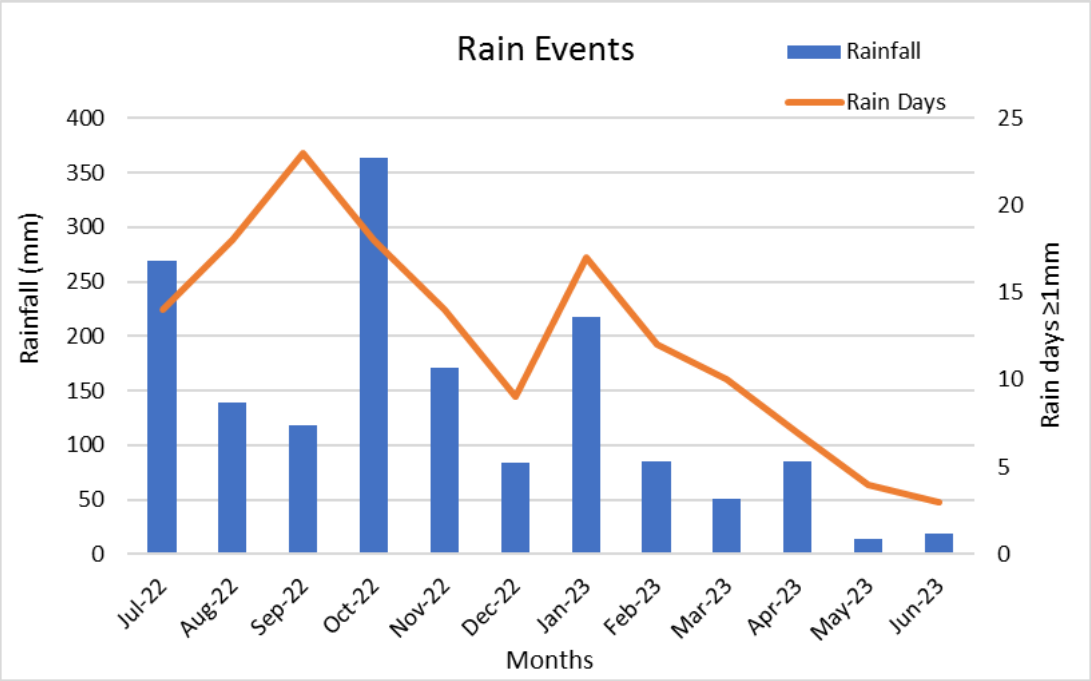
Condition B34 of the development consent and condition M5 of EPL 944 (varied March 2023) requires monitoring of meteorological conditions at the site. A new weather station was installed in 7/12/22to provide continuous meteorological monitoring data for the operation, replacing the previous station which required monthly download of data. Summaries of this data are provided in the following sections. This replaces the weather station previously used from Peppertree. Data for this report has been obtained from the original Peppertree weather station prior to commissioning of the new weather station.

6.2.1 Rainfall

A total of 1614.3mm of rainfall with 149 rain days was recorded at the site weather station during the reporting period. This was slightly higher to the previous reporting period that recorded 1065mm with 121 rain days. Rainfall was highest during October 2022 with 363mm and was the lowest in May 2023 with 14mm (Graph 6.1). The number of rain days ranged from 3-23 days per month.

Table 6.1 – Total Monthly Rainfall (mm) (2022/23)

Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	**Tot**
269	139	118	363	171	84	217	84.5	50.8	84.8	14.2	19	1614.3
Number of Rain Days (≥1mm)												
14	18	23	18	14	9	17	12	10	7	4	3	149



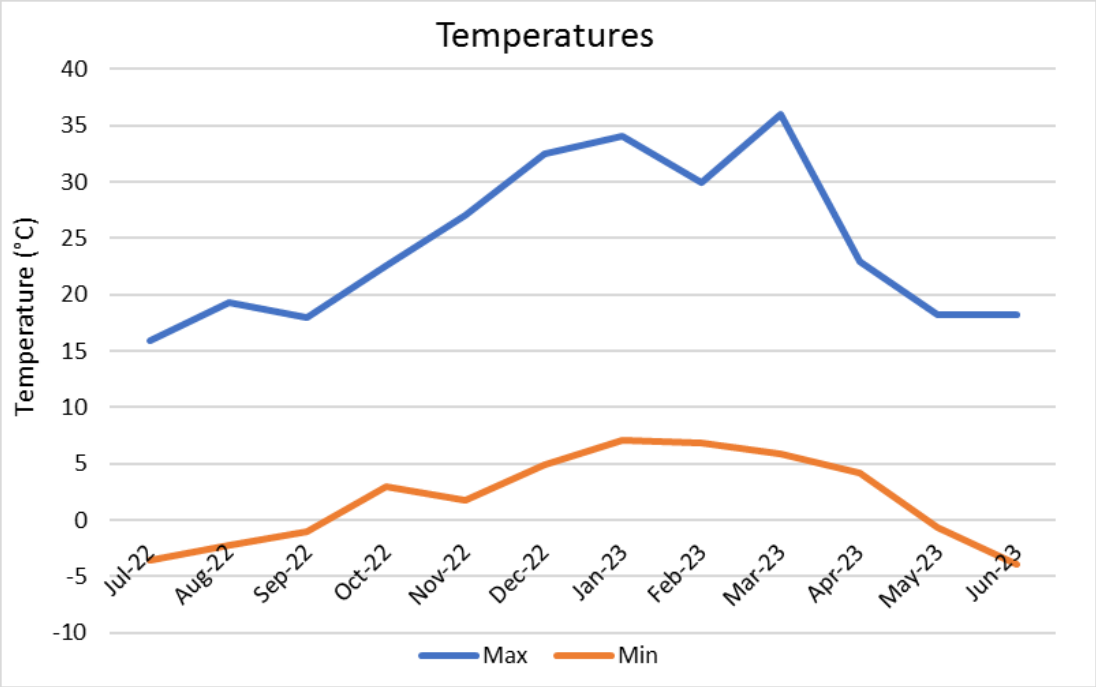
Graph 6.1 – Monthly rainfall and number of rain days

6.2.2 Temperature

Temperatures were hottest in summer months with the highest maximum of 36°C in March 2023 and were coldest during the winter months with a lowest minimum of -3.9°C in June 2023 (Graph 6.2). The average maximum and minimum temperatures for the reporting period were 24.5°C and 1.8°C respectively, which were lower maximums and minimums than recorded in the previous period.

Table 6.2 - Minimum and Maximum Monthly Temperatures (°C) (2022/23)

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Max	15.97	19.32	17.97	22.52	27.03	32.48	34.08	29.9	36.04	22.87	18.24	18.17
Min	-3.57	-2.24	-1.03	2.98	1.78	4.86	7.12	6.85	5.88	4.16	-0.68	-3.92



Graph 6.2 – Monthly Minimum and Maximum Temperatures

6.3 Air Quality

An Air Quality and Greenhouse Gas Management Plan (AQMP) was prepared for the site as required by the development consent what was approved by DPE in September 2022. The AQMP documents control measures and management initiatives, with the main objectives being to minimise the dust exposure to all persons working on site as well as to reduce the offsite dust impacts, remain in compliance with stack emission limits and mitigate dust nuisance. The AQMP provides a program detailing the assessment criteria, monitoring locations and procedures, reporting protocol and compliance checking procedures for air quality management at the Mine for the Continued Operations project.

6.3.1 Assessment Criteria

Marulan South Limestone Mine operates an air quality monitoring program as required by EPL Licence 944 and the AQMP. This program includes monitoring of ambient dust levels with deposited dust and particulates, as well as emissions of specific metals and both nitrogen and sulphur oxides from the kiln and hydrator stacks as detailed in Table 6.5. The NSW EPA air quality impact assessment criteria for dust emissions which are applicable to the Continued Operations Project are presented in Table 6.3 below.

Table 6.3 – NSW EPA Air Quality Impact Assessment Criteria (dust)

Pollutant	Averaging Period	Impact	Criterion
TSP	Annual	Total	(a, c) 90 µg/cm^3
PM_{10}	Annual 24 hour	Total Total	(a, c) 25 µg/cm^3 (b) 50 µg/cm^3
$PM_{2.5}$	Annual 24 hour	Total Total	(a, c) 8 µg/cm^3 (b) 25 µg/cm^3
Deposited Dust	Annual	Incremental Total	2g/m^2/month 4g/m^2/month

Notes:
[a] Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources).
[b] Incremental impact (i.e. incremental increase in concentrations due to the development on its own).
[c] Excludes extraordinary events such as bushfires, prescribed burning, dust storms, fire incidents or any other activity agreed by the Planning Secretary.

The NSW EPA air quality impact assessment criteria for NO_2 and SO_2 emissions which are applicable to the Continued Operations Project are presented in Table 6.4.

Table 6.4 - NSW EPA Air Quality Impact Assessment Criteria (NO_2 and SO_2)

Pollutant	Averaging Period	Criterion
NO_2	1 hour Annual	246 µg/cm^3 62 µg/cm^3
SO_2	10 minutes 1 hour 24 hour Annual	712 µg/cm^3 570 µg/cm^3 228 µg/cm^3 60 µg/cm^3

6.3.2 Kiln and Hydration Stack Monitoring

In accordance with EPA Licence 944 Condition L2, the actual load of an assessable pollutant discharged from the mine during the reporting period must not exceed the load limit specified for the assessable pollutant in table 6.5 below. Emissions of these pollutants are monitored annually, and the actual load of each pollutant is calculated in accordance with the relevant load calculation protocol provided by the EPA and reported in the EPA Annual Return. The current load limits are detailed in Table 6.5.

Table 6.5 - Assessable Pollutant

Assessable Pollutant - Air (Kg)	Coarse Particulates	Fine Particulates	Lead	Mercury	Nitrogen Oxides	Sulphur Oxides
Load Limit	8,050	5,050	6.00	2.00	91,680	170
Load 21/22	2,075	2,080	0.568	0.378	87,031	39.676
Load 22/23	7,395	3,638	0.769	1.462	73,089	30.806

Kiln stack and hydrator stack monitoring results from the previous and the current reporting periods are presented in Table 6.6. All stack monitoring results were below the 100th percentile for both existing concentration limits and for Group 5 emission standards. The latest Annual Stack Monitoring was undertaken in March 2023.

Table 6.6 - Kiln Stack and Hydrator Stack Results

Pollutant	Kiln Stack (11)		Hydrator Stack (12)
Units: mg/m^3	Nitrogen Oxides	Solid Particles	Solid Particles
Sampling Method:	TM-11	TM-15	TM-15
Existing 100th percentile concentration limit	2,500	250.0	250.0
Group 5 100th percentile concentration limit	2,000	100	100
Result 2021/2022	370	8.4	<2
Result 2022/2023	300	43	<2

Notes: Monitored results on a Dry Basis, corrected to 101.325kPa and 0^{0}C

6.3.3 Dust Deposition, PM_{10}, $PM_{2.5}$ and TSP Monitoring

Dust Deposition

Ambient dust levels are monitored at three depositional dust gauges. The dust gauges are referred to as 'Freddy's Hill' (EPL Point 18) located to the northwest of the mine and 'Store Paddock Hill' located to the northeast of the mine (EPL Point 16). As required by the EPL variation, a third deposited dust gauge was added to the monitoring network at the Sub Station (EPL Point 17), which was monitored from January 2023. The dust deposition gauges are monitored by mine personnel with samples being delivered to NATA-accredited Boral Laboratories for dust analyses.

Results for dust deposition monitoring for the deposited dust monitoring sites are shown in Table 6.7 and Graph 6.3 below.

Table 6.7 – Deposited Dust (g/m^2/month Insoluble Solids)

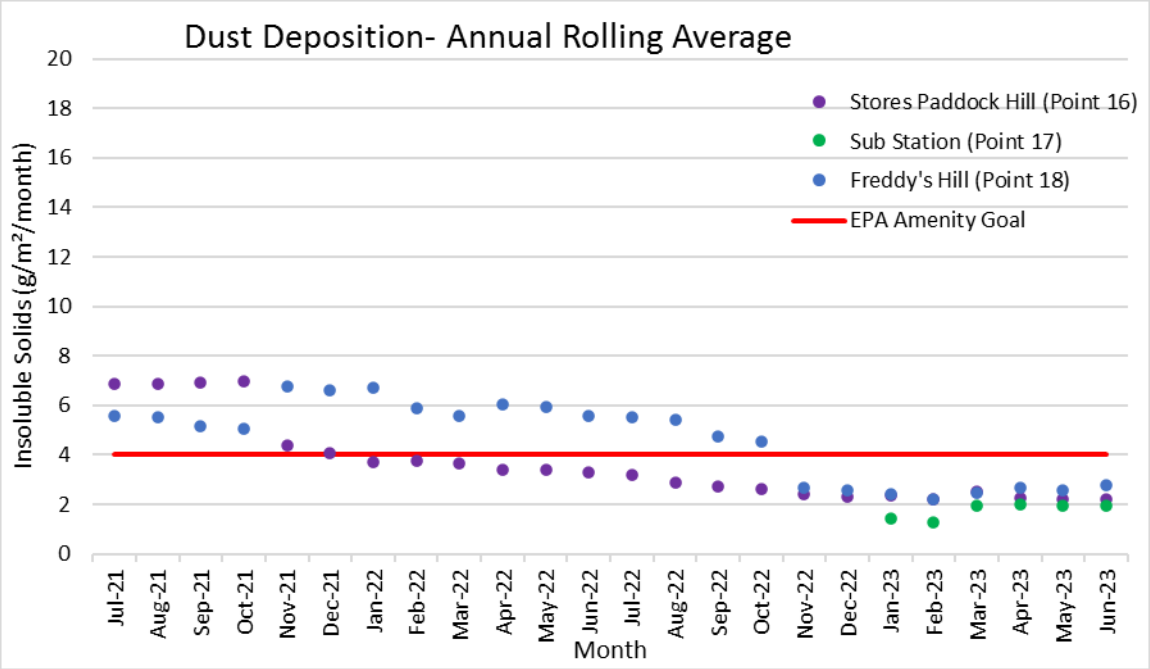
Gauge	Store Paddock Hill EPA ID 16	Sub Station EPA ID 17	Freddy's Hill EPA ID 18
2019/2020 Annual Average	11.56	N/A	7.23
2020/2021 Annual Average	6.94	N/A	5.71
2021/2022 Annual Average	3.27	N/A	5.59
2022/2023 Annual Average	2.19	1.95#	2.77

Note:# six month average January to June inclusive

The rolling average level of insoluble solids at Freddy's Hill Site 18 fluctuated from 2.22g/m^2/month to 5.54g/m^2/month during the reporting period. Prior to November 2022, the rolling average was above the assessment criteria and then dropped below the criteria for the remainder of the year. This does not constitute a non-compliance with the Development Consent because the gauge is on Boral owned land. Whilst this gauge is located on Boral-owned land the data is useful in determining the relative sources of dust which contribute to the levels experienced at the nearest non-company owned residences further from the mine. The distance to the nearest non-Boral owned residence is approximately 1.2km further to the northwest from this monitoring location.

The annual rolling average for the Store Paddock Hill Site 16 shows a decreasing trend over the previous reporting periods (Graph 6.3) with an annual average of 2.77g/m^2/month for the past 12 months. The previously high deposition levels were attributed to the Peppertree waste emplacement area which had progressed to within a 10m proximity of the gauge. The emplacement has been rehabilitated and dust emissions have decreased as a result. Deposited dust results remained below the EPA amenity goal for the entirety of the reporting period.

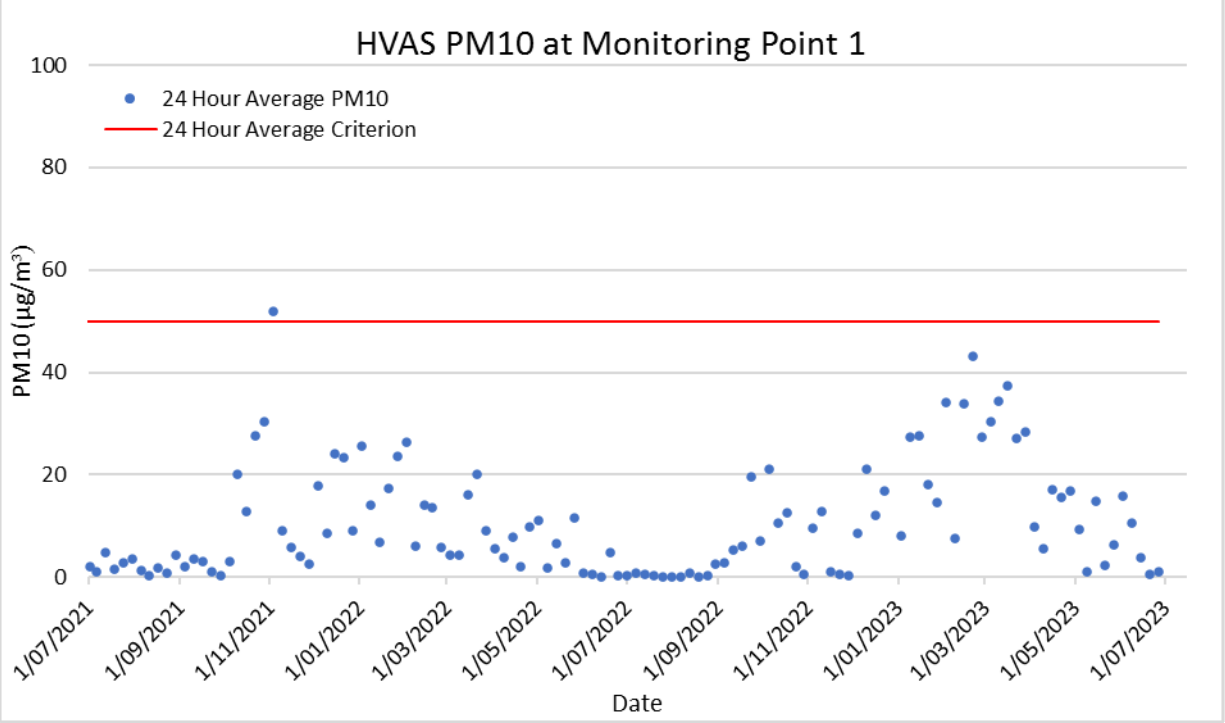
The data from the Sub Station was collected from January 2023 and the EPL was varied in March 2023 to include this gauge. The results remained consistently below the EPA amenity criteria guidelines with an average of 1.95g/m^2/month for the six months to June 2023 (Graph 6.3).



Graph 6.3 - Rolling Average Dust Deposition at EPL Points 16, 17 and 18

PM_{10}

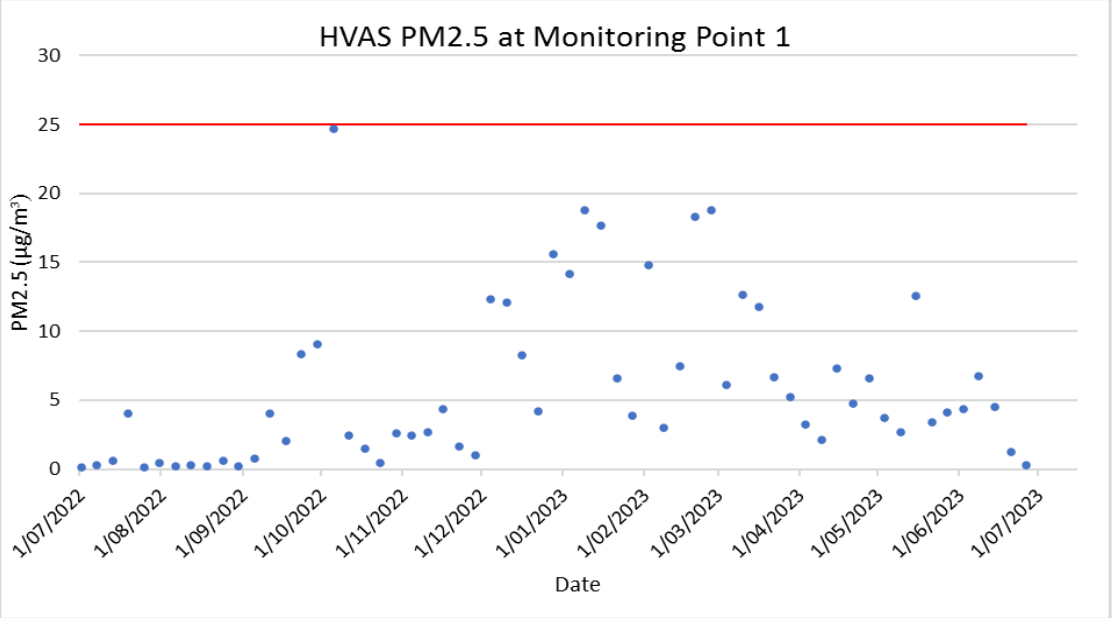
The PM_{10} high volume air sampler (HVAS) is referred to and located at the 'Nearest Resident' and identified as Monitoring Point 1 in the EPL. The monitoring results for the reporting period and the previous period are shown in Graph 6.4. The 24-hour average PM_{10} indicated that there were no exceedances of the 24 –hour average EPA amenity criteria during the reporting period and only one exceedance since monitoring commenced. The annual average during 2022-23 reporting period was 11.8 µg/m³ which is well below the annual criterion of 25 µg/m³.



Graph 6.4 - PM_{10} Monitoring Point 1 HVAS

$PM_{2.5}$

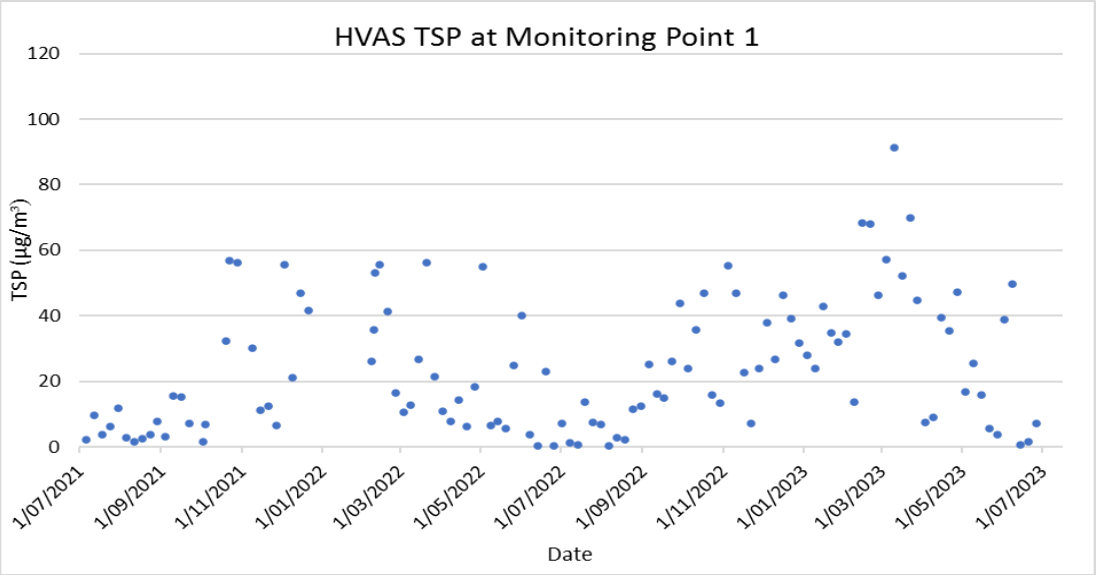
The $PM_{2.5}$ concentrations were monitored by the high volume air sampler (HVAS) in conjunction with Peppertree Quarry from January 2023 as required by SSD7009 for the Continued Operations Project. The monitoring results for the reporting period and the previous period are shown in Graph 6.5. The 24-hour average $PM_{2.5}$ indicated that the monitoring results did not exceed the 24 –hour average EPA amenity criteria. The annual average was 5.9 µg/m³ which is below the annual criterion of 8 µg/m³.



Graph 6.5 - $PM_{2.5}$ Monitoring Point 1 HVAS

Total Suspended Particulate Matter

TSP was also monitored by the site's HVAS from January 2023. Results for the reporting period and the previous period are shown below in Graph 6.6. The annual average was 27.57 µg/m³ which is well below the annual criterion of 90 µg/m³.



Graph 6.6 - TSP Monitoring Point 1 HVAS

6.4 Biodiversity

A Biodiversity Management Plan (BMP) was prepared in accordance with condition B54 of the Continued Operations Project development consent and was approved in April 2022. The BMP covers vegetation clearing, management of remnant vegetation, pest and weed management, establishes biodiversity performance indicators and rehabilitation completion criteria as well as ongoing biodiversity monitoring initiatives. The specific objectives of the BMP are to:

- comply with requirements including the development consent;
- meet the obligations and commitments identified in the EIS;
- ensure compliance with relevant environmental legislation;
- outline management actions and controls to protect and enhance biodiversity values;
- ensure appropriate and representative monitoring is conducted for verification that the BMP is effectively implemented and meeting its objectives; and
- ensure appropriate contingencies and resources for mitigating adverse impacts to native vegetation areas.

The BMP has designed the following vegetation clearing protocol which is implemented prior to and during the clearing of vegetation on site:

- ground dwelling fauna will be identified and relocated prior to clearing;
- suitably qualified personnel will be engaged to supervise felling of hollow bearing trees;
- displaced fauna will be caught and relocated to pre-designated areas by qualified wildlife handlers; and
- the NSW Wildlife Information and rescue Service will be requested to handle and care for wildlife encountered during operations.

No vegetation has been cleared during the reporting period.

6.4.1 Biodiversity Offsets

A Biodiversity Development Assessment Report was prepared By Niche to support the EIS for SSDA7009. This identified a number of ecosystems and species that would be impacted by the project and generated the number of credits of each that would be required to offset these impacts. Boral will be offsetting the impacts using two properties, which are established as Stewardship Sites under the BAM to provide in-perpetuity protection and management of biodiversity values. Short, medium and long term measures have been developed as part of the Biodiversity Stewardship Agreements (BSAs) to manage the offset areas. The majority of the required credits have been retired through the Boral owned Stewardship Site Coolumburra' which satisfies all of the ecosystem credit requirements (except for Box Gum Woodland) and the majority of the species credit requirements for the Project. The first payment from the Biodiversity Conservation Trust was received for the site during the reporting period. The site is now under active management and the BSA details specific management measures and monitoring requirements which have commenced. Annual reporting to BCT will commence in the coming reporting period.

In addition, Boral has negotiated security of credits to satisfy the full State and Commonwealth offset liabilities for Box Gum Woodland via a privately owned existing Biodiversity Stewardship Agreement. The residual species credit requirements will be met by payment into the Biodiversity Conservation Fund.

6.5 Vibration and Air blasting

In accordance with Condition L5 of EPL 944, mining operations are required to employ practices to limit the effects from blasting as follows:

Ground Vibration
- Peak particle velocity not to exceed 10mm/sec
- Peak particle velocity not to exceed 5mm/sec in more than 5% of the total number of blasts over a period of 12 months

Blast Overpressure
- Blast overpressure noise level not to exceed 120dB(lin) for any blast
- Blast overpressure noise level not to exceed 115dB(linear) in more than 5% of the total number of blasts over a period of 12 months

The above criteria also aligns with the operational blast emissions criteria (Continued Operations Project Development Consent Condition B11). The following protocols are currently followed in regard to blasting:

- ❒ Blasting is conducted between the hours of 9am and 5pm Monday to Friday with no blasting occurring on public holidays. If blasting is delayed, the shot will be left overnight and blasted the next day within the allowable hours.
- ❒ Only one blast per day is allowed in accordance with CoC B14.
- ❒ Prior to production blasting, Boral will contact affected landowners or occupiers within two kilometres of the pit seeking expressions of interest in being notified of future blasts.
- ❒ Marulan South Limestone Mine operations shall be in daily contact with the adjacent Boral Peppertree Quarry operations to reduce the possibility of blasting concurrently.
- ❒ As per the BMP, individual blast design records shall be maintained to assist in the design and optimisation of future events, planning and control of blasting emissions and to provide a traceable system of documentation in case of accident or complaint.
- ❒ The mine shall maintain a record of the Blast Design and monitoring Airblast Overpressure and Ground Vibration for each blast event in a suitable format guided by the requirements of AS 2187.2-1993.
- ❒ Prior to blasting, warning sirens continue to be activated in accordance with safe blasting procedures.

Predictions were made in the EIS based on a review of the last three years of blasting data. Table 6.8 below shows calculated overpressure and vibration levels at the B5 receiver due to blasting from the mine. The B5 receiver is located to the north-west of the operation at "Turkey Farm", 950m from the closest blast. The predictions below are assuming a Maximum Instantaneous Change (MIC) from the blast of 1,760 (8x220)kg.

Table 6.8 Predicted Overpressure and Vibration Levels for Blasting Stage 1 and 2 at B5

Stage	Measurement	Result

1 (Approximately 5 years; commencing 2019)	Peak Overpressure dB(Lin)	117
	PPV mm/sec	2.34
2 (Approximately 7-8 years following Stage 1)	Peak Overpressure dB(Lin)	113
	PPV mm/sec	1.34

The predicted blast vibration and overpressure levels are below the building damage criteria of 10mm/s and 133 dB(Lin) respectively and was also below the human annoyance and discomfort criteria of 2mm/s and 115 dB(Lin) at all dwellings of sensitive receivers.

Table 6.9 details the Airblast Overpressure and the Ground Vibration level monitoring results for the total 97 blasts undertaken at Marulan South during the reporting period. These blasts were monitored at the Boral owned residence on Marulan South Road to the northwest of the mine and at the Sub Station since January 2023 (located west to northwest of the pit on Marulan South Road). There were no exceedances of the blast emissions criteria outlined in the consent and the EPL. On average blasting overpressure and vibration results at both Marulan South Road and the Substation were below the predictions. All blasting was undertaken within the approved time between 9:00am to 5:00pm Monday to Friday.

Table 6.9- Blast Monitoring Results

Date	Time	Marulan South Road		Substation	
		Vibration (mm/s)	Overpressure (dB(A)	Vibration (mm/s)	Overpressure (dB(A)
04-Jul-22	15:37	No trigger	No trigger		
07-Jul-22	15:36	No trigger	No trigger		
11-Jul-22	15:29	97.6	0.16		
14-Jul-22	11:44	No trigger	No trigger		
18-Jul-22	15:36	96.4	0.23		
21-Jul-22	15:32	100.7	0.12		
25-Jul-22	15:23	97.6	0.12		
28-Jul-22	15:33	95.2	0.17		
01-Aug-22	16:00	96.7	0.15		
02-Aug-22	16:15	95.2	0.17		
03-Aug-22	16:15	112.7	0.05		
04-Aug-22	15:27	87.4	0.05		
10-Aug-22	15:45	99.6	0.17		
15-Aug-22	14:28	98.3	0.15		
18-Aug-22	15:25	88.9	0.10		
22-Aug-22	15:16	100.9	0.20		
25-Aug-22	12:00	101.2	0.13		
29-Aug-22	15:23	92.6	0.13		
31-Aug-22	15:23	99.7	0.18		
05-Sep-22	14:20	102.3	0.13		
07-Sep-22	13:36	95.2	0.13		
08-Sep-22	15:16	105.4	0.22		
12-Sep-22	14:30	97.9	0.17		
14-Sep-22	15:18	97.6	0.17		
15-Sep-22	13:19	88.9	0.12		
19-Sep-22	9:00	No trigger	No trigger		

Date	Time	Marulan South Road		Substation	
		Vibration (mm/s)	Overpressure (dB(A)	Vibration (mm/s)	Overpressure (dB(A)
23-Sep-22	15:10	No trigger	No trigger		
26-Sep-22		No trigger	No trigger		
29-Sep-22	15:00	99.6	0.13		
05-Oct-22	13:41	108.2	0.17		
06-Oct-22	14:41	No trigger	No trigger		
07-Oct-22	11:18	No trigger	No trigger		
10-Oct-22	15:35	99.5	0.07		
12-Oct-22	15:27	101.3	0.15		
13-Oct-22	15:39	108.1	0.16		
18-Oct-22	15:46	87.6	0.05		
19-Oct-22	12:18	101.2	0.19		
24-Oct-22	16:06	96.4	0.13		
26-Oct-22	15:36	98.1	0.15		
31-Oct-22	13:19	90.5	0.17		
02-Nov-22	15:15	102.8	0.17		
03-Nov-22	9:40	96.5	0.14		
07-Nov-22	12:45	90.6	0.15		
09-Nov-22	15:39	97.7	0.13		
14-Nov-22	14:53	No trigger	No trigger		
17-Nov-22	14:58	No trigger	No trigger		
21-Nov-22	12:10	No trigger	No trigger		
23-Nov-22	14:10	No trigger	No trigger		
28-Nov-22	14:20	95.7	0.19		
30-Nov-22	14:40	103.3	0.23		
05-Dec-22	15:47	94.1	0.15		
08-Dec-22	14:46	96.8	0.18		
12-Dec-22	9:30	109.7	0.22		
15-Dec-22	13:04	89.1	0.11		
19-Dec-22	12:10	106.3	0.26		
21-Dec-22	12:39	94.3	0.14		
11-Jan-23	14:37	97.9	0.13	No trigger	No trigger
12-Jan-23	13:50	97.9	0.17	No trigger	No trigger
16-Jan-23	14:55	103.8	0.39	No trigger	No trigger
23-Jan-23	15:37	95.8	0.17	91.5	0.14
25-Jan-23	13:16	97.4	0.35	98.9	0.19
13-Feb-23	3.40PM	98.8	0.16	No trigger	No trigger
17-Feb-23	9.54AM	No trigger	No trigger	91.3	0.16
20-Feb-23	1.01PM	92.1	0.28	94	0.19
22-Feb-23	3.35PM	102.7	0.13	101.9	0.13
01-Mar-23	1.16PM	96.4	0.21	102.8	0.14
02-Mar-23	3.43PM	101.9	0.26	94	0.22
08-Mar-23	2.12PM	107.4	0.12	104.9	0.21
13-Mar-23	12.59PM	94.7	0.2	95.9	0.22
15-Mar-23	12.08PM	101.9	0.2	88	0.22
20-Mar-23	1.57PM	103.4	0.14	91.5	0.17
30-Mar-23	3.20PM	94.9	0.34	103.5	0.24
03-Apr-23	2.05PM	102.6	0.24	105.9	0.31
13-Apr-23	1.42PM	102.5	0.2	105.2	0.26
17-Apr-23	1.01PM	No trigger	No trigger	101.7	No trigger
19-Apr-23	1.36PM	96.1	0.17	101.7	0.19
20-Apr-23	1.31PM	No trigger	No trigger	100.7	0.21

Date	Time	Marulan South Road		Substation	
		Vibration (mm/s)	Overpressure (dB(A)	Vibration (mm/s)	Overpressure (dB(A)
26-Apr-23	12.41PM	No trigger	No trigger	106.7	No trigger
01-May-23	3.39PM	No trigger	No trigger	98.2	0.15
03-May-23	1.24PM	104.6	0.16	104.2	0.19
08-May-23	2.53PM	105.4	0.27	104.6	0.19
09-May-23	2.55PM	No trigger	No trigger	97.4	0.13
11-May-23	11.49AM	No trigger	No trigger	93.5	0.15
15-May-23	1.59PM	99.5	0.17	94.7	0.13
17-May-23	12.34PM	No trigger	No trigger	95.7	0.13
22-May-23	10.16AM	96.9	0.13	96.6	0.13
25-May-23	2.04PM	98.7	0.27	113.4	0.13
29-May-23	3.37PM	101.8	0.18	106.4	0.22
01-Jun-23	1.18PM	100.8	0.22	108.9	0.13
05-Jun-23	10.43AM	100	0.22	104.6	0.24
08-Jun-23	12.28PM	No trigger	No trigger	88.6	0.12
14-Jun-23	1.33PM	92.6	0.19	108.6	0.14
15-Jun-23	4.06PM	97	0.45	97.4	0.13
20-Jun-23	11.46AM	99.6	0.17	96.6	0.14
22-Jun-23	4.40PM	91.1	0.17	88.6	0.12
26-Jun-23	1.10PM	119.1	0.28	118.5	0.24
29-Jun-23	2.00PM	94.9	0.17	102.6	0.13

6.6 Operational Noise

During the reporting period, an updated Noise Management Plan was approved which detailed noise criteria as defined by Section B1 of the Continued Operations Project development consent. These are provided in Table 6.10. The Noise Management Plan established a hierarchical approach to ensure that operations comply with the relevant conditions of the consent:

- Mine operations will be managed to meet the criteria presented in Table 6.10 and EPL noise criteria, through operational practices and the implementation of reasonable and feasible noise controls.
- Where noise levels exceed noise criteria or verified noise complaints are received, ensure all noise controls are in place or determine the need to reduce operations and point of source noise.
- Liaise with the local community regarding scheduled works which are predicted to have increased noise impacts.

Table 6.10 – Operational Noise Criteria

Receivers	Project Noise Trigger Level (dBA)		
	Day	Evening	Night
R9	40	36	36
All other residents	40	35	35

Note: Daytime 7:00am-7:00pm; Evening 7:00pm-10:00pm; Night 10:00pm-7:00am

Noise levels for daytime, evening and night resulting from the continuation of mining operations for each stage of the 30 year mine life were predicted in the EIS. Noise levels from

two worst-case operating scenarios comply with the noise trigger levels at all stages over all time periods. The predicted noise levels at Receiver 9 (R9) are shown in Table 6.11 below.

Table 6.11 Predicted Noise Levels at R9 ($L_{Aeq, 15min}$ dBA)

Scenario	Stage	Daytime	Evening	Night	Complies
Overburden Removal, Overburden Emplacement, Limestone Removal ('4+2')	1 Start	30	31	31	Yes
	1 End	27	28	28	Yes
	2	32	31	31	Yes
	3	29	30	30	Yes
	4	26	27	27	Yes
Overburden Removal and Emplacement ('6')	1 Start	33	34	34	Yes
	1 End	36	36	36	Yes
	2	34	35	35	Yes
	3	32	33	33	Yes
	4	26	27	27	Yes

Current mitigation measures will continue to be followed to avoid the likelihood of exceedances in the future. This entails a quarterly noise monitoring program based on attended noise monitoring. To supplement quarterly attended noise monitoring, a continuous unattended noise monitoring station has been established between the western overburden emplacement and the nearest potentially affected receiver location identified as R9.

The quarterly noise monitoring commenced in the first quarter of 2023 based on commencement of the Continued Operations Project. Attended noise monitoring was undertaken on 28/03/2023 and 7/06/2023 by Muller Acoustic Consulting Pty Ltd. Attended noise monitoring was conducted at five noise monitoring locations for 15-minute periods for three attended events during day, evening, and night periods each quarter. Where possible, throughout each measurement the operator quantified the contribution of each significant noise source. Extraneous noise sources such as wind gusts, insects, birds, dogs barking, offsite train noise and residential noise were audible throughout the attended measurements.

The March 2023 noise assessment identified that the mine was only audible at Location R12 during the evening and night. The noise was a production hum audible throughout the measurement, recorded at 31dBA and 30dBA during the evening and night respectively. These results are below the trigger level of 35 dBA for both time periods, are in line with the Scenario '4+2' predicted noise levels and below the Scenario '6' predictions outlined in Table 6.11 above. The mine was not audible at the other four monitoring locations at any time of day.

The June 2023 attended noise assessment identified that noise emissions generated by the mine were only audible at one monitoring location (R12) throughout the evening measurement period and inaudible at all other monitoring locations. The mine contribution was described as a processing hum which was barely to just audible for 50% of the measurement. Noise levels recorded from the mine were <30dBA which is below the trigger level in Table 6.10, in line with the Scenario '4+2' predicted noise levels and below the Scenario '6' predictions outlined in Table 6.11 above. The contributions at all monitoring locations satisfied the consent conditions at their respective assessed receivers.

6.7 Aboriginal Heritage

The Aboriginal Cultural Heritage Management Plan (ACHMP) was approved in March 2022 in accordance with Condition B60 of the Continued Operations Project development consent. The plan provides guidance on:

- management procedures for historic heritage values within, and adjacent to, the mine during pre-construction and construction phases;
- protocols and procedures for new cultural finds and human remains;
- protocols for undertaking activities in areas that have not been previously assessed;
- administrative requirements, including post-project management of historical finds and recovered material, ongoing compliance, regular review and update of the HHMP to ensure its functionality is maintained through the mine life; and
- includes a strategy for the care, control and storage of heritage relics salvaged from the site.

Five archaeological sites were identified for salvage excavation during the ACHA for SSDA7009 (EMM 2019). These sites are within two localities: adjacent to Marulan Creek (MSL 046; MSL 047; MSL 057 and MSL 045) and on a flat spur at the main Project site MSL 055. This ACHMP only addresses the sites adjacent to Marulan Creek and excludes MSL 055 because that site is now within the PTQ MOD 5 footprint and subject to the salvage measures detailed in the PTQ AHMP (Boral & EMM 2021).

The field work was carried out between 19 – 22 June 2023 by EMM Archaeologists accompanied by representatives from Ngunawal Heritage Aboriginal Corporation, Thunderstone Aboriginal Cultural and Land Management Services and Pejar Local Aboriginal Lands Council.

Each of the 38 Aboriginal sites with management requirements within the southern section of the project area were visited and were managed according to the guidelines set out within the ACHMP. A total of 72 artefacts were collected from 16 Aboriginal sites. One new Aboriginal site (MSL2301) was recorded during the work. MSL2301 is characterised as an open site artefact scatter comprising a total of 14 stone artefacts eroding from the southern bank of a dam.

Salvage of the sites adjacent to Marulan Creek will be undertaken prior to construction of the Marulan Creek Dam and reported in a future Annual Review once undertaken as per the protocol in the ACHMP.

6.8 Combustion Risk and Management

The storage of coal used as a supplementary fuel for the calcination of limestone in the lime kilns is the only activity previously identified on site with the potential for spontaneous combustion. The primary use of natural gas as kiln fuel has reduced the potential risk of spontaneous combustion.

The risk of spontaneous combustion is minimized by CO monitoring, alarming and a triggered, stored CO_2 discharge system sized to extinguish combustion. This system is serviced by

Wormald, a division of Tyco Australia Pty Ltd. These services are carried on a planned preventative maintenance schedule held within BCL's MAXIMO maintenance management system.

6.9 Bushfire

Bushfire response and management is an ongoing site program both from a safety and environmental aspect. The Marulan South Operations Bushfire Management Plan seeks to maintain and monitor bushfire prone areas and equipment; minimise the risk of bushfires spreading from the project site; and establish responses and controls to fires.

An annual bushfire risk assessment is undertaken at the commencement of each bushfire season in October. The bushfire management plan addresses associated risks and lays out requirements for very high risk days relating to things such as hot work, vehicles driving on vegetation etc. Boral is aware of the risks of bushfire and has implemented the following safeguards:

- ❒ Fire fighting equipment is on hand during hot work activities at all times;
- ❒ Safe Work Method Statements are required for all activities on site and the risks of bushfire are considered;
- ❒ Fire extinguishers are installed in mobile machinery;
- ❒ Cleared asset protection zones have been created around all buildings and infrastructure;
- ❒ Water storages on site are available for use in firefighting as necessary; and
- ❒ One of the two water carts on site must remain full at all times to be available on site for emergencies.

The Bushfire Management Plan was reviewed in February 2020 following the Morton Bushfires. Specific measures for evacuation were updated to include refuge in the pit as a secondary option to evacuation via Marulan South Road as it was demonstrated that the fire threat could be more widespread than previously mitigated against. Three levels of threat were identified based on RFS categorisation and associated response measures incorporated into the management plan.

During the reporting period, bushfire risk has been low given the higher rainfall and lower fuel loads. Long range forecasts suggest that bushfire risk will remain low for the coming reporting period as well.

6.10 Geotechnical Stability

Open pit and waste emplacement slope stability is an aspect of limestone mining activities with the potential for both safety and environmental impacts particularly as the depth of mining increases. The use of improved blasting techniques, the development of procedures for

managing slope stability issues and training instruction for site inspections have previously been implemented and continue.

Geotechnical investigations were undertaken in April 2023 by WSP Australia Ltd (WSP) for the preparation of the annual geotechnical report for the Marulan Limestone Mine. The assessment predominantly focused on the slip that occurred at Barbers Creek Emplacement in November 2022, but also examined Bryce's Emplacement, High dump in South Pit and slumped areas in North Pit and the South Pit Rim.

The inspections covered the current exposures to provide an overview of the potential long term performance of the pit walls in limestone and which will need to remain to allow production to continue under the Continued Operations Project. Known areas of instability were also covered in the 2023 assessment. The assessment made a number of recommendations which are summarised as follows:

- To address risk mitigation, works on the west of Barbers Creek Emplacement should be extended to the south as well, since they bear a similar risk of instability.
- Bryce's Emplacement is also prone to instability, as it is affected by the same underlying mechanisms as Barbers Creek Emplacement. WSP recommend that slope monitoring of Bryce's is continued monthly to detect slope deformation.
- Potential remedial measures of the South Pit Rim could include removing large blocks from the existing road and install rock barriers or nets down slope to capture future rockfalls.

Ongoing assessment, monitoring and remediation of the Barbers Creek Emplacement will continue in the next reporting period.

6.11 Hydrocarbon Contamination

Hydrocarbons used on site include fuels (diesel and petrol), oils and greases. The 95,000L double lined diesel tank was removed from the diesel storage facility in North Pit and relocated to a temporary refuelling station to the south of Ring Road following refurbishment. The one 40,000L tank and one 20,000 tank that were being utilised in interim were removed during the reporting period. The area is fully bunded where any potential spills can be adequately contained and managed in accordance with emergency response procedures and classified and disposed of in accordance with relevant waste legislation.

The potential for hydrocarbon contamination resulting from leakages and spills continues to be minimised by the implementation of documented hydrocarbon spill procedures and the use of biological oil spill kits located across site operational areas. These spill kits are maintained and serviced by approved contractor services and checked by BCL.

Oils are stored within bulk storage tanks within a roofed storage facility at the mine. A maximum of 10,000L of hydraulic oil, engine oil, and torque fluids respectively are stored within these storage tanks. Small quantities of greases are required for maintenance of plant and equipment. Storage, handling, containment and disposal of workshop hydrocarbons is managed in accordance with AS 1940:2004.

Review of procedures, equipment and training for hydrocarbon management and spill response is an ongoing commitment. Testing of the management system and responses is undertaken generally every 12 months.

6.12 Public safety

A security plan has been fully operational since 2006 and was upgraded with the new access requirements between Peppertree and the mine. This plan is reviewed annually.

Features of the security plan and system include the following:

- A 3 metre tall automated sliding security gate at the exit of the Sand Plant Road.
- A 3 metre tall sliding gate located at the Main office, connected to chain mesh fencing for appropriate scrutiny of all site visitors.
- A pedestrian gate near the visitor's car park for office access to ensure visitor sign in.
- Two swing gates located on the Lime Kiln Road prior to the main weighbridge and associated chain mesh fencing.
- Chain mesh fencing of the mine site perimeter and around the main entry areas to limit points of entry and exit to the control points (gates).
- Signage for both the new and existing mine perimeter fencing.

All visitors report to the "off lease" Site Administration and Training Main Office to sign in prior to gaining entry to Mining Lease CML 16.

Review and upgrade of the Site's Induction system for visitors, contractors and employees is an on-going commitment as part of the Site Safety Management System.

7. WATER MANAGEMENT

An updated site Water Management Plan (WMP) was completed in August 2022. The updated WMP covers the Stage 1 and 2 expansions of the mine but will need to be updated again prior to the commencement of Stage 3. The new management plans were approved at the beginning of the 2023 calendar year as the mine transitioned to the Continued Operations Project.

7.1 Erosion and Sediment Management

Current methods of erosion control including the use of clean water diversions to limit run off over disturbed areas, contour banks on the exposed batters of waste emplacements, rock and concrete lined drainage structures, sediment ponds and the re-establishment of vegetation continue to be effective means of reducing erosion on exposed areas. Periodic inspections on drainage are performed to ensure water runs to either the North pit or South pit voids.

Use of a daily water balance model within the surface water assessment concluded that the water management system is extremely robust and is secure for the mining operations. Overflow from storage dams and runoff can be estimated at 580ML per annum, which is expected to evaporate or seep into groundwater. Clean water and "mine supply water" storages are detailed in Table 7.2 - Stored Water Volumes.

The erosion and sediment control system is managed through control plans which have been progressively updated to meet changes as the project develops. The new WMP continues this process in order to meet the obligations and commitments identified in the SSD approval. The existing surface water management system provides measures to divert runoff from the overburden emplacements to sediment basins designed in accordance with current guidelines. Rehabilitated landforms are designed to shed water without causing excessive erosion and downstream pollution. During rehabilitation, topsoil is prioritised for the high-risk erosion areas on the overburden emplacement slopes, and alternative media for vegetation growth is used on lower slopes and flat areas.

Maintenance of dams and drainage lines continued where possible following high rainfall events which occurred during the reporting period.

7.1.1 Sewerage Waste Management

No changes to sewerage waste management have occurred during the reporting period. The Marulan South Limestone Mine continues to operate five sewerage treatment facilities:

- Main envirocycle unit that receives effluent from main offices, laboratory, bathrooms, store and conference room. This aerated water treatment system was refitted with new pumps and upgraded during the reporting period to maintain compliance with Council requirements.
- Two Lime plant envirocycle units servicing the kiln control room, hydration, dispatch and workshop areas.
- Two Septic tanks, one located at the "machine shop"/primary crusher the other adjacent to the "Fettlers' shed".

Another septic system services the former “Club” facility, north of the main office and located “off-lease”.

To ensure no overflow occurs from the “machine shop”/primary crusher septic tank, this unit continues to be inspected and pumped out weekly by an accredited waste disposal contractor. The “Fettler’s shed” and “Club” units are adequately serviced by adsorption trenches.

7.2 Surface Water Management

7.2.1 Pollution Control Strategies

The Marulan South Limestone Mine continues to operate under the Environment Protection Licence (EPL) No. 944 and is required to prevent pollution of waters. The existing water management system involving three major catchments, (northern, southern and western emplacement areas) and associated infrastructure continued to operate during the 2022/2023 reporting period. The performance measures for the pollution control system are as follows:

- Maintain separation between clean, dirty (i.e. sediment laden) and mine water management systems.
- Minimise the use of clean and potable water on the site.
- Maximise water recycling, reuse and sharing opportunities.
- Minimise the use of make-up water from external sources.
- Design, install, operate and maintain water management systems in a proper and efficient manner.
- Minimise risks to the receiving environment and downstream water users.

The surface water management system is an integrated network of pipelines, drains, dams and sediment basins that provide dual purposes of water supply for on-site use and erosion and sediment control functions for runoff generated from disturbed areas. The water management system will be progressively developed over the life of the mine. A site water balance has also been developed to assess the performance of the water management system.

As part of the new SSD approval, the eastern emplacement batters will be progressively rehabilitated which will significantly reduce the sediment load leaving the site. This work is nearing completion which will allow all future runoff from the Eastern Emplacement to be fully contained with the South Pit. Over the next three years, overburden will be used to:

- Backfill the South Pit and subsequently extend the emplacement of overburden to the west to create a single Southern Overburden Emplacement (SOE).
- Extend the existing Western Overburden Emplacement to the north.
- Construct a Northern Overburden Emplacement, also referred to as Peppertree Quarry Southwestern Overburden Emplacement.
- except for the section of the SOE that drains directly to the South Pit, overburden and haul road drainage will be directed to a series of new sediment basins that have been appropriately sized.
- runoff collected in the sediment basins would either be pumped to one of the mine water dams for reuse in limestone processing or dust suppression or would drain to the mine pit.

An overview of the current water management plan is provided in Plate 1.

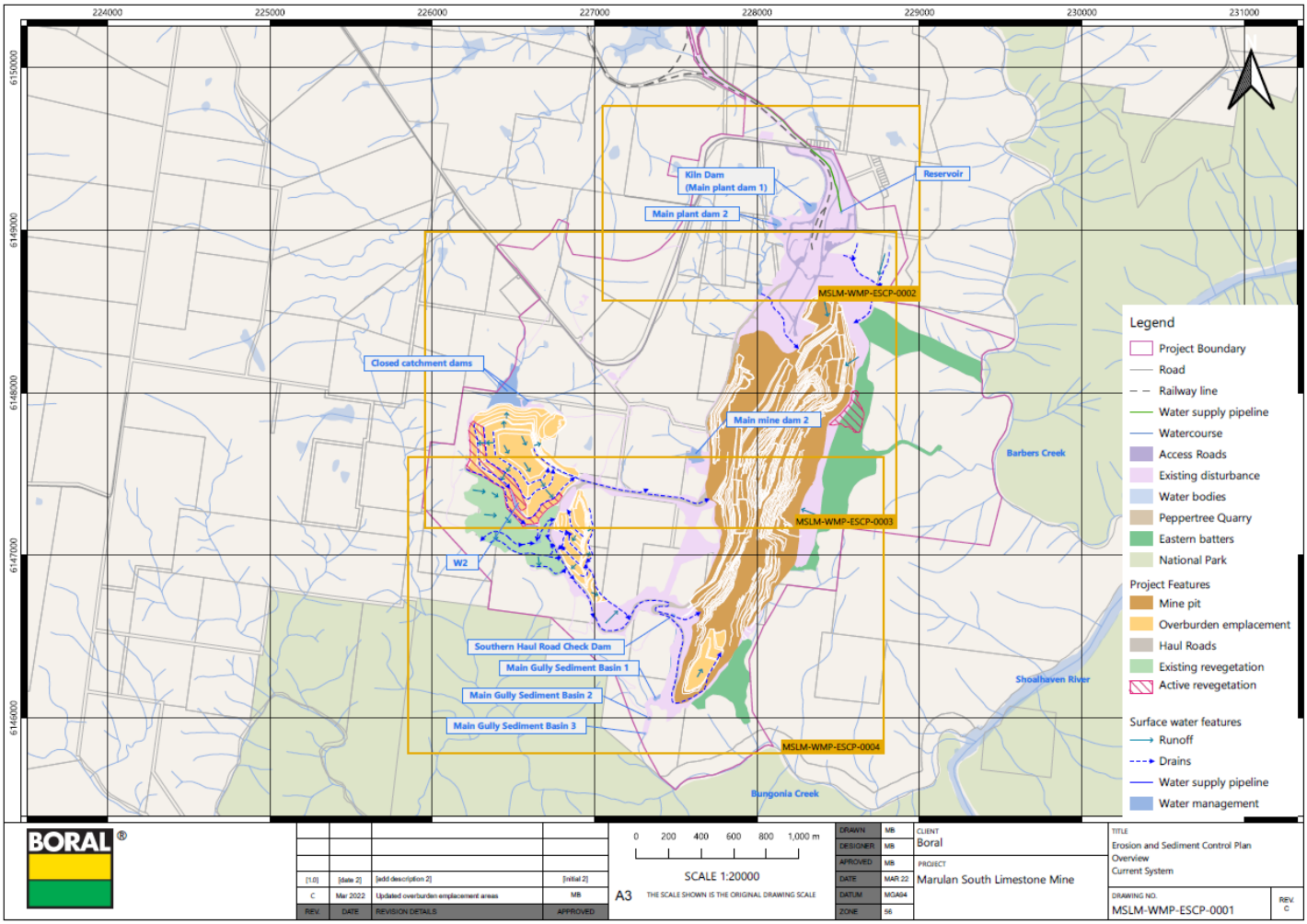


Plate 1 – Existing Surface Water Management System

7.2.2 Pollution Control Storages

A description of the current pollution control dams is provided in Table 7.1 while the estimated volumes stored within the pollution control structures is provided in Table 7.2.

Table 7.1 - Dam Descriptions

Dam name	Description
Clean Water Dam 1	Clean water diversion dam constructed in late 2007 above Main Plant Dam 2. Between Blue Lagoon and Kiln Dam
Clean Water Dam 2	Clean water diversion dam constructed as above but not previously recorded. Between Blue Lagoon and Kiln Dam
Minor Farm Dam 1	"Off-lease" farm dam upstream of Main Mine Dam 1. Near old weather station
Minor Farm Dam 2	Farm dam upstream of Main Mine Dam 1. Next to Black Dam
Minor Farm Dam 3	Potential New Clean Water Dam added as per MOP Plan 4-1. Near Substation
Minor Farm Dam 4	On Lime Dump Rd near Sweeper
Minor Farm Dam 5	Robs Farm House near Gate
Minor Farm Dam 6	Robs Farm House on bend in driveway
Minor Farm Dam 7	Robs Farm House NW larger than MFD8
Minor Farm Dam 8	Robs Farm House N smaller than MFD7
Minor Mine Dam 1	Clean water dam North of Main Gully waste emplacement. East of TRN compound

Dam name	Description
Minor Mine Dam 2	Clean water dam North-East of Main Gully waste emplacement. On metro road in new Central Dam area
Minor Mine Dam 3	Clean water dam, East of North Pit. Black dam
Main Plant Dam 1	"Off-lease" dam north of lime plant. Holds Tallong water and some plant area run-off
Main Plant Dam 2	Main lime plant water re-cycling dam on lease boundary. Blue lagoon
Main Mine Dam 1	Mine Dam 1 has been covered by the advance of the west emplacement.
Main Mine Dam 2	Mine water supply dam to west of shale road on boundary.
North Pit Void	Overflow from enlarged Kiln Dam and runoff from the plant (31 ha) northern catchment of the mine pit (68 ha). Not yet constructed- will be in an area of tyre storage behind secondary
Plant Sediment Dam	Small sediment pond upstream from Main Plant Dam 2
South Pit Void	See Note 4.
Southern Haul Road	Pre-treatment sediment check dam in roadside drainage. East of Maggie Dump
Check Dam	Near Main Gully diversion of southern haul road prior to entry to South Pit. No longer exists
Sediment Dams 1-3	Main Gully control and monitoring dams
Green Lagoon	Drainage line east of Dave Shep Drive
Swimming Pool	Western Batters Pit Void. Currently empty and will be mined and expanded in near future, may not hold water after that time.

Table 7.2 - Stored Water Volumes Locations

	Volumes held – ML		
	At start of Jul 2022	At end of Jun 2023	Estimated Storage Capacity
Clean Water (Non-Mine Supply)			
North Catchment			
Clean Water Diversion Dam 1**	0.6	0.6	0.6
Clean Water Diversion Dam 2	0.6	0.6	0.6
Minor Farm Dam 1	0.3	0.2	0.3
Minor Farm Dam 2	1.0	0.75	1.0
Potential Clean Water Dam	4.0	4.0	4.0
Minor Mine Dam 1	4.0	4.0	4.0
Minor Mine Dam 2	0.5	0.25	0.5
Minor Mine Dam 3	14.3	10.0	15.3
Total Clean Water (Non-Mine supply)	25	20.4	26
Mine Supply Water			
North Catchment			
Main Plant Dam 1	24	21	27
Main Plant Dam 2#	14	10	11
South & West Catchments			
Main Mine Dam 2	43	40	43
Total Mine Supply Water Dams	81	71	81
Sediment Water			
North Catchment			
North Pit Void	na	na	na
Plant Sediment Dam	0.3	0.3	0.3
South & West Catchments			
Western Batters Sump	11	11	11
South Pit Void	na	na	na
Southern Haul Road Check Dam	na	na	0.08
Sediment Dam 1	5.8	4.7	5.8
Sediment Dam 2	0.2	0.2	0.2
Sediment Dam 3	0.8	0.8	0.8
Total Sediment Water Dams	18.1	17.0	18.1

Notes:
**Estimated from aerial survey data July 2023 for End of reporting period*
 # Estimated capacity subject to cleaning of sediment.

7.2.3 Surface Water Monitoring and Reporting

The approved surface water monitoring program is detailed in the Water Management Plan for the Continued Operations project. Surface water monitoring is undertaken quarterly at sites upstream and downstream of the mine. These sites include the Shoalhaven River, Bungonia Creek and Barbers Creek (Figure 5). An additional sample is taken from the lower end of the Blowhole, prior to entry into Bungonia Creek. The Blowhole is a groundwater seep, or spring which is representative of groundwater situated below the elevation of South Pit. The surface water monitoring results are outlined below in this section, and a comprehensive description can be found in the Surface Water Assessment Report attached as Appendix D.

Additionally, an automatic water sampler is located in the lower section of Main Gully which is triggered automatically when the water levels in the sediment control pond rise during a significant storm event. Overflow events occurred during July 2022 and October 2022 following heavy rainfall. Results for July 2022 and three separate events in October 2022 are presented in Table 7.3 and Table 7.4 respectively.

From the 1st July to 4th July 2022 inclusive, 206mm of rainfall was recorded at the site weather station which exceeded the 95% 5 day rain event for Marulan.

In the five days to 9th October 2022, 158mm of rainfall was recorded which exceeded the 95% 5 day rain event for Marulan of 52.8mm. A further 132.5mm was recorded from the 21st-25th October, and a final 31mm on the 31/10. The total rainfall recorded for the month was 363mm. Both of the July and October events were caused by a persistent off shore low pressure system resulting in widespread flooding.

Table 7.3- Main Gully Overflow Water Quality Monitoring Results July 2022

Date	pH Units	EC (µS/cm)	Suspended Solids (mg/L)	Turbidity (NTU)	Oil and Grease
3/7/2022	7.86	426	148	350	<5
4/7/2022	8.03	453	10	61.1	<5
5/7/2022	8.06	469	12	60.4	<5
6/7/2022	8.13	528	8	37.9	<5
7/7/2022	8.19	616	8	28.2	<5
8/7/2022	8.18	664	6	20.1	<5

Table 7.4- Main Gully Overflow Water Quality Monitoring Results October 2022

Date	pH Units	EC (µS/cm)	Suspended Solids (mg/L)	Turbidity (NTU)	Oil and Grease
8/10/2022	6.86	487	23	35.6	<5
9/10/2022	7.48	421	589	895	<5
10/10/2022	7.86	457	132	245	<5
22/10/2022	7.97	604	1460	3110	<5
23/10/2022	8.02	460	730	1660	<5
31/10/2022	7.87	564	1260	2710	<5

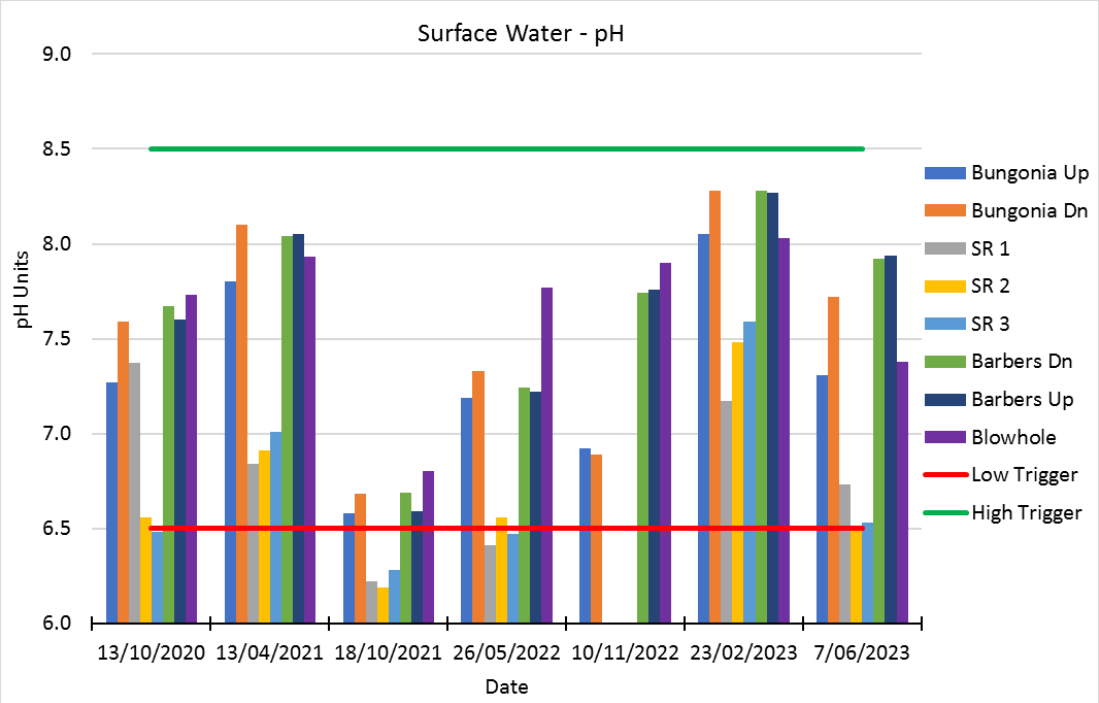
**Three individual events are separated by bold lines*

The results show that during storm events when discharge occurs, suspended solids can be elevated however pH and conductivity are comparable with Bungonia Creek. Figure 11 of Appendix D shows that suspended solids loading with Bungonia Creek rose slightly during the same period. Although the Main Gully discharge would have an influence on solids loading within Bungonia Creek, Figure 11 of Appendix D, shows that the upstream sample site in

Bungonia Creek had a slightly higher suspended solids loading than the downstream site during this high rainfall period. Figure 27 of Appendix D, also shows that the Shoalhaven River was also elevated upstream of the confluence with Bungonia Creek indicating that there was widespread movement of sediment within the receiving waters during this period of high rainfall.

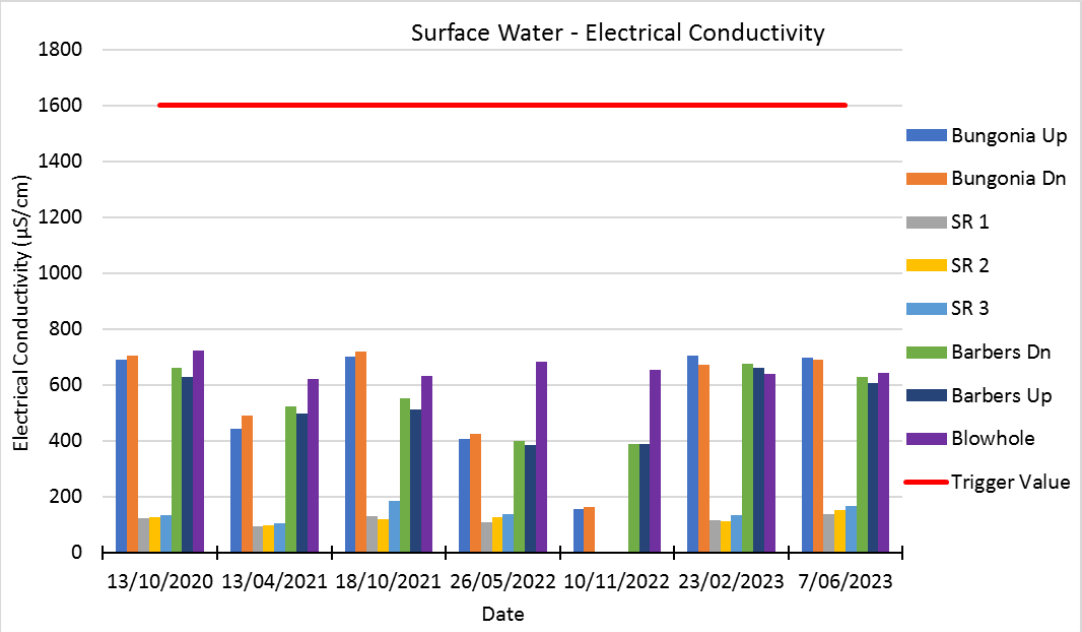
An extended ambient surface water quality monitoring program is also in place as envisaged in the EIS. Sampling was increased from biannual to quarterly at the beginning of 2023. This includes measurements taken from sites upstream and downstream of the mine on Bungonia Creek and Barbers Creek, at three sites along the Shoalhaven River (SR) and at the Main Gully Sample Point located downhill of the Spring (Blowhole). Due to high water levels following extended high intensity rainfall events in October 2022, safely accessing the sample locations on the Shoalhaven River was not possible for the 3rd quarter of surface water monitoring.

Surface water trigger values have been outlined in the Water Management Plan and are noted in Graphs 7.1 - 7.6 below. The purpose of the trigger values is to provide indicators of whether the mine is having an influence on the receiving water quality. Graphs 7.1 - 7.6 present the water quality parameters over the last two reporting periods.



Graph 7.1 – Ambient Surface Water Quality – pH

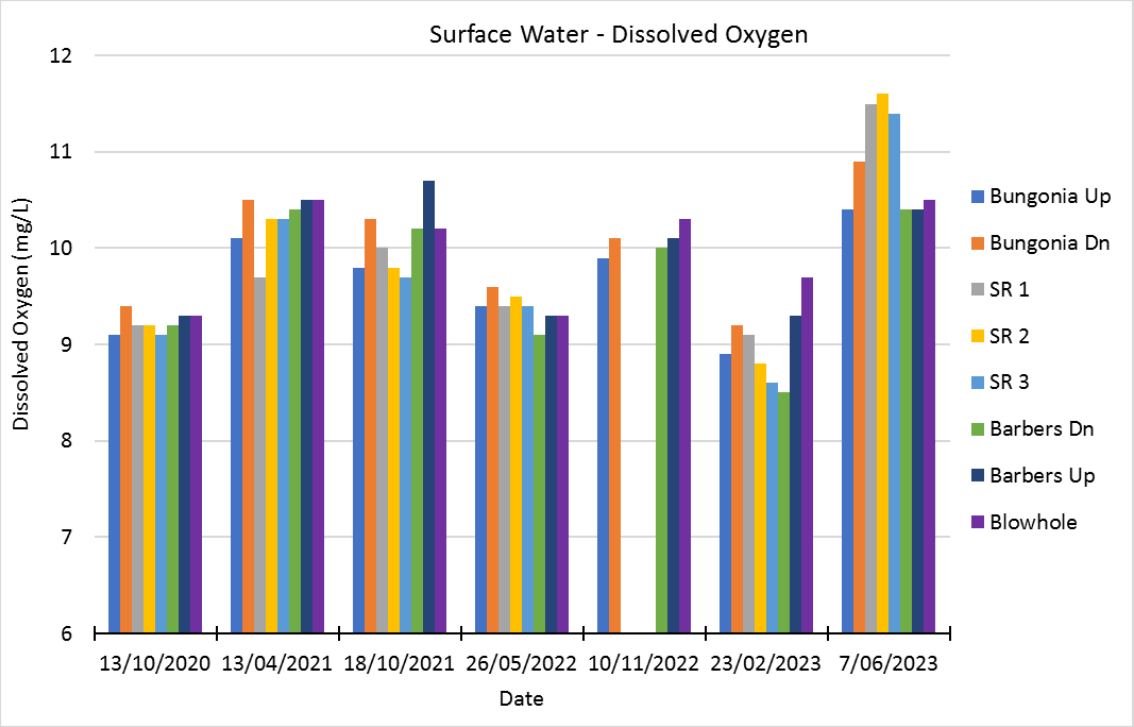
Graph 7.1 shows the pH values of the eight sample sites over the past three reporting periods. Bungonia Creek and Barbers Creek are well within the upper and lower trigger values, with averages of 7.41 pH and 7.64 pH respectively over the past three years. Levels at the Bungonia downstream site are approximately 0.2 pH higher than the upstream sample site, and both sites on Barbers creek are relatively equal. The pH levels in the Shoalhaven River are consistently lower than both Bungonia Creek and Barbers Creek, with pH levels ranging from 6.19 pH units to 7.59 pH over the three sampling locations. The Blowhole three-year average is 7.65 pH. The pH is governed by geological influences, particularly the large limestone deposit. Given the limestone's marine origin, salt level is also largely controlled by geological influences.



Graph 7.2 – Ambient Surface Water Quality – Electrical Conductivity

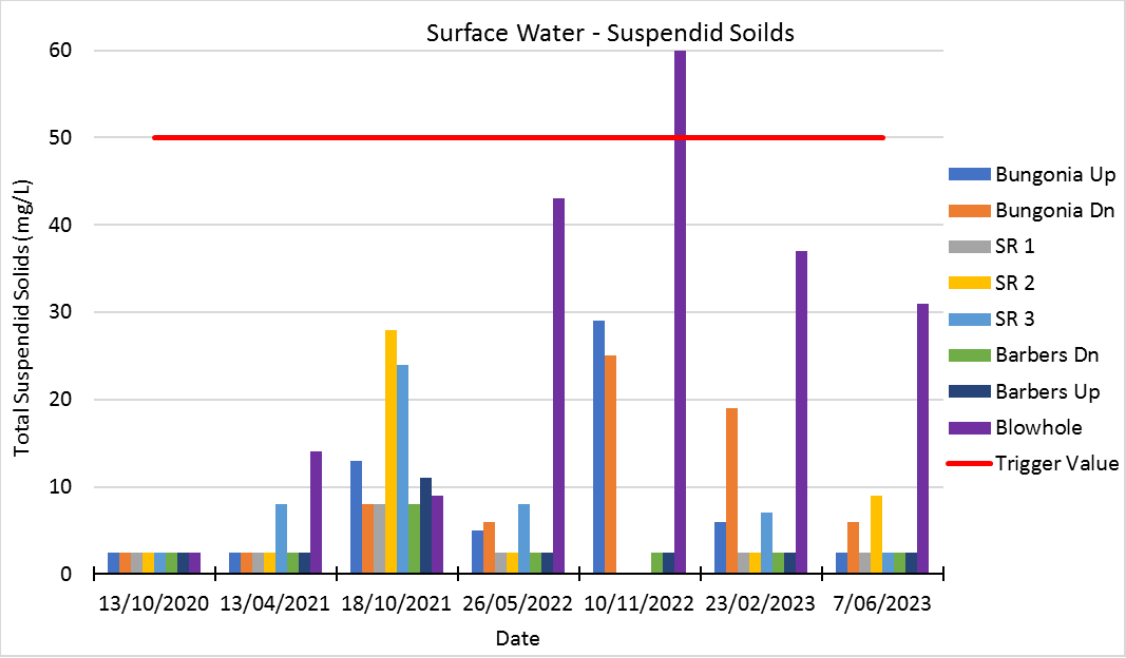
The electrical conductivity is significantly lower in the Shoalhaven River than all other sampling sites with a three-year average of 127 µS/cm (Graph 7.2). Bungonia and Barbers Creek three-year averages of 547 µS/cm and 535 µS/cm respectively lie significantly lower than the trigger value of 1600 µS/cm, and show levels representative of the surrounding limestone aquifer. The three-year average conductivity values have dropped over 70 µS/cm since the previous reporting period in Barbers Creek and Bungonia Creek. This may be due to the high rainfall experienced in recent years. The average electrical conductivity at the Blowhole recorded over a three-year period is 656 µS/cm. Although levels of electrical conductivity have dropped during the reporting period, the water quality remains in a healthy and stable state.

The variation in pH and conductivity, which is a measure of salt, is considered natural and caused by surrounding marine based geological strata. The physical and chemical properties of Shoalhaven River will naturally vary as it passes through different geological strata and land uses. The variations would occur in mineral content, nutrients, pH and dissolved solids.



Graph 7.3 – Ambient Surface Water Quality – Dissolved Oxygen

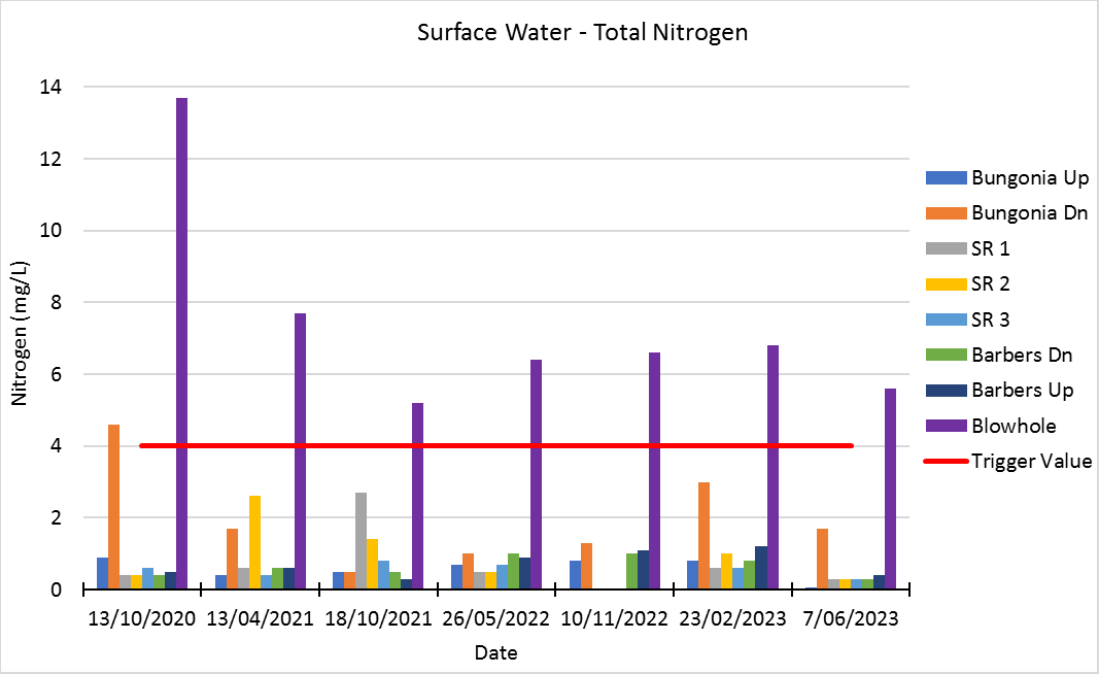
The dissolved oxygen levels range from 8.5 mg/L to 11.6 mg/L with an average of 9.84 mg/L over a three-year period across all ambient surface water monitoring sites (Graph 7.3). Results show that the waterways have sufficient dissolved oxygen levels to support a healthy aquatic environment including fish populations.



Graph 7.4 – Ambient Surface Water Quality – Total Suspended Particles

Suspended solid concentrations exceeded the trigger level at the Blowhole for the first time October 2022 (Graph 7.4). This elevated level is likely due to the prolonged rainfall flushing out

the sediment contained in the karst system over time. The levels were often under detection limits of 5 mg/L (recorded as half of the limit value: 2.5 mg/L).



Graph 7.5 – Ambient Surface Water Quality – Total Nitrogen

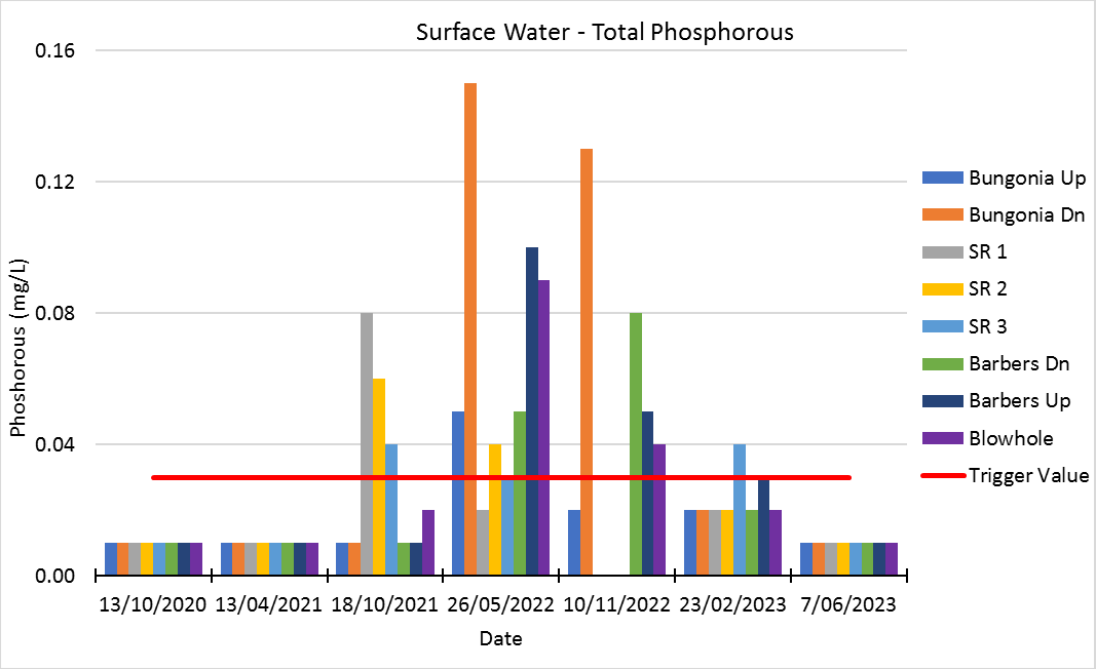
Total Nitrogen levels were the highest at the Blowhole with a three-year average of 7.4 mg/L (Graph 7.5). Concentrations at Bungonia and Barbers Creeks usually remained below the trigger level of 4 mg/L with respective averages of 1.28 mg/L and 0.69 mg/L. A sample at Bungonia Creek down exceeded the trigger level on one occasion in October 2020, with a value of 4.6 mg/L. Nitrogen levels in the Shoalhaven River recorded an average of 0.82 mg/L and did not exceed 3.0 mg/L.

Total Nitrogen is the combined value of both Nitrite (NH2-) and Nitrate (NO3-) in the natural environment, Nitrite readily oxidises to Nitrate. Laboratory results are presented as Nitrate+Nitrite-N which is their respective Nitrogen contents. The conversion for both are as follows:

- 1mg/L nitrate-N = 4.43mg/L nitrate
- 1mg/L nitrite-N = 3.29mg/L nitrite

The nominated trigger value of 4mg/L of Nitrogen is conservative. ANZECC 2000 guidelines state that Nitrate concentrations less than 400mg/L in livestock drinking water should not be harmful to animal health. The Australian Drinking Water Guidelines (2011) stipulate 50mg/L of Nitrate as an appropriate long term health criteria in drinking water.

Nitrogen and Phosphorous occur naturally but are also caused by agricultural fertilisers. Although Nitrogen levels at the Blowhole are uncharacteristically high, it does not pose a hazard to either humans or animals. However, the cause of the elevated Nitrogen is unknown. For natural systems to yield Nitrogen at the measured levels would indicate the presence of high levels of organic matter. As the volume of the Blowhole discharge is relatively small, there is only a minor increase in Nitrogen levels downstream.



Graph 7.6 – Ambient Surface Water Quality – Total Phosphorous

As shown in Graph 7.6, Phosphorous was above the trigger levels at a variable number of sites from October 2021 until November 2022. It is thought that the elevated concentrations during this time are a result of runoff from saturated soils in agricultural areas within the catchment following over a year of above-average rainfall and storm events. The concentration of nutrients will continue to be monitored and investigations into the cause of the elevated nitrogen will be reported in the next Annual Review. It should also be noted that the actual concentrations are very low and would not cause adverse algal growth within the receiving waters.

The WMP has also included a requirement to conduct quarterly stream and riparian vegetation health inspections of surface water monitoring sites. The inspections commenced in the reporting period and have involved photographing the channel and creek banks, description of the condition and noting any changes observed since the last inspection. The most recent inspection was conducted in June 2023 which concluded that there were no visual changes to the geomorphology or surrounding vegetation to the creeks and river which could be attributed to the mine. The assessment confirmed that based on the observations, there have been no impacts to groundwater dependent ecosystems, the alluvial aquifers or the natural springs within the gorge. The complete Surface Water Assessment Report has been attached as Appendix D.

7.2.4 Future Improvements

Surface water management procedures will be amended and updated as mining operations move forward in the upcoming reporting period. In particular, the specific surface water management controls to be implemented as part of the proposed Marulan Creek Dam and Marulan South Road alignment operations are to be aligned with the SSDA approval.

7.3 Groundwater Management

The quality and quantity of ground water may be impacted by sediments, dissolved salts, sewage effluent, hydrocarbons and chemicals generated or associated with surface water run-off from limestone mining and lime processing operations at the Marulan South Limestone Mine.

7.3.1 Pollution Control Strategies

It has been assumed and reported in previous AEMRs that sediment laden surface waters re-directed into the North and South pits do not significantly impact on groundwater. Water containing both fine and coarse sediments are effectively filtered as it percolates through the limestone bed under the North and South pits. This effectiveness is currently evident from dry pit floors even after a day or two of rain and also by the quantity of sediment trapped on the surface of the pit floors.

Water quality impacts of concern to groundwater from site related activities include oil, grease and total suspended solids. Whilst the diversion of surface water from the mine area into the North and South pits will control the risk of sediment laden water overflowing off site, the monitoring of oil and grease at these locations will need to be carried out to enable any contamination to be detected and rapid action to be taken to prevent any further contamination entering the groundwater.

7.3.2 Monitoring and Reporting

There are three groundwater sources located on site, including a shallow unconsolidated aquifer within the weathered zone where groundwater exists between pores and deeper consolidated bedrock aquifer located between rock fractures.

A total of eight monitoring bores were installed in 2014 within and adjacent to the pit area to determine the baseline groundwater levels and quality for the SSD project groundwater assessment. Monitoring bores MW01 and MW02 were located in the north pit and south pit respectively, and were removed as bench development progressed in 2017 and 2018. Bore MW04D was damaged and subsequently water quality analysis was not possible until June 2023. The remainder of the bores continue to be monitored for water quality twice-yearly. Screened formations of the bores include limestone, sandstone, weathered regolith and volcanics such as dacite, tuffs and andesite.

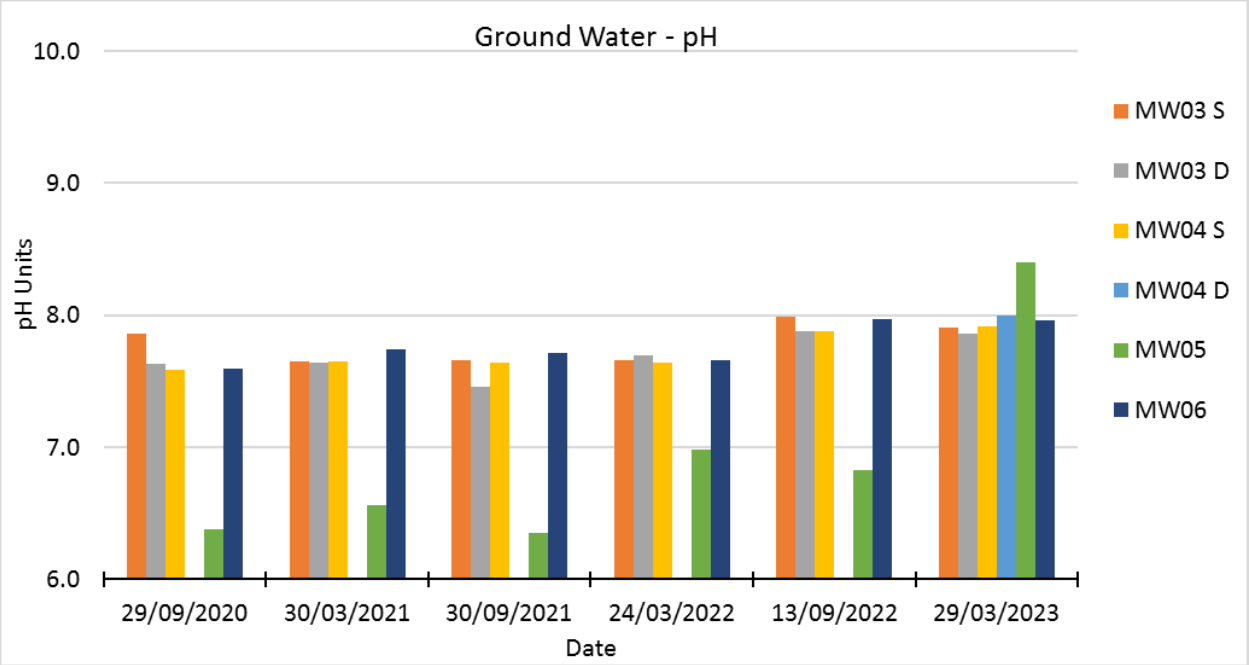
Monitoring Point 13 on EPL 944 requires monitoring of groundwater for oil and grease and suspended solids on a quarterly basis. Monitoring Point 13 is the groundwater bore MW05. Table 7.6 shows the results of monitoring as required by the EPL for the past two reporting periods whilst pH and conductivity are presented in Graphs 7.7 and 7.8 below.

Table 7.5 – EPL Monitoring Point 13

Date	Oil and Grease (mg/L)	TSP (mg/L)
30/09/2021	<5	11
13/12/2021	<5	15
24/03/2022	<5	11
8/06/2022	<5	14
13/09/2022	<5	18
21/12/2022	<5	48

Date	Oil and Grease (mg/L)	TSP (mg/L)
29/03/2023	<5	26
21/06/2023	<5	13

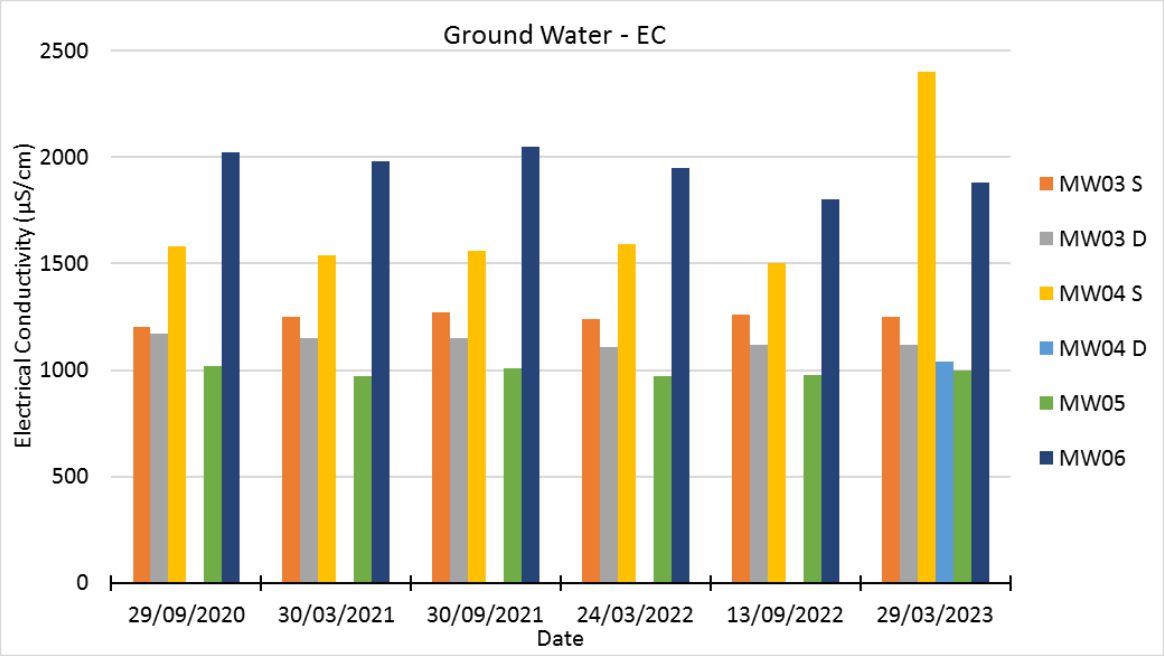
All the results for the reporting period are below the detection limits for Oil and Grease. TSS ranges from 11 to 48 mg/L at the licenced monitoring point (Table 7.3).



Graph 7.7 – Monitoring Bore Ground Water - pH

All of the bores excluding MW05 are generally neutral to slightly alkaline, within a 1 pH unit range (Graph 7.7). In the past, differences in pH levels have resulted from variability in host rock geology, although no such trends have been observed in the past two reporting periods.

The pH of MW05 dropped from a long term average of 9.5 to an average of 6.6 pH over the past two reporting periods, before increasing again to 8.4 pH in March 2023. There is a positive correlation between pH and alkalinity, so as total alkalinity ($CaCO_3$) falls the natural buffering capacity of the water decreases as does its ability to neutralise acid, and pH decreases. This has been attributed to a decrease in water level which has reduced the aquifer's exposure to the baked limestone in the proximity of the bore, which in turn reduced its inherent carbonate concentration.



Graph 7.8 – Monitoring Bore Ground Water - Electrical Conductivity

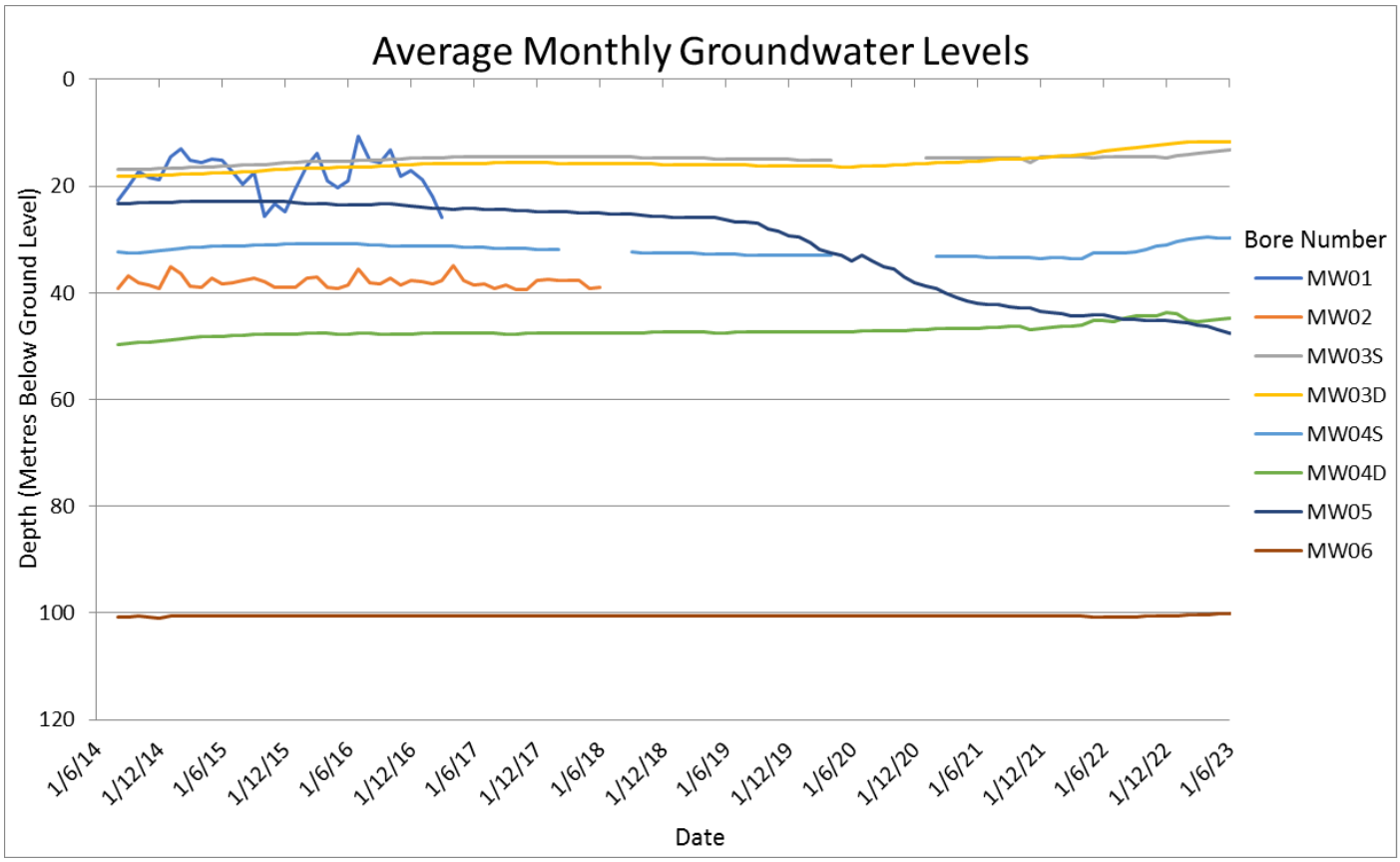
Graph 7.8 above shows variability among monitoring bore conductivity levels over the past three reporting periods. Host geology significantly influences conductivity of the bores, with limestone bores such MW05 with the lowest salinity ranging from 971 to 1020 µS/cm, and bores hosted in volcanics with conductivity levels as high as 2050 µS/cm at MW06 and 2400 µS/cm at MW04S. This fresh to slightly brackish water is defined as 'marginal' for drinking water use, but suitable for stock water and aquatic ecosystems.

7.3.3 Groundwater Levels

Groundwater levels are recorded daily from monitoring bores using pressure transduced piezometers. The piezometers are downloaded quarterly in correspondence with water quality sampling and the recordings are cross checked with manual water level measurements.

Historical water levels of bores in the pit contrast strongly with those located outside pit. Bores located in the pit such as MW01 and MW02 (both of which are now discontinued) had rapid responses to rainfall and runoff that seeps directly through the limestone. As an alternative, the remainder of the bores outside of the pit do not show variation associated with rain events because such fluctuation is buffered by the regolith situated above the groundwater level. The standing water level in these bores has either been fairly static or increased slightly since 2014.

The standing water level in monitoring bore MW05 presents a gradual decline from March 2017 until May 2019, then a much more rapid decrease from June 2019 until present. The decrease in standing water level observed at MW05 was expected based on groundwater modelling predictions of pit development. It is believed that the rapid decline was a result of the removal of the cross-cutting dolerite dyke in the North Pit which appeared to be 'damming' groundwater up-dip. Since the water level of this bore is artificially high (perched) it is also not reflective of the impact the quarry is having on regional groundwater levels. MW03 and MW04 are more accurate representations of the surrounding granite groundwater systems which have not as yet been impacted by the limestone removal within the mine. Graph 7.9 below shows that bore levels as monitored since 2014.



Graph 7.9 – Average Monthly Groundwater Levels from Monitoring Bores

The groundwater impact assessment conducted for the SSDA by AGE Consulting in 2019 does not predict any private bores will be impacted by drawdown greater than 1 metre during the 30 year SSD7009 consent period for the mine. The groundwater monitoring to date supports this conclusion.

7.3.4 Groundwater Review

An annual groundwater review will be prepared at the end of each calendar year which will evaluate groundwater levels using monitoring data from the mine's monitoring network and the Peppertree Quarry groundwater monitoring network.

In conjunction with the quarterly surface water monitoring, the stream and riparian health is also assessed as defined as an aquatic survey in the Groundwater Management Plan. A photographic record is kept for comparison and visual observations are compared to historical baselines observations and climatic conditions. Any ecological and environmental anomalies observed through ongoing ecological and environmental monitoring will be compared with the annual groundwater level data.

The intention of the routine groundwater monitoring plan at the mine site is to identify any mine related impacts on the local aquifer systems. No specific groundwater monitoring will be initiated within the Bungonia Creek and Barbers Creek gorge due to the impracticality of installing groundwater monitoring infrastructure. For this reason, quarterly monitoring will identify any changes in stream and vegetation health which is an indicator of any impacts on Groundwater Dependent Ecosystems (GDEs) and general terrestrial and aquatic ecology.

Monitoring was conducted during the reporting period and no changes to riparian health or mine related impacts were observed. The work undertaken is outlined in the Surface Water Monitoring Report attached as Appendix D.

Monitoring of the spring (also known as the Blowhole) is also covered in the Surface Water Management Plan. Spring flow is regarded as groundwater which becomes surface water in this case, and hence there is an overlap between surface water and groundwater monitoring. A photographic record of the Blowhole as well as quarterly water quality testing is documented. No changes to flow or water quality were recorded at the Blowhole in the reporting period, as discussed in the Surface Water Monitoring Report attached as Appendix D.

No alluvial aquifers are mapped along Barbers Creek, Bungonia Creek and the Main Gully south west of the mine. The Shoalhaven River alluvial aquifers are situated outside the predicted zone of drawdown and not deemed necessary for groundwater monitoring.

7.3.5 Future Improvements

The potential impact of the SSD7009 approved 30-year mining plan on groundwater was assessed by a numerical groundwater flow model which was prepared in accordance with the Aquifer Interference Policy. The assessment identified two risk areas. The first is the potential impacts on the quality and volume of groundwater flowing between the western mining area and the eastern Bungonia gorge system. The second is the potential risk to the water level at private bores located on the plateau to the west of the mine.

A model predicted that there will be only a minimal change in groundwater resources outside the limestone bodies following the mining project. The dolerite dyke running through the current north section of the northern pit is the only barrier identified to potentially prevent drainage in the future. The assessment also found that assuming no changes to the pit fractures, there will be a slight increase in recharge into the limestone from a larger overall mine pit area and increased flow into Bungonia Creek.

There are no specific groundwater mitigation measures required however Table, Condition B43 of SSD7009 provides performance indicators applicable to groundwater. In order to verify the impact predictions made in the EIS and to confirm adherence to the performance indicators, the existing groundwater monitoring program will be enhanced. This will include monitoring of the newly installed production bore WB07 and the installation of two additional monitoring bores MW8 and MW9. These will be installed in the coming reporting period.

A Trigger Action Response Plan has been developed which forms the basis for ongoing assessment of potential groundwater impacts. The following key actions and responses will be undertaken if a trigger threshold is exceeded.

- The re-confirmed exceedances will prompt an investigation, conducted by suitably qualified personnel, to determine the reasons for the exceedance, which could include but not be due to the influence of climatic conditions, agriculture abstraction or mining activities.
- In the case exceedances are attributed to mining activities, changes in groundwater conditions, such as a decrease in water level or increase in salinity, will be compared to

performance measures to evaluate the significance of any impacts on the groundwater system.

- Furthermore, the response and action to trigger exceedances in the TARP should determine if the trigger event resulted in an incident.

The results of the trigger investigations will be reported in each Annual Review. If it is clear each year that the groundwater baseline is changing in response to factors not related to mining such as climate or other land uses then the trigger thresholds will be recalculated. If this occurs the Ground Water Management Plan will be updated.

7.4 Water Access Licences and Water Take

Water take for the reporting period is detailed in Table 7.6 below.

Table 7.6 - Water Take

WAL	Works Approval	Water Source	Entitlement (ML)	Water Use (ML) 2022/2023
WAL25207	10WA102352	Shoalhaven River Water Source	76	76
WAL25373	10WA102377	Shoalhaven River Water Source	10	10
WAL25352	10WA102352	Shoalhaven River Water Source	1	1 (Stock and Domestic, used for domestic purposes only)
WAL24697	10WA115141 And 10WA116142	Goulburn Fractured Rock Groundwater Source	12	Nil
WAL41976	10CA122907 (statement of approval)	Goulburn Fractured Rock Groundwater Source	838	4.7

The volume of incidental groundwater intercepted in the mining areas will be estimated using the site water balance model each calendar year. The site water balance method compares rainfall and runoff inputs to the pits with pumping outputs and storage changes to estimate incidental groundwater take from the mining areas. This data will be published in subsequent annual reviews.

8. REHABILITATION STRATEGY

A Rehabilitation Strategy was prepared for the site as required by the consent for the Continued Operations Project and approved by DPE on 16th September 2022. This chapter summarises the environmental performance compared to the requirements of the Rehabilitation Strategy.

8.1 Rehabilitation Risk Assessment

A Rehabilitation Strategy was developed for the Marulan South Limestone Mine in April 2022. This strategy included:

- Rehabilitation Objectives;
- Rehabilitation Completion Criteria;
- Conceptual Final Landform; and
- Rehabilitation Risk Assessment.

The Rehabilitation Strategy identified the key constraints to achieving rehabilitation success. These are:

Soil pH conditions: The overall limited availability of topsoil material suitable for use in rehabilitation is exacerbated by elevated pH levels exhibited in the overburden materials used as growth medium layers to date. This has impeded the successful development of a growth medium layer that can support rehabilitation.

Steep slopes: Although overburden emplacements have been designed to mimic adjacent natural steep slopes, landform steepness has contributed to rehabilitation establishment issues in some emplacements, leading to potential derivative impacts of erosion and downstream water quality impacts.

Climate: Highly variable and irregular climatic conditions hinder rehabilitation development. Such conditions include hot summers, cold winters and periodic droughts. It is important to plan towards rehabilitation in the traditional windows of Spring and Autumn, but allow flexibility in long term rehabilitation planning to allow for drought periods and capitalising on La Nina (wetter) periods.

Water supply: Rehabilitation success has been impacted upon by water shortages following good initial germination. Irrigation trials have been set up previously, with limited success. The most effective irrigation has been natural rainfall.

Environment: Local environmental factors resulting from mine location have impeded rehabilitation establishment. Such factors include browsing by herbivorous pests such as goats and rabbits, native macropod species, as well as weed competition.

Measures to reduce these risks have been incorporated into the design of the rehabilitation program which are discussed further in the following sections.

8.2 Rehabilitation Objectives

The current rehabilitation strategy encompasses the following landform objectives across all rehabilitation domains:

- Rehabilitated land will be geotechnically stable and will not present a greater safety hazard than surrounding land to land-users, public, livestock and native fauna accessing or transiting the post-mining area;
- Land capability will, at a minimum, be returned to a class similar to that existing prior to Project commencement (Class V, VII or VIII);
- Except for mine void, mined land will be visually compatible with the surrounding natural landscape.
- Rehabilitated landforms will be designed to shed water without causing excessive erosion or increasing downstream pollution.
- Rehabilitated landforms will not negatively impact visual amenity for nearby residents and users of conservation reserves.

8.3 Site Domains

Mining domains were previously referred to as "primary" domains which are operation based such as infrastructure areas and overburden emplacements and final land use domains were previously known as "secondary" domains indicating post-mining land use objectives. The domains are shown in Figure 6 and Figure 7, and outlined in Tables 8.1 and 8.2 below. These will be revised and updated during the finalisation of the new RMP.

Table 8.1 – Primary Rehabilitation Domains

No.	Domain	Description	Area (Ha)
1	Infrastructure Area	Includes processing facilities, workshops, buildings, roads and rail, dams, pipelines and hard stand. Will remain operational until the end of the project life.	106.2
2	Waste Lime Storage/ Emplacement Area	Located in western overburden emplacement area for placement and capping of waste lime materials.	2.0
3	Water Management Areas	Sediment basins and water supply dams including the proposed Marulan Creek dam infrastructure.	30.0
4	Overburden Emplacement Areas	Existing overburden emplacement west and south of the open cut pit.	246.3
5	Stockpiled Material Area	Designated areas for management of raw, processed and product materials. (Incorporated into Domain 1).	0
6	Open Cut Mine Void	The open cut mine void will expand toward the west pit during development.	155.5

No.	Domain	Description	Area (Ha)
7	Rehabilitation Areas	Rehabilitated overburden emplacement areas, currently consists of rehabilitated areas of the western overburden emplacement, Bryce's Gully Emplacement, Barbers Emplacement and Eastern batters (south).	58
Total			598

Table 8.2 – Secondary Rehabilitation Domains

No.	Domain	Description	Area (Ha)
A	Native Woodland Areas	Former overburden emplacements and infrastructure areas rehabilitated to native woodland communities.	326.8
B	Trees over Grass-Landform Stability	Mix of tree, shrub and groundcover vegetation established on the eastern batters to promote long term erosion control and landform stability.	37.1
C	Final Mine Void	Post mining, the residual void will be approximately 240-270m deep, up to 900m wide (east to west) and 2000m long (north to south) with steeply sloping 'benched' walls and a generally level floor. This domain also includes approximately 8.9ha of the Southern overburden emplacement.	106.3
D	Visual Screening	Tree and shrub vegetation established around the void perimeter and upper slopes/ benches to promote visual screening and landform stability.	29.7
E	Water Management	Drainage control and water supply structures.	23.4
F	Infrastructure	Individual infrastructure items (mainly roads) incorporated into other domains to support post mining land use.	74.6
Total			598

8.4 Rehabilitation of Disturbed Land

8.4.1 Seed Sources and Application

Seed spray trials conducted at the south-western end of the Western Overburden Emplacement during 2020 showed best results with Flexterra FGM with ryegrass and couch cover seed mix. This therefore has been selected from the trials and will be used to rehabilitate the remainder of the Western Overburden Emplacement area.

Further hydroseeding was conducted in Spring 2022 and Autumn 2023 within the Western Overburden Emplacement area. This seeding has taken well as a dense mat of clover was visible at the end of the reporting period. It is envisioned that further areas to be seed sprayed will include a thicker layer of topsoil to improve germination success.

8.4.2 Rehabilitation Activities

During the reporting period, overburden continued to be emplaced in the existing Western Overburden Emplacement, with approximately 5 metres in height remaining on the highest batter until final height is reached. No rehabilitation was undertaken in the South Pit and rehabilitation activities are detailed in the following sections.

Western Overburden Emplacement

Rehabilitation works during the reporting period have focused on the second highest bench of the Western Overburden Emplacement (WOE) as per the Rehabilitation Plan in Plate 1. Flexterra FGM with ryegrass and couch cover seed mix (Table 8.3) was selected from the previous hydro-seeding trials to rehabilitate 5.1ha of the Western Overburden Emplacement during Spring 2022 (See Plate 2 below). The hydro-seeding conducted in Spring was deemed to be extremely successful, with close to complete groundcover by the end of June 2023.

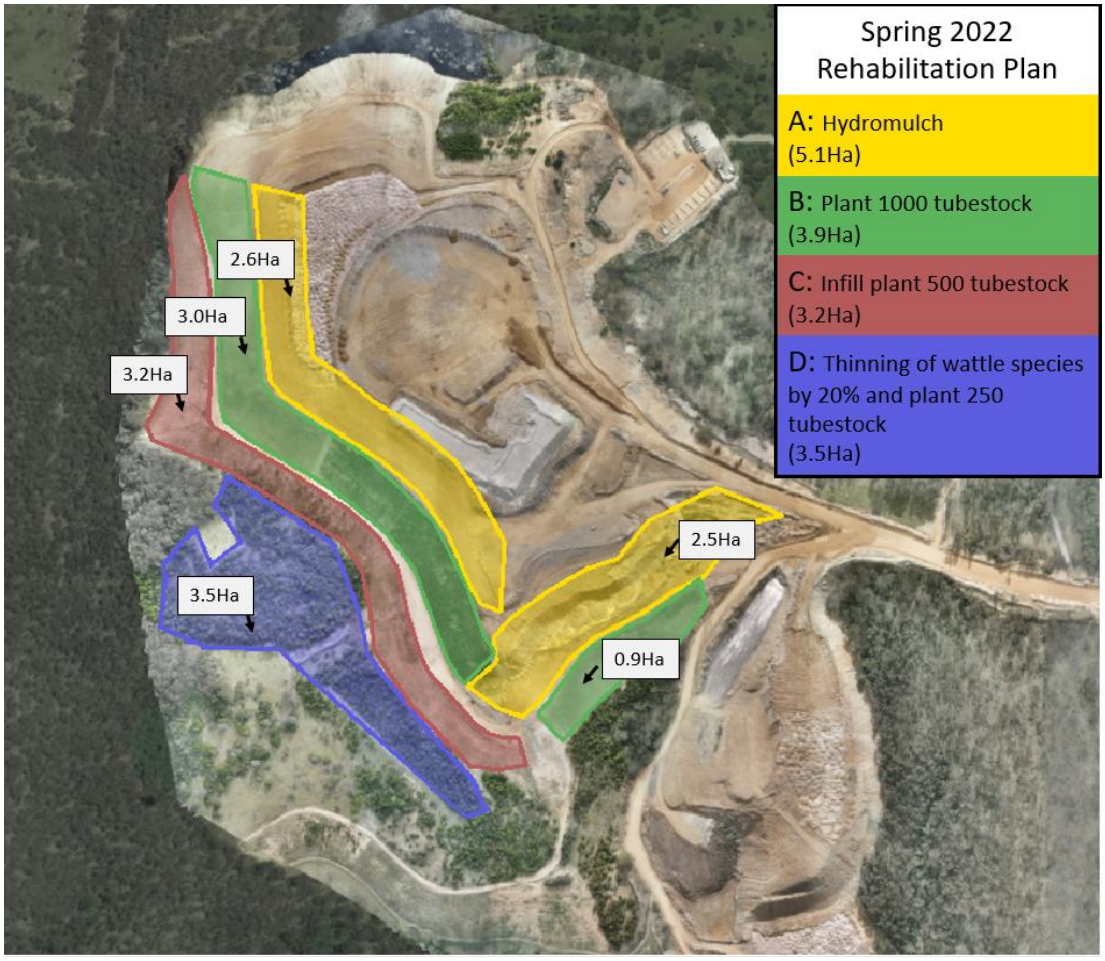


Plate 1 Western Overburden Emplacement Rehabilitation conducted in Spring 2022


Plate 2 Western Overburden Emplacement Rehabilitation May 2022

Additionally, 1000 tubestock were planted over the last years hydro-mulched area (B in Plate 1- shaded green), and infill planting of 500 tubestock will occur within the previous years rehabilitation to replace unsuccessful plants (C in Plate 1- shaded red). All tubestock will be sourced from current species lists. The Acacias were not thinned out (as per D in Plate 1- shaded blue) during the reporting period. These trees are reaching the end of their lifespan and it is anticipated that they will naturally die within the next few reporting periods to allow space for juvenile native trees to emerge.

Table 8.3 Ryegrass and Couch Cover Seed Mix

Seed Type	Species Name	Amount (Weight)
Grasses	Austrodanthonia spp	2kg
	Microlaena stipoides	2kg
	Chloris spp	2kg
	Themeda australis	2kg
Shrubs	Acacia falcata	0.3kg
	Acacia decora	0.5kg
	Acacia decurrens	0.5kg
	Acacia mearnsii	2kg
	Acacia rubida	1kg
	Acacia ulicifolia	0.3kg
	Dodonaea viscosa	1kg
	Hardenbergia violacea	0.5kg
	Indigofera australis	2kg
	Leptospermum obovatum	0.1kg
	Kunzea parvifolium	0.1kg
	Daviesia ulicifolia	0.2kg
Trees	Eucalyptus blakelyii	0.3kg
	Eucalyptus melliodora	0.3kg
	Eucalyptus mannifera	0.3kg
	Eucalyptus viminalis	0.3kg
	Allocasuarina littoralis	0.3kg

Bryce's Gully

The site specific Bryce's Gully Rehabilitation Strategy was implemented in 2019. The general objectives for rehabilitation of the gully are to construct a geotechnically stable landform which does not present a greater safety hazard than the surrounding land; create land to be visually compatible with the surrounding natural landscape and to not negatively impact the visual amenity of the gully. The rehabilitation progression is monitored annually using EFA (See Section 8.4).

As required by the strategy, tube stock was planted in nominated locations along the benches and drainage lines in the upper part of the gully and along steep sections adjacent to erosion channels in the southern part of the gully. These areas were fenced to prevent loss of tube stock due to grazing. Weed control measures were performed involving hand spot-spraying of tussock in targeted areas to ensure persistence of vegetation on the banks and to prevent erosion. Hand weeding was conducted inside the fenced areas, and plants were watered and fertilised using the irrigation system where required. Maintenance activities involved the application of fertiliser and water via an irrigation system which has been installed on the slope.

Inspections during January 2023 showed that regeneration is going well on the upper benches with the tube stock becoming more established (Plate 3). Low levels of loss were recorded, and thus replacement of tube stock has not yet been required. Further down the slope in the narrower sections of the gully there has been less success with the species planted due to wetter conditions and less light and alternate replacement species such as sandpaper fig will be investigated in the coming period.

Future rehabilitation work on Bryce's Gully will likely include additional planting of tube stock within new rehabilitation enclosures on the lower section of the gully (See Plate 4), spot spraying and replacing of tube stock where necessary.

A Geotechnical report on Bryce's Gully was completed during the reporting period which deemed the slope unstable at this time (See Section 6.11). It was advised that personnel should avoid entering this area as it may not be safe. Rehabilitation works planned for the 2023-2024 reporting period have been put on hold until actions can be put forth to ensure slope stability.

Plate 3 Current status of Bryces Gully bench 2 (EFA site 4) January 2023

8.4.3 Feral Animal Control

There has been much habitat disturbance on the project site associated with feral animals including rabbits, brown hares, foxes, goats and more recently deer. During the reporting period goats located on site were captured by a rural contractor, taken off site and sold. Additionally aerial culling was undertaken by the National Parks and Wildlife Services in the vicinity of the mine.

8.4.4 Weed Management

Schedule 4 Class 4 noxious weeds recorded on site include Blackberry, Pampas grass, Paterson's curse, Serrated tussock, and Sweet Briar. In accordance with the Noxious Weeds Act 1993, "the growth and spread of the plant (Class 4 weeds) must be controlled according to the measures specified in a management plan published by the local control authority".

During the 2022-2023 reporting period weed control was conducted as per the Marulan South Limestone Mine Weed Management Plan. Management action for priority species during the reporting period was carried out as follows:

- Blackberry and Serrated Tussock were spot sprayed in autumn with a follow up spray scheduled for spring 2023;
- Pampass Grass was spot sprayed in summer 2022. Seed heads were removed and larger plants slashed and resprayed in June 2023. A follow up spray will occur in spring 2023;

- Weeds including Thistle, St. John's Wort and Patterson's Curse are spot sprayed twice yearly or when required. The next round of spraying for these species will occur in spring, when these species are in flower and more visible;
- Larger Hawthorn and Cotoneaster plants are cut and painted, while spot spraying smaller plants also occurs in summer and spring months.

8.5 Rehabilitation Monitoring

8.5.1 Rehabilitation Monitoring - Ecosystem Function Analysis

An Ecosystem Function Analysis (EFA) developed by Tongway and Hindley (2004) is being utilised to assess the rehabilitation progression at the mine. The EFA monitors transects to measure the landscape function, vegetation dynamics, habitat complexity and disturbance. These measures are converted into indices for comparisons of rehabilitation over time and to undisturbed reference sites. The methodology used does not replace the traditional methods of monitoring vegetation and fauna but adds a functional interpretation to link vegetation structure and organisation more closely with soil function and the development of habitat for native fauna.

The site is surrounded by National Park and State Conservation Area bushland to the South and East, and farmlands to the North and West. The end result of the rehabilitation process is a return of the site to natural woodland where possible, or as sustainable grazing pasture where appropriate.

Monitoring surveys are scheduled to occur on a biannual basis, with monitoring undertaken in May 2022 and January 2023. Generally, surveys will occur in Autumn and Spring to record seasonal differences in floristic structure and composition in the reference areas, to identify seasonally occurring plant species, and to note the effects of seasonal conditions on plant germination on exposed rehabilitation sites.

A total of five transects, including one reference site were surveyed, as described in Table 8.4 below.

Table 8.4- Transect Description

Transect	Landscape Position	Comments
Reference 1 (R1)	South-West of the WOE	Has not been disturbed by mining activities
T1	Located at the northern end of the WOE, Domain 4.1w in the 2018-2023 MOP	Monoculture of *acacia* species with juvenile *Eucalypts*. Rehabilitated in 2005 and 2008. Discontinued due to expansion of the west overburden emplacement.
T2	South of the active area within the WOE, Domain 7.1w in the 2018-2023 MOP	Flat ground with groundcover of weed species and older monoculture of *Acacia*. Rehabilitated in 2005.
T3	Far south of the WOE Domain 7.1w in the 2018-2023 MOP	Rehabilitation occurred in 2017. Many *Acacia* with juvenile *Eucalyptus* and *Allocasuarina*. Many weeds present.

Transect	Landscape Position	Comments
T4	Second bench of Bryces Dump Domain 7.3e in the 2018-2023 MOP	Stable slope, high vegetation cover is mostly weeds, moss and dying serrated tussock. Rehabilitated in 2019/2020
T5	WOE - first bench, Domain 4.1w in the 2018-2023 MOP	Transect established April 2021. Rehabilitation trial conducted January 2019. High grass, broadleaf weed density with increased *Acacias* on lower half.

A summary of the January 2023 EFA results are presented below, while the complete report is provided as Appendix C.

Field surveys involved the collection of patch/interpatch and soil surface condition data for each transect. This data is used to calculate the landscape organisation, soil stability, infiltration and nutrient cycling indices. The landscape organisation and soil surface assessments are most useful when compared over time, during subsequent monitoring surveys.

Table 8.5 contains the Landscape Function Analysis (LFA) and Soil Surface Assessment (SSA) results. Minimal changes to soil characteristics were measured in January 2023. Soil structure takes many years to develop and it takes many years for a soil type to change its composition. The proportion of bare ground is now negligible at all sites apart from Site 3 due to increased native ground cover, annual weed growth and increase leaf litter.

Site 2 and 4 had the highest stability index with an extensive, localised layer of litter, high rain splash protection and a high presence of vegetative and biological cover. Moss was identified for the first time on Site 3, and it is expected that it will have a positive contribution to the soils biological crust cover rating in years to come. Since infiltration scores were similar to, or higher than the reference site, no further infiltration improvements are necessary. Only small improvements in nutrient cycling indices were recorded in January 2023, since only little changes were recorded for the overall soil assessment. A slight improvement of nutrient cycling is still required for Site 3, which would involve increased vegetation, litter and biological cover. Brush-matting can be recommended to achieve this.

Table 8.5- Landscape Function Analysis and Soil Surface Assessment Results

Index	T2	T3	T4	T5	Reference
Landscape Organisation	100	77	98	98	94
Stability	72	58	73	63	74
Infiltration	70	60	55	60	55
Nutrient Cycling	58	48	72	60	57

Vegetation Composition is measured by species richness at three strata levels and by cover percentages (Table 8.7). The canopy is split into middle (1-3m tall) and upper canopy (>3m). Stem count is used as a measure of vegetation density. An inventory of all species recorded is provided in Table 8.8.

Species Richness is fairly consistent across the sites, except for lower shrub richness in the rehabilitated areas compared to the reference site. Species Richness of Revegetated Areas still often remains below the Species Richness of the Reference Transect. It is natural for species richness to be low in newly colonised and regenerating areas, with complexity

increasing with time. The groundcover richness ranges from 16 to 30 species per transect, although a significant proportion of groundcover species are weeds (see Table 8.8).

Percent covers varied considerably among all five transects. There is a large percent of bare ground in transect T3 which can have negative impacts on soil stability and nutrient cycling, although this percent dropped from 50% to 39% in the past 6 months. T4 has a high groundcover percentage, although is lacking a middle and upper storey level. Seeding and tube stock planting has occurred in this area and will seek to address this issue over time.

The rehabilitated sites T2 and T5 in particular, have a considerably high density of mature acacia species, which is not representative of the reference site. Care must be taken when conducting rehabilitation that species mixes reflect the surrounding native vegetation.

Table 8.6- Vegetation Composition Results

Species Richness	**T2**	**T3**	**T4**	**T5**	**Reference**
Groundcover	25	16	30	29	23
Shrub	1	1	2	1	4
Canopy	4	7	1	2	7
Average Cover (%)					
Groundcover	51.5	18.15	50.25	50.45	12.25
Shrub Cover	34.8	19	5.25	8.4	2.25
Leaf Litter	48.5	43.15	47.25	34.9	84.25
Bare Ground	1	38.65	3	11.35	3.5
Canopy Cover	43.5	0	0	21	24.5
Total Stem Density Count					
1-3m	1	9	0	16	1
3m+	10	0	0	3	2

Table 8.7- Transect Species List

Transect 2	Transect 3	Transect 4	Transect 5	Reference
Weed species				
Sonchus asper	*Plantain lanceolata*	*Verbena brasiliensis*	*Hirschfeldia incana*	*Euphorbia maculata*
Plantago lanceolata	*Medicago minima*	*Stachys byzantina*	*Sonchus arvensis*	*Euphorbia peplus*
Erigeron bonariensis	*Hirschfeldia incana*	*Erigeron canadensis*	*Sinapis arvensis*	*Gamochaeta sp*
Centaurea Melitensis	*Euphorbia peplus*	*Solanum nigrum*	*Plantago lanceolata*	*Hypochaeris glabra*
Lactuca serriola	*Hypochaeris glabra*	*Cirsium vulgare*	*Dittrichia graveolens*	*Asclepias fascicularis*
Cirsium vulgare	*Geranium molle*	*Sonchus asper*	*Erigeron bonariensis*	*Nassella trichotoma*
Hirschfeldia incana	*Atractylis cancellata*	*Marrubium vulgare*	*Sonchus Asper*	*Daucus carota*
Silybum marianum	*Modiola caroliniana*	*Dittrichia graveolens*	*Hypochaeris glabra*	*Erigeron bonariensis*
Rumex acetosella	*Erigeron bonariensis*	*Geranium dissectum*	*Lythrum salicaria*	*Portulaca oleracea*
Hypochaeris glabra	*Erigeron canadaensis*	*Erigeron sumatrensis*	*Cirsium vulgare*	*Euchiton japonicus*
Erodium moschatum	*Sonchus Asper*	*Helminthotheca echioides*	*Helminthotheca echioides*	*Solanum nigrum*
Erigeron canadaensis	*Dodonaea viscosa*	*Sonchus oleraceus*	*Erigeron canadensis*	*Dichondra repens*
Erigeron sumatrensis	*Centaurea Melitensis*	*Plantain lanceolata*	*Dichondra repens*	*Verbena bonariensis*
Sonchus oleraceus	*Lactuca serriola*	*Machaeranthera tanacetifolia*	*Euchiton japonicus*	
Gamochaeta coarctata	*Cirsium vulgare*	*Scorzoneroides*	*Lythrum salicaria*	
Verbena brasiliensis		*Leontodon saxatilis*	*Erigeron canadensis*	
Dichondra repens		*Tetraneuris scaposa*	*Conyza bonariensis*	
Solanum nigrum		*Modiola caroliniana*	*Onopordum acanthium*	
Portulaca oleracea		*Andropogon virginicus*	*Anagallis arvensis*	
Oxalis dillenii		*Hypochaeris glabra*		
Ageratina adenophora		*Anagallis arvensis*		
Tagetes minuta		*Hirschfeldia incana*		
Improved Pasture Species				
Trifolium repens	*Trifolium repens*	*Trifolium repens*	*Trifolium repens*	*Poaceae sp.*
Phallaris sp.	*Phallaris sp.*	*Heteropogon contortus*	*Dactylis glomerata*	*Poa sieberiana*

Transect 2	Transect 3	Transect 4	Transect 5	Reference
	Lolium sp.	*Paspalum dilatatum*	*Cynodon dactylon*	*Cyperaceae sp.*
	Cenchrus Clandestinus	*Cynodon dactylon*	*Phallaris minor*	*Microlena spp*
	Cynodon dactylon	*Chloris gayana*	*Chloris gayana*	
			Poa pratensis	
			Lolium	
			Festuca arundinacea	
Native Understorey Species				
		Lomandra Longifolia	*Chrysocephalum apiculatum*	*Goodenia pinnatifida*
			Unknown groundcover	*Patersonia occidentalis*
			Hardenbergia violacea	*Chrysocephalum apiculatum*
				Indigofera australis
				Hardenbergia violacea
				Vicia tetrasperma
				Vittadinia muelleri
Mid to Upper Storey Species				
Acacia decurrens	*Acacia parramattensis*	*Pittosporum multiflorum*	*Dodonaea sp*	*Hakea sp.*
Acacia mearnsii	*Acacia falciformis*	*Pittosporum undulatum*	*Acacia decurrens*	*Eucalyptus eugenioides*
Eucalyptus cinerea	*Acacia mearnsii*		*Acacia mearnsii*	*Acacia sp. (juvenile)*
Eucalyptus macrorhyncha	*Acacia longifolia*			*Eucalyptus mannifera*
	Acacia decurrens			*Eucalyptus bosistoana*
	Allocasuarina littoralis			*Ozothamnus diosmifolius*
	Eucalyptus cinerea			*Olearia viscidula*
	Acacia parramattensis			*Eucalyptus cinerea.*
	Gleditsia triacanthos			*Acacia decurrens*
				Casuarina sp. (juvenile)

The Habitat Complexity is scored from 0 to 3 on the following five features to survey the extent of available niches for vertebrate fauna (Table 8.8). The index shows that all rehabilitated transects have lower habitat complexity levels than the reference transect. Transect T2 has an improved Habitat Complexity Score from the previous reporting period.

Table 8.8- Habitat Complexity Scores

Transect	Tree Canopy %	Shrub Canopy %	Ground Herb %	Litter %	Water Availability	Habitat Complexity Index
2	3	2	3	2	1	11
3	0	2	1	1	0	4
4	0	1	2	2	1	6
5	1	1	3	1	0	6
Reference	2	1	1	3	2	9

The EFA monitoring program is primarily designed to track rehabilitation progression and success through time. These results can be used as a baseline for the future.

8.5.2 Progressive Rehabilitation Strategy

The Marulan South Limestone Mine has a progressive rehabilitation strategy which considers the continued 30 year SSDA mine operation. The rehabilitation strategy has been updated to satisfy the consent conditions.

Plate 4- Western Overburden Emplacement Rehabilitation Plan Spring 2023

The rehabilitation activities planned for 2023-2024 reporting period will include the following actions, including those shown in Plate 4:

- Use of soil ameliorants to prepare soil for seeding;

- Cross-ripping followed by hydro-mulching and seeding of a total of 4ha in the WOE on the second highest bench (2.5ha) and the southern portion of the third bench (1.5ha) as per Plate 4 (A- highlighted yellow);
- A total of approximately 1000 tubestock will be planted over the last years hydro-mulched area of the WOE (total 5.1ha) on the southern portion of the lowest bench (2.5ha) and west of the third bench (2.6ha) as per Plate 4 (B- highlighted green);
- Thinning out the Acacia species located in the 2014 rehabilitation area with a density reduction of approximately 20%, located on the south-west lower bench of the WOE (total 2.3ha) as per Plate 4 (C- highlighted blue);
- Replacement of removed Acacias with 250 tubestock of Eucalypt and other native mid-upper storey species on the south-west lower bench of the WOE, as per Plate 4 (C- highlighted blue);
- Final uppermost bench within the WOE with 5 metres in height remaining to be used for topsoil storage during the reporting period as per Plate 4 (D- highlighted red);
- The planting out the new rehabilitation enclosures on the lower sections of Bryce's Gully and ongoing fertilisation and watering via the irrigation system as required; and
- Monitoring and maintenance Bryce's Gully including weed control measures when required.

The following actions may need to be taken as per recommendations from the LFA/EFA rehabilitation monitoring program:

- Controlling weeds within rehabilitation areas;
- Management and control of feral animals as required;
- Management and control of erosion;
- Revisiting rehabilitation methodologies in areas that may have failed;
- Infilling tube stock to improve species richness or in areas with failed plantings.
- General maintenance including irrigation and fertilising; and
- Repairing fences, access tracks and other land management activities.

8.6 Further Development of the Final Rehabilitation Plan

A Conceptual Rehabilitation Plan has been developed for the Continued Operations Project which is detailed in the Rehabilitation Strategy, and a Final Rehabilitation Plan will be developed for the RMP. This involves rehabilitation of all out-of-pit overburden emplacements and infrastructure sites to a native vegetation community. The final void will be reduced by partial in-pit placement of overburden in the south pit with additional visual screening of the extraction area. The revegetation of the emplacement area will include a mixture of native trees, shrubs and grasses representative of regionally occurring woodland, namely White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

The completion criteria specified in the SSD EIS and approved Rehabilitation Strategy commitments include a minimum of 70% vegetation cover, 50% if rocks, logs or other features of cover are present and no areas of weed infestation.

9. COMMUNITY RELATIONS

The Marulan South Limestone Mine has been owned and operated previously by BCSC and now Boral Cement Limited since 1987 and continues to provide direct employment currently for approximately 95 local people who travel from the towns of Goulburn (35kms), Marulan (12kms), Berrima (60kms) and surrounding areas.

Services provided by Boral Cement include a contracted bus service for employees travelling from Goulburn. In addition, a helicopter landing station is maintained in support of emergency responses, which may occur on site or in the adjoining Bungonia National Park and State Conservation Area.

During the reporting period, meetings have continued for the Marulan South Operations CCC. Meetings are held on a three-monthly basis and committee members are emailed an update including the monitoring data from the previous quarter. Minutes from the meetings are provided on the Boral Marulan South Operations website.

9.1 Environmental Complaints and Enquiries

Two complaints were received from the public during the reporting period. These have been detailed below in Table 9.1.

Table 9.1 Complaints register:

Date and time	Complaint received from	Nature of complaint	Outcome of Investigation
8/1/23	Public (EPA)	Email received from the EPA on 24/01/23 regarding concern around sediment laden water entering Bungonia Creek with a drop pin and photo provided.	Bungonia creek monitoring: TSS results show no impact on the creek from the main gully system. Latest TSS results obtained on 10/11/22 were 29mg/L and 25mg/L for Bungonia Creek up and Bungonia Creek down respectively. 24/1/23: Drone flight attempted- very difficult to locate the position of the blowhole and maintain drone signal from within the mine. No intrusion of water was visible. 30/1/23: Service conducted and data download on the Main Gully Overflow monitor and weather station for rain data. There have been no overflow events for the months of Dec 2022 and January 2023. It was determined that the sediment laden water observed was not contributed to by the mines Main Gully water surface water catchment but rather the underground 'blowhole' cave (also known as B68 Main Gully Spring) system which is fed by the greater area.

Date and time	Complaint received from	Nature of complaint	Outcome of Investigation
15/6/23	Public (Council)	Emailed received from the council on 15/5/23 notifying the site that there had been a Pampas Grass sighting and providing a map	16/6/23: The observation was discussed via phone call, establishing the location of the Pampas grass sighting, and confirming that the site was in compliance with the site's Weed Management Plan which is displayed on the Boral website. Under this management plan, Pampas is sprayed during the December-May period and again during the September-October Period. Council suggested that Boral remove the heads from any remaining accessible Pampas plants. 16/6/23: The Weed Management Plan was sent to Council in a follow up email and a contractor was engaged to remove any remaining heads from accessible Pampas grass, with the next spray scheduled for the September-October period via foot and drone for any inaccessible plants.

9.2 Community Liaison

Boral conducted a specific community liaison program as part of the SSD approval process in addition to its normal ongoing community engagement activities. The additional liaison provided information on community attitudes and concerns which assisted in the development of the ongoing mine operation strategic planning and environmental mitigation strategies.

The current engagement activities include:

- ❒ Regular community newsletters;
- ❒ Active participation in local events;
- ❒ Arranging site inspections and one on one consultation;
- ❒ Active engagement with key government and non-government organisations; and
- ❒ Maintenance of an environmental and community complaints register and actively managing and resolving community issues as they arise.

9.3 Community Involvement

Boral is engaged in local community events and has been involved in some of the most significant events since 2011. Boral is a proud major sponsor of the Tallong Apple Day Festival held annually in May, the Goulburn Mulwaree Council community bike ride, a sponsor of the Tallong public school numeracy award, Careers Expo, IQA site visit and slope stability course and the Mayoral Charity golf day.

10. INDEPENDENT AUDIT

There were no independent audits required during the reporting period. The SSD approval will require an Independent Environmental Audit to be undertaken within one year of commencement of development under the consent and every three years thereafter. The first of these audits will not be required to be undertaken until the 2023/2024 reporting period.

11. INCIDENTS AND NON-COMPLIANCES

One reportable incident occurred during the 2022-2023 reporting period as detailed below. This incident occurred prior to the commencement of operations under SSD7009. This incident did not represent a non-compliance with any conditions of SSD7009.

On the 25/11/22, a landslip occurred on the eastern batters into an unnamed drainage line approximately 700 meters above Barbers Creek, although the slip material remained within the site boundary. The site initiated its Pollution Incident Response Management Plan and applicable stakeholders were notified.

Bothe the EPA and Resources Regulator inspected the landslip on the 8/12/22 and a clean up notice was received from the EPA on the 16/12/22. The notice requested that Boral *engage a suitably qualified expert with the capacity to undertake an assessment of the landslip and its risk to the environment.*

The Resources Regulator also issued a Directive to investigate the cause of the slip and to determine the most appropriate long term remediation options.

An Environmental Monitoring Plan was submitted to the EPA detailing how the impacts of the landslip on the downstream environment will be monitored. The plan stated that drone seeding and a polymer spray of the batters would be undertaken if there are any impacts to Barbers Creek. Boral took preventative action on 17/6/23 and sprayed the batters before any impacts could occur. An envirobond product which included a glue to stabilise the surface was applied at a rate of 10,000L/ha over the 4.5ha area with grass seed added to the mix. This polymer spray is designed to prevent any potential erosion into the creek.

The Environmental Monitoring Plan also outlined monitoring of ground movement of the batters, and the tributary by weekly drone footage as well as monitoring of Barbers Creek water quality.

Five rounds of monthly and two rounds of quarterly water quality monitoring of pH, Total Suspended Solids (TSS), Turbidity (NTU) were undertaken at the tributary, directly upstream and downstream of the tributary in Barbers Creek as well as at the original Barbers Creek upstream site. Monitoring results combined with photographic monitoring of the creek bed and the surrounding vegetation showed no evidence of erosion or other associated impacts to the creek.

The site continues to work with the Resources Regulator on the most suitable long-term solution to the slip as part of the Directive response.

The results of this monitoring program and Resources Regulator Directive will be reported in the 2023-24 Annual Review.

12. ACTIVITIES PROPOSED FOR NEXT PERIOD

Activities for the coming reporting period primarily centre around the implementation of the various management plans associated with the SSD post-approval process.

12.1 Current Approved Management Plans and Strategies

The SSDA development consent requires a number of plans and strategies which were prepared during the reporting period. The following plans which were approved include:

- Noise Management Plan.
- Blast Management Plan.
- Air Quality and Greenhouse Gas Management Plan.
- Water Management Plan (including Site Water Balance, Erosion and Sediment Control Plan, Surface Water Management Plan, Marulan Creek Dam Management Plan, and Groundwater Management Plan).
- Biodiversity Management Plan.
- Aboriginal Cultural Heritage Management Plan.
- Historic Heritage Management Plan.
- Bushfire Management Plan
- Rehabilitation Strategy.
- Rehabilitation Management Plan.
- Traffic Management Plan.
- Environmental Management Strategy.

These plans have been prepared in accordance with relevant guidelines and in consultation with DPE and relevant government agencies. The plans provide details on statutory requirements, relevant limits or performance criteria and performance indicators, as well as a description of the measures to be implemented to comply with these requirements. The plans also detail monitoring programs to assess the environmental performance of the development and the effectiveness of the management measures. Protocols for managing and reporting any incidents, non-compliance or exceedances of impact assessment criteria are also included.

During the 2023-24 reporting period, the various management strategies and plans will continue to be implemented.

12.2 SSD7009 Post Approval Requirements

Actions remaining to be undertaken include:

- Prepare a new Rehabilitation Management Plan to take into account the approved mine plan and specific conditions of the new Mining Lease 1857.

- Relinquishment of CML16.
- Active protection of nominated Aboriginal sites scheduled for avoidance in proximity to development footprint.
- Preclearance surveys to be undertaken prior to clearing any vegetation within the approved disturbance area.

12.3 Rehabilitation Activities Planned for 2023-24

The rehabilitation activities planned for 2023-2024 reporting period will include:

- Use of soil ameliorants to prepare soil for seeding;
- Cross-ripping followed by hydro-mulching and seeding of a total of 4ha in the WOE on the second highest bench (2.5ha) and the southern portion of the third bench (1.5ha);
- A total of approximately 1,000 tubestock will be planted over the last years hydro-mulched area of the WOE (total 5.1ha) on the southern portion of the lowest bench (2.5ha) and west of the third bench (2.6ha);
- Thinning out the Acacia species located in the 2014 rehabilitation area with a density reduction of approximately 20%, located on the south-west lower bench of the WOE (total 2.3ha);
- Replacement of removed Acacias with 250 tubestock of Eucalypt and other native mid-upper storey species on the south-west lower bench of the WOE;
- Final uppermost bench within the WOE with 5 metres in height remaining to be used for topsoil storage during the reporting period;
- The planting out the new rehabilitation enclosures on the lower sections of Bryce's Gully and ongoing fertilisation and watering via the irrigation system as required;
- Monitoring and maintenance Bryce's Gully including weed control measures when required; and
- Ongoing monitoring and remediation of the Barbers Creek Emplacement as required.

12.4 Mining Operations

Mining operations will continue in accordance with SSD7009 which is likely to involve:

- pre-stripping of topsoil in approved mine expansion and emplacement areas;
- overburden removal and emplacement;
- drill and blast activities;
- extraction of limestone and clay shale;
- Clay shale will continue to be mined by excavator or front-end loader;
- hauling of overburden and extracted resource;
- crushing, screening and stockpiling operations;

- product despatch predominantly by rail but also by road;
- maintenance and rehabilitation activities; and
- environmental and rehabilitation monitoring.

Further exploration will be undertaken to further develop the geological model and assist with future mine planning.

Figures

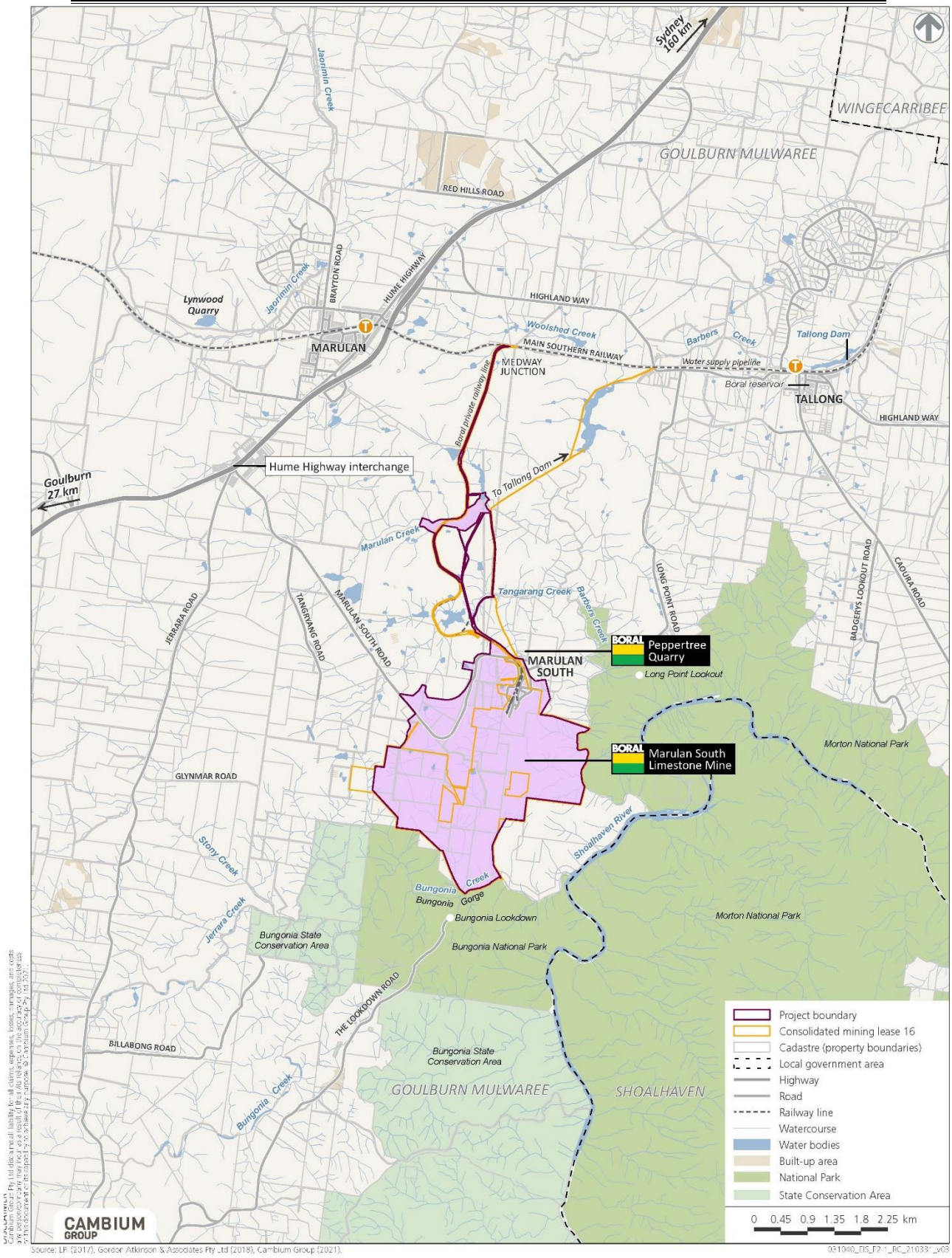


Figure 1 – Regional Location

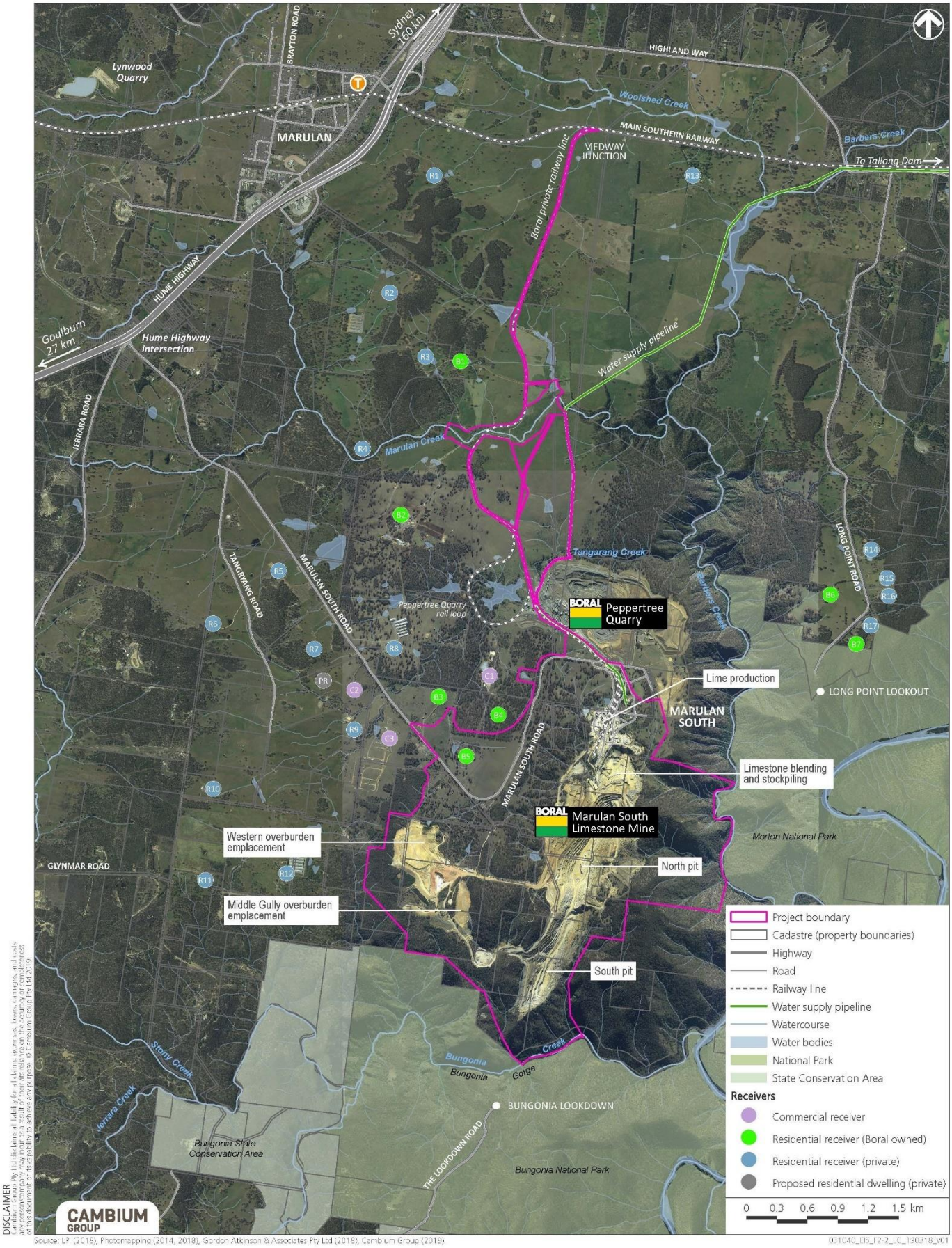


Figure 2 – Local Context

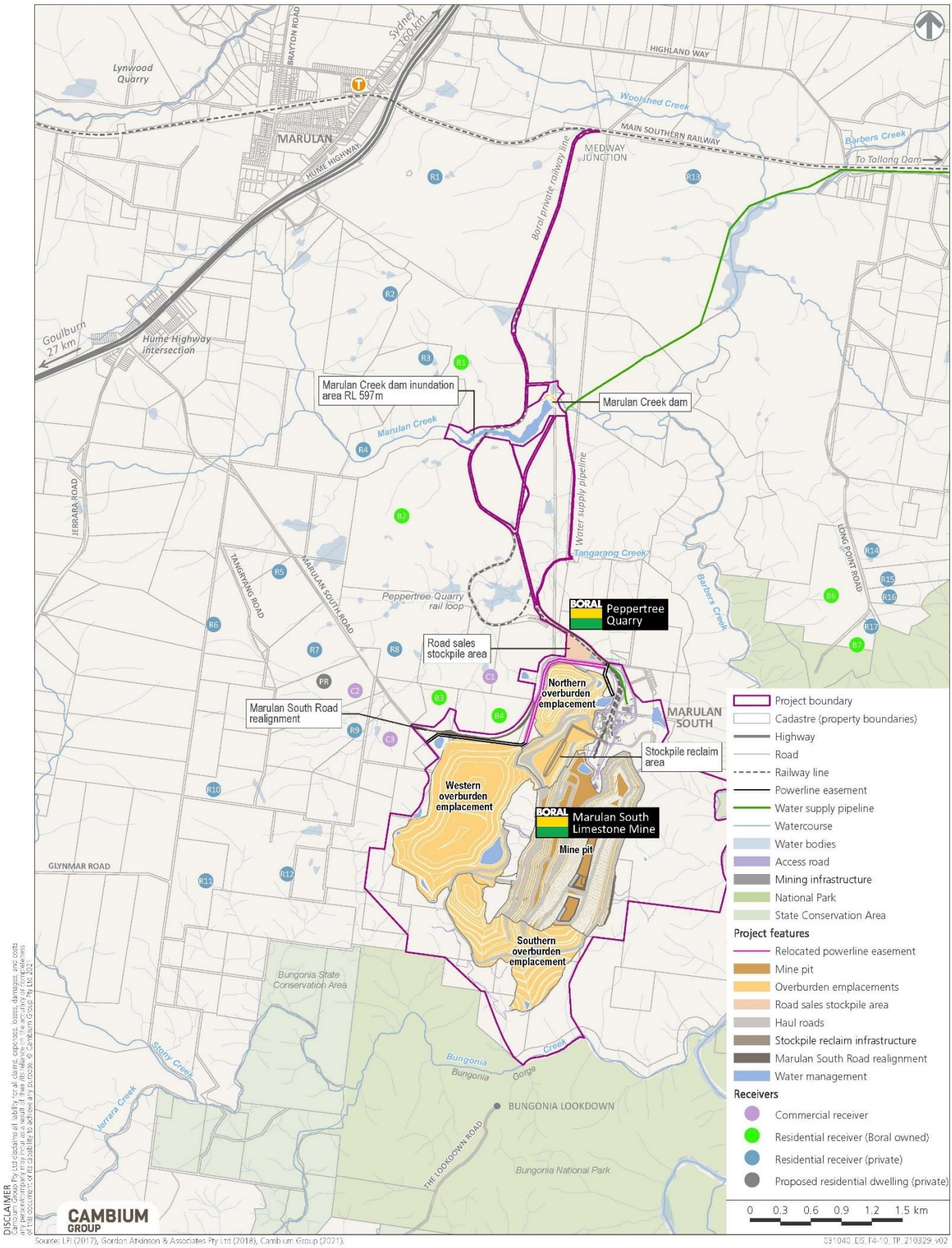


Figure 3 – Approved Project

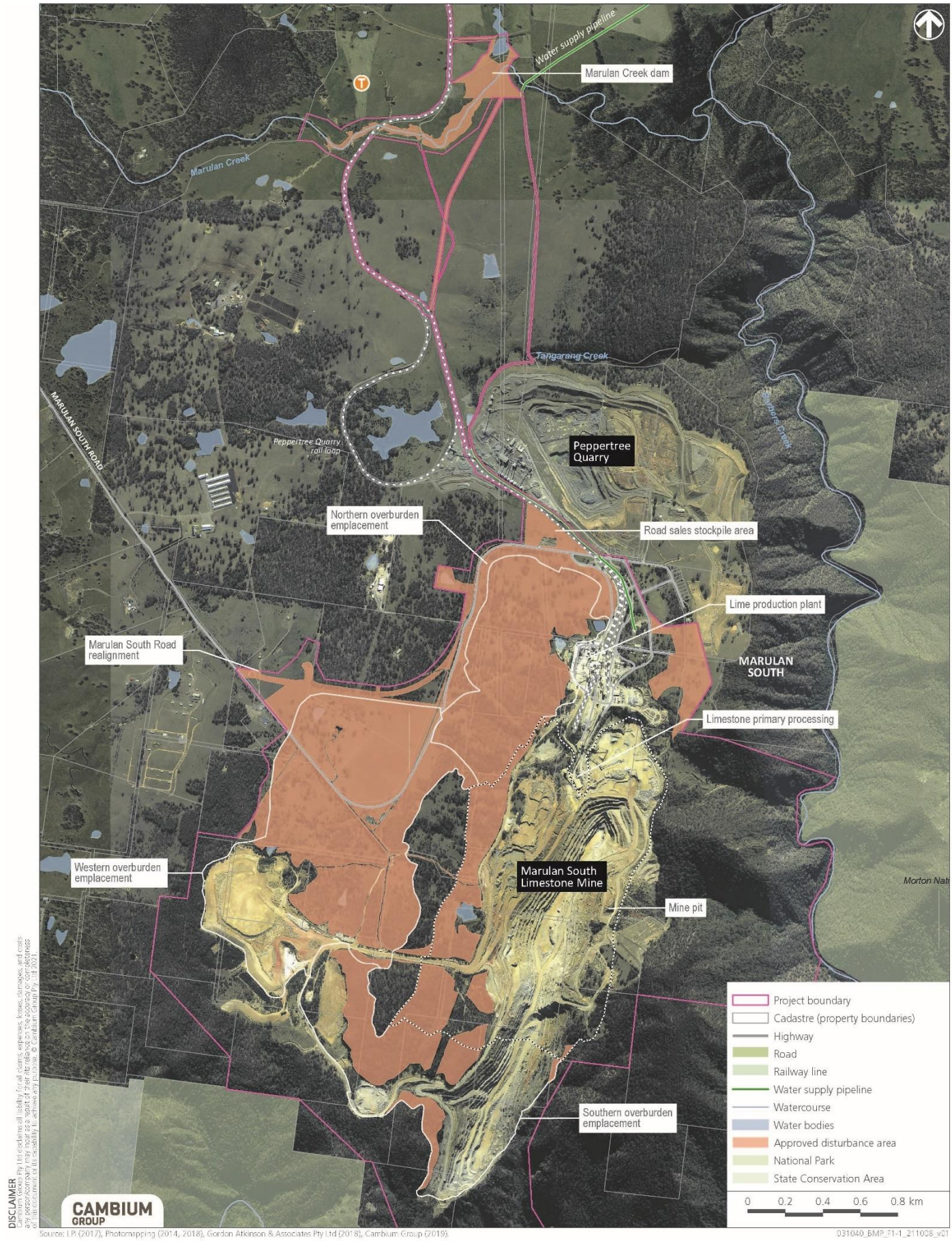


Figure 4 – Approved Disturbance Area

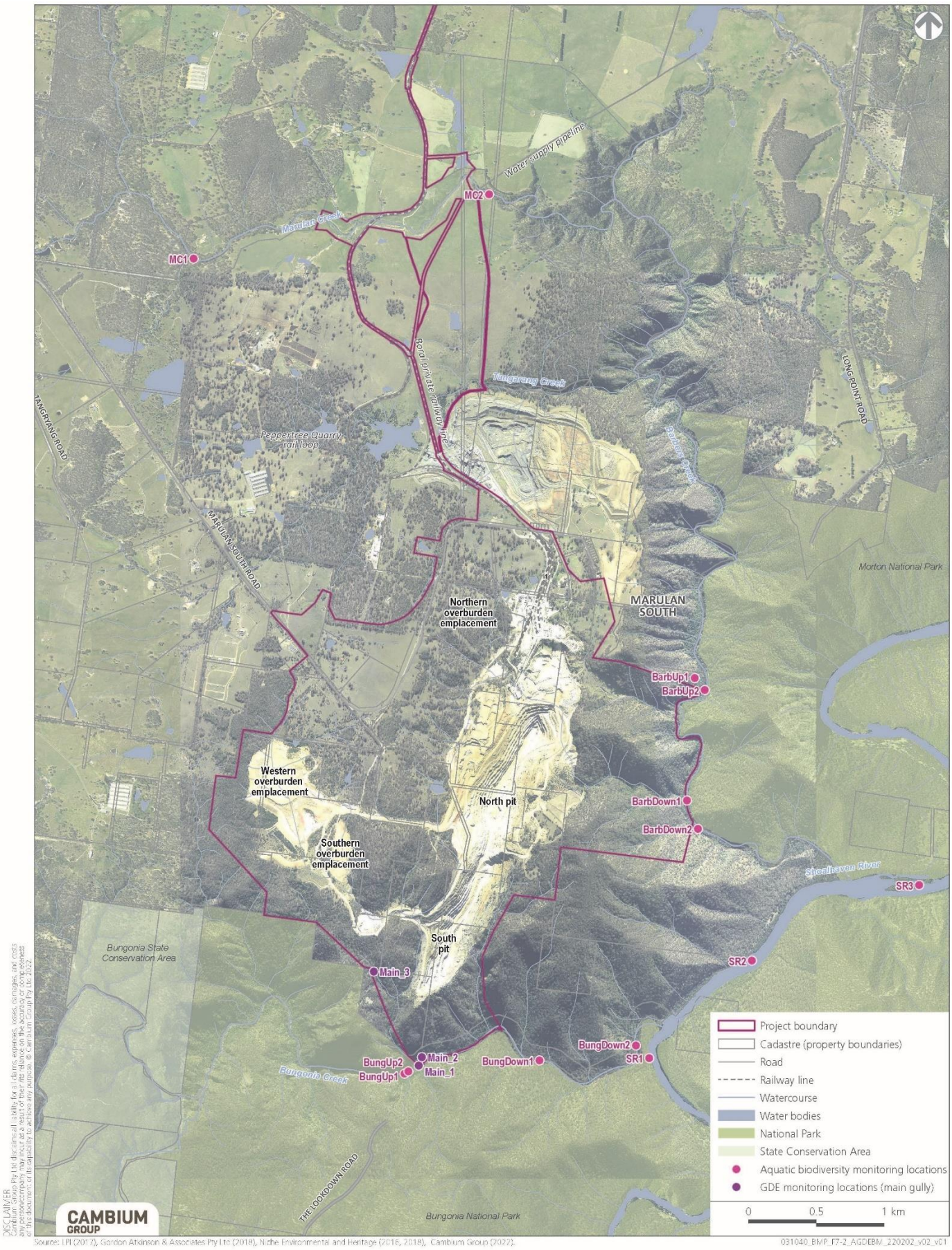


Figure 5 – Monitoring Sites

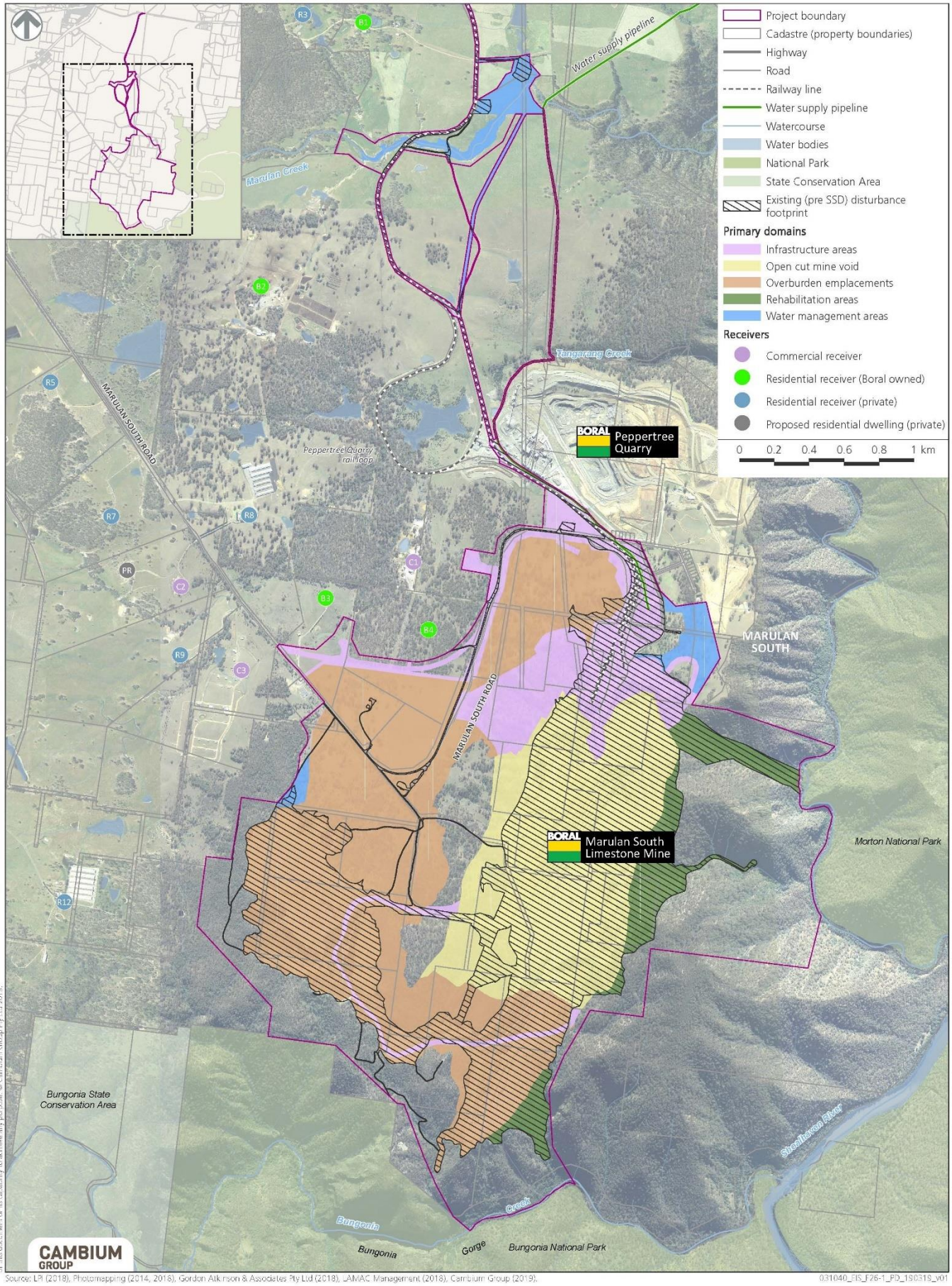


Figure 6 – Mining Domains

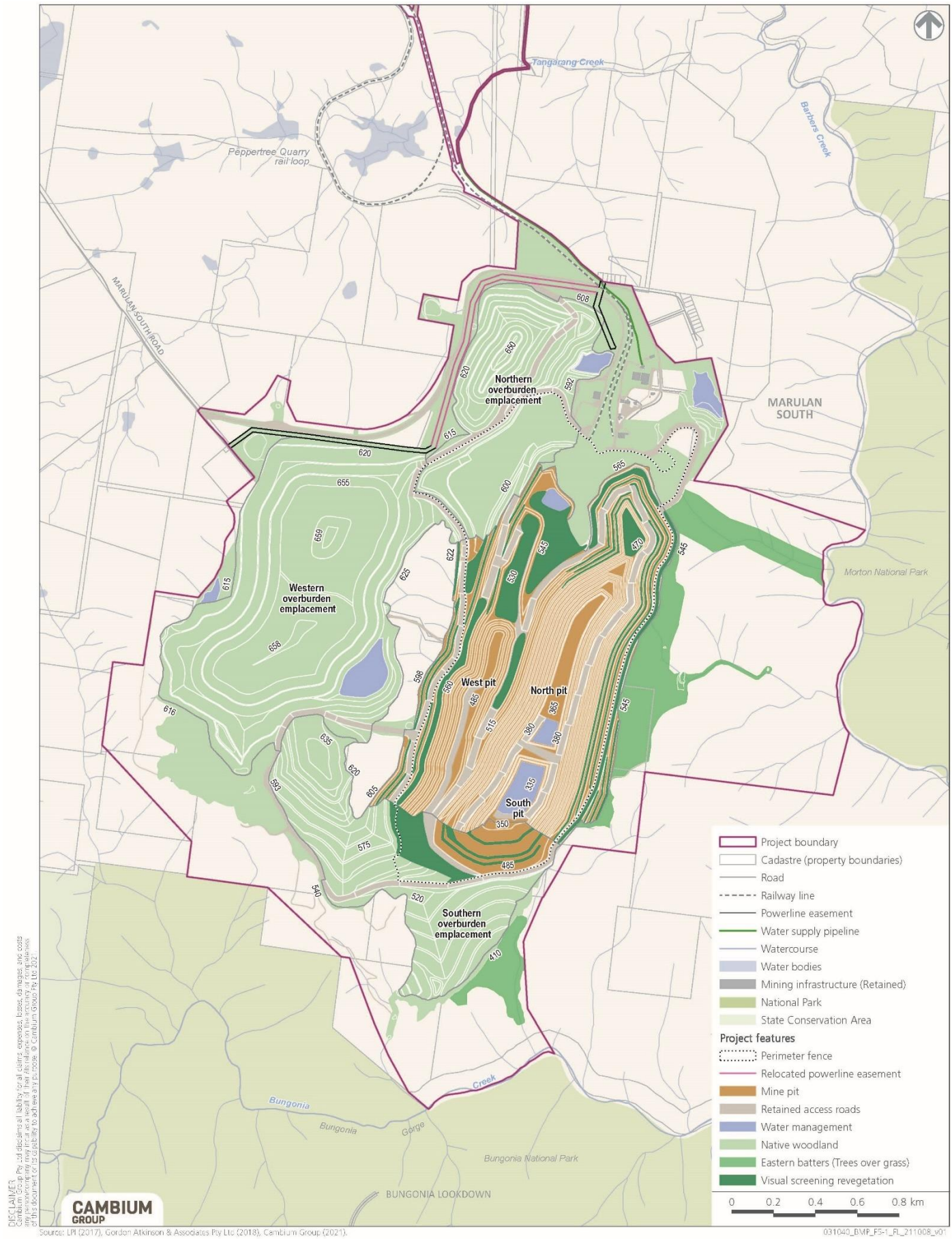


Figure 7 – Final Rehabilitation Plan

APPENDIX A - EPA Licence

Environment Protection Licence

Licence - 944

Licence Details	
Number:	944
Anniversary Date:	28-January

Licensee
BORAL CEMENT LIMITED
PO BOX 6041
NORTH RYDE NSW 2113

Premises
MARULAN SOUTH LIMESTONE MINE AND LIME PLANT
HUME STREET
MARULAN SOUTH NSW 2579

Scheduled Activity
Cement or lime works
Mining for minerals

Fee Based Activity	Scale
Cement or lime production	> 100000-250000 T annual production capacity
Mining for minerals	> 2000000-5000000 T annual production capacity

Contact Us
NSW EPA
6 Parramatta Square
10 Darcy Street
PARRAMATTA NSW 2150
Phone: 131 555
Email: info@epa.nsw.gov.au
Locked Bag 5022
PARRAMATTA NSW 2124

Environment Protection Licence

Licence - 944

Environment Protection Licence

Licence - 944

Environment Protection Licence

Licence - 944

Information about this licence

Dictionary

A definition of terms used in the licence can be found in the dictionary at the end of this licence.

Responsibilities of licensee

Separate to the requirements of this licence, general obligations of licensees are set out in the Protection of the Environment Operations Act 1997 ("the Act") and the Regulations made under the Act. These include obligations to:

- ensure persons associated with you comply with this licence, as set out in section 64 of the Act;
- control the pollution of waters and the pollution of air (see for example sections 120 - 132 of the Act);
- report incidents causing or threatening material environmental harm to the environment, as set out in Part 5.7 of the Act.

Variation of licence conditions

The licence holder can apply to vary the conditions of this licence. An application form for this purpose is available from the EPA.

The EPA may also vary the conditions of the licence at any time by written notice without an application being made.

Where a licence has been granted in relation to development which was assessed under the Environmental Planning and Assessment Act 1979 in accordance with the procedures applying to integrated development, the EPA may not impose conditions which are inconsistent with the development consent conditions until the licence is first reviewed under Part 3.6 of the Act.

Duration of licence

This licence will remain in force until the licence is surrendered by the licence holder or until it is suspended or revoked by the EPA or the Minister. A licence may only be surrendered with the written approval of the EPA.

Licence review

The Act requires that the EPA review your licence at least every 5 years after the issue of the licence, as set out in Part 3.6 and Schedule 5 of the Act. You will receive advance notice of the licence review.

Fees and annual return to be sent to the EPA

For each licence fee period you must pay:

- an administrative fee; and
- a load-based fee (if applicable).

Environment Protection Licence

The EPA publication “A Guide to Licensing” contains information about how to calculate your licence fees. The licence requires that an Annual Return, comprising a Statement of Compliance and a summary of any monitoring required by the licence (including the recording of complaints), be submitted to the EPA. The Annual Return must be submitted within 60 days after the end of each reporting period. See condition R1 regarding the Annual Return reporting requirements.

Usually the licence fee period is the same as the reporting period.

Transfer of licence

The licence holder can apply to transfer the licence to another person. An application form for this purpose is available from the EPA.

Public register and access to monitoring data

Part 9.5 of the Act requires the EPA to keep a public register of details and decisions of the EPA in relation to, for example:

- licence applications;
- licence conditions and variations;
- statements of compliance;
- load based licensing information; and
- load reduction agreements.

Under s320 of the Act application can be made to the EPA for access to monitoring data which has been submitted to the EPA by licensees.

This licence is issued to:

BORAL CEMENT LIMITED
PO BOX 6041
NORTH RYDE NSW 2113

subject to the conditions which follow.

Environment Protection Licence

Licence - 944

1 Administrative Conditions

A1 What the licence authorises and regulates

A1.1 This licence authorises the carrying out of the scheduled activities listed below at the premises specified in A2. The activities are listed according to their scheduled activity classification, fee-based activity classification and the scale of the operation.

Unless otherwise further restricted by a condition of this licence, the scale at which the activity is carried out must not exceed the maximum scale specified in this condition.

Scheduled Activity	Fee Based Activity	Scale
Cement or lime works	Cement or lime production	> 100000 - 250000 T annual production capacity
Mining for minerals	Mining for minerals	> 2000000 - 5000000 T annual production capacity

A2 Premises or plant to which this licence applies

A2.1 The licence applies to the following premises:

Premises Details
MARULAN SOUTH LIMESTONE MINE AND LIME PLANT
HUME STREET
MARULAN SOUTH
NSW 2579
SHIRE OF MULWAREE, PARISH OF MARULAN, COUNTY OF ARGYLE

A2.2 Additional Premises Description:

Lot 1 DP 23030; Lot 130 A/C 15310-179; Lot 186 A/C 15310-179; Lot 189 A/C 15310-179; Lot 193 A/C 15310-179; Lot 4 DP 216767; Lot 82 DP 750029; Lot 114 DP 750029; Lot 115 DP 50029; Lot 131 DP 750029; Lot 132 DP 750029; Lot 154 DP 750029; Lot 156 DP 750029; Lot 165 DP 750029; Lot 197 DP 750029; Lot 196 DP 750029; Lot 6 DP 111641; Lot 7 DP 111641; Lot 1 DP 527500; Lot 2 DP 527500; Lot 3 DP 527500; Lot 1701 DP 610507; Lot 1702 DP 610507; Lot 1 DP 617992; Lot 3 DP 617992; Lot 14 DP 111641; Lot 15 DP 111641; Lot 16 DP 111641; Lot 9 DP 111645; Lot 1 DP 371167; Lot 113 DP 830458; Lot 1 DP 860561; Lot 2 DP 860561; Lot A DP 368922; Lot B DP 368922; Lot 2 DP 536838; Lot 22 DP 867667; Lot 1 DP 1124189; Lot 2 DP 1124189; Lot 12 DP 881240; Lot 23 DP 867667; Lot 3 DP 203290; Lot 4 DP 203290; Lot 282 DP 750029; Lot 32 DP 750029; Lot 193 DP 750029; Lot 115 DP 750029; Lot 186 DP 750029; Lot 179 DP 750029; Lot 83 DP 750029; Lot 155 DP 750029; Lot 87 DP 750029; Lot 98 DP 750029; Lot 187 DP 750029; Lot 191 DP 750029; Lot 7303 DP 1149129; Lot 7301 DP 1149129; Lot 7302 DP 1149129; Lot 7300 DP 1149129; Lot 24 DP 867667; Lot 1 DP 860561; Lot 2 DP 860561; Lot 1 DP 261615; Lot 2 DP 527500; Lot 1 DP 527500; Lot 1 DP 106569; Lot 2 DP 106569; Lot

100 DP 1064794; Lot 12 DP 570616; Lot 111 DP 830458; Lot 114 DP 830458; Lot 112 DP 830458; Lot 113 DP 830458; Lot 2 DP 1186554; Lot 1 DP 132244; Lot 2 DP 132244; Lot 3 DP 106569; Lot 3 DP 527501; Lot 4 DP 106569 and Lot 21 DP 657523.

A2.3 The premises is identified by the most recently approved premises map held on EPA electronic file as DOC23/6902-2.

A3 Information supplied to the EPA

A3.1 Works and activities must be carried out in accordance with the proposal contained in the licence application, except as expressly provided by a condition of this licence.

In this condition the reference to "the licence application" includes a reference to:
a) the applications for any licences (including former pollution control approvals) which this licence replaces under the Protection of the Environment Operations (Savings and Transitional) Regulation 1998; and
b) the licence information form provided by the licensee to the EPA to assist the EPA in connection with the issuing of this licence.

2 Discharges to Air and Water and Applications to Land

P1 Location of monitoring/discharge points and areas

P1.1 The following points referred to in the table below are identified in this licence for the purposes of monitoring and/or the setting of limits for the emission of pollutants to the air from the point.

Air

EPA identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
1	Dust monitoring		High Volume Air Sampler labelled as "EPL1" on map titled "230109 EPL944 Premise Map" (DOC23/6902-2)
11	Discharge to air; Air emissions monitoring	Discharge to air; Air emissions monitoring	Kiln Stack labelled as "EPL11" on map titled "230109 EPL944 Premise Map" (DOC23/6902-2)
12	Discharge to air; Air emissions monitoring	Discharge to air; Air emissions monitoring	Lime Hydration Plant Stack labelled as "EPL12" on map titled "230109 EPL944 Premise Map" (DOC23/6902-2)
16	Dust Monitoring		Dust Deposition Gauge located within the premises labelled as "EPL16" on map titled "230109 EPL944 Premise Map" (DOC23/6902-2)
17	Dust monitoring		Dust deposition gauge at Sub station. Dust monitoring station located within the premises labelled as "EPL17" on map titled "230109 EPL944 Premise Map" (DOC23/6902-2)

18	Dust monitoring	Dust deposition gauge at Freddy's hill. Dust monitoring station located within the premises labelled as "EPL18" on map titled "230109 EPL944 Premise Map" (DOC23/6902-2)
21	Weather monitoring	Weather monitoring station located within the premises labelled as "EPL21" on map titled "230109 EPL944 Premise Map" (DOC23/6902-2)

P1.2 The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.

Water and land

EPA Identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
13	Groundwater Monitoring		Groundwater Monitoring Point labelled as "MW05" on map entitled 'EPL 944 Groundwater Monitoring Point Location Change- December 2020" (DOC20/1014984)

3 Limit Conditions

L1 Pollution of waters

L1.1 Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.

L2 Load limits

L2.1 The actual load of an assessable pollutant discharged from the premises during the reporting period must not exceed the load limit specified for the assessable pollutant in the table below.

L2.2 The actual load of an assessable pollutant must be calculated in accordance with the relevant load calculation protocol.

Assessable Pollutant	Load limit (kg)
Coarse Particulates (Air)	8050.00
Fine Particulates (Air)	5050.00
Lead (Air)	6.00
Mercury (Air)	2.00
Nitrogen Oxides (Air)	91680.00

Sulfur Oxides (Air)	170.00

Note: An assessable pollutant is a pollutant which affects the licence fee payable for the licence.

Note: Lead and Mercury load limits were derived from 5 years of annual returns and discussion with the licensee. Load limits are to be reviewed in 2025.

L3 Concentration limits

L3.1 For each monitoring/discharge point or utilisation area specified in the table/s below (by a point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table.

L3.2 Air Concentration Limits

POINT 1

Pollutant	Units of measure	100 percentile concentration limit	Reference conditions	Oxygen correction	Averaging period
PM10	micrograms per cubic metre	25(Annual) 50(24hr)			
PM2.5	micrograms per cubic metre	8(Annual) 25(24hr)			
Total suspended particles	micrograms per cubic metre	90			Annual

POINT 11

Pollutant	Units of measure	100 percentile concentration limit	Reference conditions	Oxygen correction	Averaging period
Nitrogen Oxides	milligrams per cubic metre	2000			

POINT 12

Pollutant	Units of measure	100 percentile concentration limit	Reference conditions	Oxygen correction	Averaging period
Solid Particles	milligrams per cubic metre	100			

Note: Point 1 sampling limits for PM10 are:
- 25 micrograms per meter squared over an averaging Annual period; and
- 50 micrograms per meter squared over an averaging 24 hour period.

Note: Point 1 sampling limits for PM2.5 are:
- 8 micrograms per meter squared over an averaging Annual period; and
- 25 micrograms per meter squared over an averaging 24 hour period.

L4 Noise limits

L4.1 Noise generated at the premises must not exceed the noise limits at times and locations specified in the table below. The locations referred to in the table below are indicated by "Marulan South Limestone Mine Continued Operations - Environmental Impacts Statement prepared for Boral Cement March 2019 - Appendix F Noise and Blasting Assessment - Figure 5.1".

Assessment Location	Day	Evening	Night	Night
-	LAeq(15min)	LAeq(15min)	LAeq(15min)	LAF(max)
R9	40	36	36	52
Other privately owned residences	40	35	35	52

L4.2 For the purpose of Condition L4.1:
a) Day means the period from 7am to 6pm Monday to Saturday and the period from 8am to 6pm Sunday and public holidays.
b) Evening means the period from 6pm to 10pm.
c) Night means the period from 10pm to 7am Monday to Saturday and the period from 10pm to 8am Sunday and public holidays.

L4.3 a) The noise limits set out in Condition L4.1 apply under the following meteorological conditions listed in the table below.

b) For those meteorological condition not referred to in condition L4.3(a), the noise limits that apply are the noise limits in Condition L4.1 plus 5dB.

Assessment Period	Meteorological Conditions
Day	Stability Categories A, B, C and D with wind speeds up to and including 0.5m/s at 10m above ground level
Evening	Stability Categories A, B, C and D with wind speeds up to and including 0.5m/s at 10m above ground level
Night	Stability Categories A, B, C and D with wind speeds up to and including 0.5m/s at 10m above ground level

L4.4 For the purpose of condition L4.3:
a) The meteorological conditons are to be determined from meteorological data obtained from the meteorological weather station identified as 'EPL21' on the most recently approved premises map held on EPA electronic file as DOC23/6902-2.
b) Stability category adopted by the licensee is 'Use of sigma thete data' in accordance with the Noise Policy for Industry (NSW EPA, 2017).

L4.5 To assess compliance:
a) with the LAeq(15minute) or the LAmax noise limits in condition L4.1 and L4.3, the noise measurement equipment must be located:
(i) approximately on the property boundary, where any residence is situated 30 meters or less from the property boundary closest to licensed premises; or where applicable;

(ii) in an area within 30 meters of a residence façade, but not closer than 3 meters where any residence on the property is situated more than 30 meters from the property boundary closest to the licensed premises; or, where applicable;

(iii) in an area within 50 meters of the boundary of the premises; or, where applicable;

(iv) at any other location identified in Condition L4.1.

b) with the LAeq(15 minute) or the LAmax noise limits in condition L4.1 and L4.3, the noise measurement equipment must be located:

(i) at the reasonably most affected point at a location where there is no residence at the location; or,

(ii) at the reasonably most affected point within an area at a location prescribed by condition L4.5(a).

L4.6 A non-compliance of condition L4.1 and L4.3 will still occur where noise generated from the premises is measured in excess of the noise limit at a point other than the reasonably most effected point at the locations referred to in condition L4.5(a) or L4.5(b).

Note: Note to L4.5 and L4.6: The reasonably most affected point is a point at a location or within an area at a location experiencing or expected to experience the highest noise generated from the premises.

L4.7 For the purpose of determining the noise generated from the premises, the modifying factor corrections in Table C1 in Fact Sheet C of the *Noise Policy for Industry* (NSW EPA, 2017) should be applied, as appropriate, to the noise measurement by the noise monitoring equipment.

L4.8 Noise measurement must not be undertaken where rain or wind speed at microphone level will affect the acquisition of valid measurements.

L4.9 Where it can be demonstrated that direct measurement of noise from the premises is impractical at location/s nominated in L4.1, the EPA may accept alternative means of determining compliance. See Chapter 7 of the *Noise Policy for Industry*.

Note: Definitions

For the purpose of this license the following definitions apply:

- *Noise* - 'sound pressure levels' for the purposes of conditions L4.1 to L4.9.
- *LAeq(15 minute)* - the value of the A-weighted sound pressure level of a continuous steady sound that, over 15 minute time interval, has the same mean square sound pressure level as a sound under consideration with a level that varies with time (AS1055.1-1997).
- *LAFmax* - the maximum sound pressure level of an event measured with a sound level meter satisfying AS IEC 61672.1-2004 set to 'A' frequency weighting and fast time weighting.

L5 Blasting

L5.1 The airblast overpressure level from blasting operations at the premises must not exceed 120dB (Lin Peak) at any time at any noise sensitive locations. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.

L5.2 The airblast overpressure level from blasting operations at the licensed premises must not exceed 120dB (Lin Peak) at any one time at any noise sensitive locations. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.

L5.3 The airblast overpressure level from blasting operations at the licensed premises must not exceed 115dB (Lin Peak) at any noise sensitive locations for more than five per cent of the total number of blasts over each reporting period. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.

L5.4 Ground vibration peak particle velocity from the blasting operations at the licensed premises must not exceed 10mm/sec at any time at any noise sensitive locations. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.

L5.5 Ground vibration peak particle velocity from the blasting operations at the licensed premises must not exceed 5mm/sec at any time at any noise sensitive locations for more than five per cent of the total number of blasts over each reporting period. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.

L5.6 Blasting at the licensed premises may only take place between 9:00am-5:00pm Monday to Friday. Blasting is not permitted on weekends or public holidays.

L5.7 Blasting outside of the hours specified in L5.6 can only take place with the written approval of the EPA.

L5.8 The airblast overpressure and ground vibration levels in conditions L5.1 to L5.4 do not apply at noise sensitive locations that are owned by the licensee or subject to a private agreement, relating to airblast overpressure and ground vibration levels, between the licensee and the land owner.

4 Operating Conditions

O1 Activities must be carried out in a competent manner

O1.1 Licensed activities must be carried out in a competent manner.
This includes:
a) the processing, handling, movement and storage of materials and substances used to carry out the activity; and
b) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.

O2 Maintenance of plant and equipment

O2.1 All plant and equipment installed at the premises or used in connection with the licensed activity:
a) must be maintained in a proper and efficient condition; and
b) must be operated in a proper and efficient manner.

O3 Dust

O3.1 All operations and activities occurring at the premises must be carried out in a manner that will prevent and or minimise the emission of air pollutants, including dust, from the premises.

O3.2 Trucks transporting materials from the premises must be covered as soon as practicable after loading prior to leaving the premises.

5 Monitoring and Recording Conditions

M1 Monitoring records

M1.1 The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition.

M1.2 All records required to be kept by this licence must be:
a) in a legible form, or in a form that can readily be reduced to a legible form;
b) kept for at least 4 years after the monitoring or event to which they relate took place; and
c) produced in a legible form to any authorised officer of the EPA who asks to see them.

M1.3 The following records must be kept in respect of any samples required to be collected for the purposes of this licence:
a) the date(s) on which the sample was taken;
b) the time(s) at which the sample was collected;
c) the point at which the sample was taken; and
d) the name of the person who collected the sample.

M2 Requirement to monitor concentration of pollutants discharged

M2.1 For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:

M2.2 Air Monitoring Requirements

POINT 1

Pollutant	Units of measure	Frequency	Sampling Method
PM10	milligrams per cubic metre	Special Frequency 2	AM-18

POINT 11

Pollutant	Units of measure	Frequency	Sampling Method
Nitrogen Oxides	grams per cubic metre	Yearly	TM-11
Solid Particles	milligrams per cubic metre	Yearly	TM-15

POINT 12

Environment Protection Licence

Pollutant	Units of measure	Frequency	Sampling Method
Solid Particles	milligrams per cubic metre	Yearly	TM-15

POINT 16

Pollutant	Units of measure	Frequency	Sampling Method
Particulates - Deposited Matter	grams per square metre per month	Monthly	AM-19

POINT 17

Pollutant	Units of measure	Frequency	Sampling Method
Particulates - Deposited Matter	grams per square metre per month	Monthly	AM-19

POINT 18

Pollutant	Units of measure	Frequency	Sampling Method
Particulates - Deposited Matter	grams per square metre per month	Monthly	AM-19

Note: For the purposes of the table(s) above:

Special Frequency 2 means the collection of samples on a one day in six cycle using HVAS fitted with size selective inlet for PM10.

M2.3 Water and/ or Land Monitoring Requirements

POINT 13

Pollutant	Units of measure	Frequency	Sampling Method
Oil and Grease	milligrams per litre	Quarterly	Grab sample
Total suspended solids	milligrams per litre	Quarterly	Grab sample

M3 Testing methods - concentration limits

M3.1 Monitoring for the concentration of a pollutant emitted to the air required to be conducted by this licence must be done in accordance with:
a) any methodology which is required by or under the Act to be used for the testing of the concentration of the pollutant; or

b) if no such requirement is imposed by or under the Act, any methodology which a condition of this licence requires to be used for that testing; or
c) if no such requirement is imposed by or under the Act or by a condition of this licence, any methodology approved in writing by the EPA for the purposes of that testing prior to the testing taking place.

M3.2 Subject to any express provision to the contrary in this licence, monitoring for the concentration of a pollutant discharged to waters or applied to a utilisation area must be done in accordance with the Approved Methods Publication unless another method has been approved by the EPA in writing before any tests are conducted.

Note: The *Protection of the Environment Operations (Clean Air) Regulation 2022* requires testing for certain purposes to be conducted in accordance with test methods contained in the publication "Approved Methods for the Sampling and Analysis of Air Pollutants in NSW".

M4 Testing methods - load limits

Note: Division 4 of the *Protection of the Environment Operations (General) Regulation 2022* requires that monitoring of actual loads of assessable pollutants listed in L2.2 must be carried out in accordance with the relevant load calculation protocol set out for the fee-based activity classification listed in the Administrative Conditions of this licence.

M5 Weather monitoring

M5.1 The meteorological weather station identified in Condition L4.4(a) must be maintained so as to be capable of continually monitoring the parameters specified in Condition M5.2.

M5.2 For each monitoring point specified in the table below the licensee must monitor (by sampling and obtaining results by analysis) the parameters specified in Column 1. The licensee must use the sampling method, units of measure, averaging period and sample at the frequency, specified opposite in the other columns.

Parameter	Units of measure	Frequency	Averaging period	Sampling Method
Air temperature	°C	Continuous	1 hour	AM-4
Wind direction	°	Continuous	15 minute	AM-2 and AM-4
Wind speed	m's	Continuous	15 minute	AM-2 and AM-4
Sigma theta	°	Continuous	15 minute	AM-2 and AM-4
Rainfall	mm	Continuous	15 minute	AM-4
Relative humidity	%	Continuous	1 hour	AM-4

M6 Recording of pollution complaints

M6.1 The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies.

M6.2 The record must include details of the following:
a) the date and time of the complaint;
b) the method by which the complaint was made;
c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;
d) the nature of the complaint;
e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and
f) if no action was taken by the licensee, the reasons why no action was taken.

M6.3 The record of a complaint must be kept for at least 4 years after the complaint was made.

M6.4 The record must be produced to any authorised officer of the EPA who asks to see them.

M7 Telephone complaints line

M7.1 The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.

M7.2 The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.

M7.3 The preceding two conditions do not apply until 3 months after: the date of the issue of this licence.

6 Reporting Conditions

R1 Annual return documents

R1.1 The licensee must complete and supply to the EPA an Annual Return in the approved form comprising:

1. a Statement of Compliance,
2. a Monitoring and Complaints Summary,
3. a Statement of Compliance - Licence Conditions,
4. a Statement of Compliance - Load based Fee,
5. a Statement of Compliance - Requirement to Prepare Pollution Incident Response Management Plan,
6. a Statement of Compliance - Requirement to Publish Pollution Monitoring Data; and
7. a Statement of Compliance - Environmental Management Systems and Practices.

At the end of each reporting period, the EPA will provide to the licensee notification that the Annual Return is due.

R1.2 An Annual Return must be prepared in respect of each reporting period, except as provided below.

R1.3 Where this licence is transferred from the licensee to a new licensee:

a) the transferring licensee must prepare an Annual Return for the period commencing on the first day of the reporting period and ending on the date the application for the transfer of the licence to the new licensee is granted; and
b) the new licensee must prepare an Annual Return for the period commencing on the date the application for the transfer of the licence is granted and ending on the last day of the reporting period.

R1.4 Where this licence is surrendered by the licensee or revoked by the EPA or Minister, the licensee must prepare an Annual Return in respect of the period commencing on the first day of the reporting period and ending on:
a) in relation to the surrender of a licence - the date when notice in writing of approval of the surrender is given; or
b) in relation to the revocation of the licence - the date from which notice revoking the licence operates.

R1.5 The Annual Return for the reporting period must be supplied to the EPA via eConnect *EPA* or by registered post not later than 60 days after the end of each reporting period or in the case of a transferring licence not later than 60 days after the date the transfer was granted (the 'due date').

R1.6 Where the licensee is unable to complete a part of the Annual Return by the due date because the licensee was unable to calculate the actual load of a pollutant due to circumstances beyond the licensee's control, the licensee must notify the EPA in writing as soon as practicable, and in any event not later than the due date. The notification must specify:
a) the assessable pollutants for which the actual load could not be calculated; and
b) the relevant circumstances that were beyond the control of the licensee.

R1.7 The licensee must retain a copy of the Annual Return supplied to the EPA for a period of at least 4 years after the Annual Return was due to be supplied to the EPA.

R1.8 Within the Annual Return, the Statements of Compliance must be certified and the Monitoring and Complaints Summary must be signed by:
a) the licence holder; or
b) by a person approved in writing by the EPA to sign on behalf of the licence holder.

Note: The term "reporting period" is defined in the dictionary at the end of this licence. Do not complete the Annual Return until after the end of the reporting period.

Note: An application to transfer a licence must be made in the approved form for this purpose.

R2 Notification of environmental harm

R2.1 Notifications must be made by telephoning the Environment Line service on 131 555.

R2.2 The licensee must provide written details of the notification to the EPA within 7 days of the date on which they became aware of the incident.

Note: The licensee or its employees must notify all relevant authorities of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act.

R3 Written report

R3.1 Where an authorised officer of the EPA suspects on reasonable grounds that:
a) where this licence applies to premises, an event has occurred at the premises; or
b) where this licence applies to vehicles or mobile plant, an event has occurred in connection with the carrying out of the activities authorised by this licence,
and the event has caused, is causing or is likely to cause material harm to the environment (whether the harm occurs on or off premises to which the licence applies), the authorised officer may request a written report of the event.

R3.2 The licensee must make all reasonable inquiries in relation to the event and supply the report to the EPA within such time as may be specified in the request.

R3.3 The request may require a report which includes any or all of the following information:
a) the cause, time and duration of the event;
b) the type, volume and concentration of every pollutant discharged as a result of the event;
c) the name, address and business hours telephone number of employees or agents of the licensee, or a specified class of them, who witnessed the event;
d) the name, address and business hours telephone number of every other person (of whom the licensee is aware) who witnessed the event, unless the licensee has been unable to obtain that information after making reasonable effort;
e) action taken by the licensee in relation to the event, including any follow-up contact with any complainants;
f) details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event; and
g) any other relevant matters.

R3.4 The EPA may make a written request for further details in relation to any of the above matters if it is not satisfied with the report provided by the licensee. The licensee must provide such further details to the EPA within the time specified in the request.

7 General Conditions

G1 Copy of licence kept at the premises or plant

G1.1 A copy of this licence must be kept at the premises to which the licence applies.

G1.2 The licence must be produced to any authorised officer of the EPA who asks to see it.

G1.3 The licence must be available for inspection by any employee or agent of the licensee working at the premises.

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Dictionary

General Dictionary

3DGM [in relation to a concentration limit]	Means the three day geometric mean, which is calculated by multiplying the results of the analysis of three samples collected on consecutive days and then taking the cubed root of that amount. Where one or more of the samples is zero or below the detection limit for the analysis, then 1 or the detection limit respectively should be used in place of those samples
Act	Means the Protection of the Environment Operations Act 1997
activity	Means a scheduled or non-scheduled activity within the meaning of the Protection of the Environment Operations Act 1997
actual load	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
AM	Together with a number, means an ambient air monitoring method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.
AMG	Australian Map Grid
anniversary date	The anniversary date is the anniversary each year of the date of issue of the licence. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
annual return	Is defined in R1.1
Approved Methods Publication	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
assessable pollutants	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
BOD	Means biochemical oxygen demand
CEM	Together with a number, means a continuous emission monitoring method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.
COD	Means chemical oxygen demand
composite sample	Unless otherwise specifically approved in writing by the EPA, a sample consisting of 24 individual samples collected at hourly intervals and each having an equivalent volume.
cond.	Means conductivity
environment	Has the same meaning as in the Protection of the Environment Operations Act 1997
environment protection legislation	Has the same meaning as in the Protection of the Environment Administration Act 1991
EPA	Means Environment Protection Authority of New South Wales.
fee-based activity classification	Means the numbered short descriptions in Schedule 1 of the Protection of the Environment Operations (General) Regulation 2009.
general solid waste (non-putrescible)	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997

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flow weighted composite sample	Means a sample whose composites are sized in proportion to the flow at each composites time of collection.
general solid waste (putrescible)	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environmen t Operations Act 1997
grab sample	Means a single sample taken at a point at a single time
hazardous waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
licensee	Means the licence holder describe d at the front of this licence
load calculation protocol	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
local authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
material harm	Has the same meaning as in section 147 Protection of the Environment Operations Act 1997
MBAS	Means methylene blue active substances
Minister	Means the Minister administering the Protection of the Environment Operations Act 1997
mobile plant	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
motor vehicle	Has the same meaning as in the Protection of the Environment Operations Act 1997
O&G	Means oil and grease
percentile [in relation to a concentration limit of a sample]	Means that percentage [eg.50%] of the number of samples taken that must meet the concentration limit specified in the licence for that pollutant over a specified period of time. In this licence, the specified period of time is the Reporting Period unless otherwise stated in this licence.
plant	Includes all plant within the meaning of the Protection of the Environment Operations Act 1997 as well as motor vehicles.
pollution of waters [or water pollution]	Has the same meaning as in the Protection of the Environment Operations Act 1997
premises	Means the premises described in condition A2.1
public authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
regional office	Means the relevant EPA office referred to in the Contacting the EPA document accompanying this licence
reporting period	For the purposes of this licence, the reporting period means the period of 12 months after the issue of the licence, and each subsequent period of 12 mo nths. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
restricted solid waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
scheduled activity	Means an activity listed in Schedule 1 of the Protection of the Environment Operations Act 1997
special waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
TM	Together with a number, means a test method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.

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TSP	Means total suspended particles
TSS	Means total suspended solids
Type 1 substance	Means the elements antimony, arsenic, cadmium, lead or mercury or any compound containing one or more of those elements
Type 2 substance	Means the elements beryllium, chromium, cobalt, manganese, nickel, selenium, tin or vanadium or any compound containing one or more of those elements
utilisation area	Means any area shown as a utilisation area on a map submitted with the application for this licence
waste	Has the same meaning as in the Protection of the Environment Operations Act 1997
waste type	Means liquid, restricted solid waste, general solid waste (putrescible), general solid waste (non-putrescible), special waste or hazardous waste
Wellhead	Has the same meaning as in Schedule 1 to the Protection of the Environment Operations (General) Regulation 2021.

Ms Debbie Maddison

Environment Protection Authority

(By Delegation)

Date of this edition: 25-August-2000

Environment Protection Licence

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End Notes

1	Licence varied by notice 1002259, issued on 18-Oct-2000, which came into effect on 12-Nov-2000.
2	Licence varied by change to Common Name field, issued on 31-May-2001, which came into effect on 31-May-2001.
3	Licence transferred through application 140465, approved on 15-Jun-2001, which came into effect on 15-Jun-2001.
4	Licence varied by notice 1008757, issued on 27-Nov-2001, which came into effect on 22-Dec-2001.
5	Licence varied by notice 1017662, issued on 21-Jun-2002, which came into effect on 16-Jul-2002.
6	Licence varied by notice 1026529, issued on 30-Apr-2003, which came into effect on 25-May-2003.
7	Licence varied by notice 1030085, issued on 21-Aug-2003, which came into effect on 15-Sep-2003.
8	Licence varied by notice 1038040, issued on 14-Jul-2004, which came into effect on 08-Aug-2004.
9	Licence varied by change to record due to LGA amalagamatio, issued on 01-Dec-2004, which came into effect on 01-Dec-2004.
10	Licence varied by notice 1044343, issued on 15-Mar-2005, which came into effect on 09-Apr-2005.
11	Licence varied by notice 1054428, issued on 24-Feb-2006, which came into effect on 21-Mar-2006.
12	Licence varied by notice 1057796, issued on 03-Apr-2006, which came into effect on 28-Apr-2006.
13	Licence varied by correction to DEC File number, issued on 07-Mar-2007, which came into effect on 07-Mar-2007.
14	Condition A1.3 Not applicable varied by notice issued on <issue date> which came into effect on <effective date>
15	Licence varied by notice 1095801, issued on 09-Feb-2009, which came into effect on 09-Feb-2009.
16	Licence varied by notice 1502865 issued on 06-Dec-2011
17	Licence varied by notice 1506039 issued on 29-Jun-2012
18	Licence varied by notice 1521469 issued on 07-Aug-2014
19	Licence varied by notice 1603582 issued on 24-Dec-2020
20	Licence varied by notice 1625174 issued on 14-Mar-2023

Environment Protection Licence

Licence - 944

APPENDIX B – Development Consent

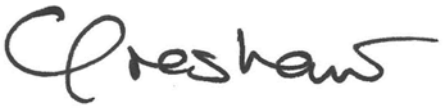
Development Consent

Section 4.36 of the Environmental Planning and Assessment Act 1979

As delegate of the Minister for Planning and Public Spaces under delegation executed on 26 April 2021, I approve the Development Application referred to in Schedule 1, subject to the conditions specified in Schedule 2.

These conditions are required to:

- prevent, minimise, or offset adverse environmental impacts;
- set standards and performance measures for acceptable environmental performance;
- require regular monitoring and reporting; and
- provide for the ongoing environmental management of the development.



Executive Director
Energy, Resources and Industry Assessments
As delegate for the Minister for Planning and Public Spaces

Sydney 19 August 2021

SCHEDULE 1

Application Number:	SSD 7009
Applicant:	Boral Cement Limited
Consent Authority:	Minister for Planning and Public Spaces
Site:	The land defined in Appendix 1
Development:	Marulan South Limestone Mine Continued Operations Project

TABLE OF CONTENTS

DEFINITIONS

Aboriginal object	Has the same meaning as the definition of the term in section 5 of the NP&W Act
Aboriginal place	Has the same meaning as the definition of the term in section 5 of the NP&W Act
Annual Review	The review required by condition D11
Applicant	Boral Cement Limited, or any person carrying out any development under this consent
Approved disturbance area	The area identified as such on the Development Layout
ARI	Average Recurrence Interval
BCA	Building Code of Australia
BC Act	*Biodiversity Conservation Act 2016*
BCD	Biodiversity & Conservation Division within the Department
BCT	NSW Biodiversity Conservation Trust
Biodiversity Offset Strategy	The Biodiversity Offset Strategy for the development as described in the document/s listed in condition A2(c) and shown conceptually in Appendix 4
Blast misfire	The failure of one or more holes in a blast pattern to initiate
CCC	Community Consultative Committee required by condition A24
Clay/Shale	Includes both Clay/Shale and White Clay
Conditions of this consent	Conditions contained in Schedule 2
Construction	All physical works to enable mining operations to be carried out, including demolition and removal of buildings or works, and erection of buildings and other infrastructure permitted by this consent
Council	Goulburn Mulwaree Council
Date of commencement	The date notified to the Department by the Applicant under condition A17
Day	The period from 7.00 am to 6.00 pm on Monday to Saturday, and 8.00 am to 6.00 pm on Sundays and Public Holidays
Decommissioning	The deconstruction or demolition and removal of works installed as part of the development
Demolition	The deconstruction and removal of buildings, sheds and other structures on the site
Department	NSW Department of Planning, Industry and Environment
Development	The development described in the documents listed in condition A2(c), as modified by the conditions of this consent
Development Layout	The plans in Appendix 2 of this consent
DPIE Crown Lands	Crown Lands Group within the Department
DPIE Water	Water Group within the Department
CEEC	Critically endangered ecological community, as defined under the EPBC Act
EIS	The Environmental Impact Statement titled *Marulan South Limestone Mine Continued Operations State Significant Development Application Environmental Impact Statement*, prepared by Element Environment, dated March 2019, submitted with the application for consent for the development, including the Applicant's Response to Submissions and additional information provided by the Applicant dated 6 November 2019, 19 February 2020, 7 May 2020, 6 July 2020, 27 July 2020, 23 March 2021, 22 April 2021, May 2021, 18 June 2021, 6 July 2021 and 23 July 2021
Environment	Includes all aspects of the surroundings of humans, whether affecting any human as an individual or in his or her social groupings
EPA	NSW Environment Protection Authority

EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environment Protection Licence under the POEO Act
Evening	The period from 6 pm to 10 pm
Feasible	Means what is possible and practical in the circumstances
Financial Year	A period of 12 months from 1 July to 30 June
Fisheries NSW	Fisheries Branch of the Primary Industries Group within the Department
Heritage NSW	Heritage Branch of the Department of Premier and Cabinet
Heritage item	An Aboriginal object, an Aboriginal place, or a place, building, work, relic, moveable object, tree or precinct of heritage significance, that is listed under any of the following: • the State Heritage Register under the *Heritage Act 1977*; • a state agency heritage and conservation register under section 170 of the *Heritage Act 1977;* • a Local Environmental Plan under the EP&A Act; • the World Heritage List; • the National Heritage List or Commonwealth Heritage List under the EPBC Act; or • anything identified as a heritage item under the conditions of this consent
Incident	An occurrence or set of circumstances that causes or threatens to cause material harm and which may or may not be or cause a non-compliance
Laden trains	Trains transporting mining or quarry products from the site
Laden trucks	Trucks transporting mining or quarry products from the site
Land	Has the same meaning as the definition of the term in section 1.4 the EP&A Act, except for where the term is used in the noise and air quality conditions in PART B of this consent where it is defined to mean the whole of a lot, or contiguous lots owned by the same landowner, in a current plan registered at the Land Titles Office at the date of this consent
Material harm	Is harm to the environment that: • involves actual or potential harm to the health or safety of human beings or to the environment that is not trivial, or • results in actual or potential loss or property damage of an amount, or amounts in aggregate, exceeding $10,000 (such loss includes the reasonable costs and expenses that would be incurred in taking all reasonable and practicable measures to prevent, mitigate or make good harm to the environment) This definition excludes “harm” that is authorised under either this consent or any other statutory approval
MEG	Mining, Exploration and Geoscience
Mine-Owned Land	Land owned by a mining, petroleum or extractive industry company (or its subsidiary or related party)
Mine closure	Decommissioning and final rehabilitation of the site following the cessation of mining operations
Mine water	Water that accumulates within, or drains from, active mining and infrastructure areas and any other areas where runoff may have come into contact with carbonaceous or saline material
Minimise	Implement all reasonable and feasible mitigation measures to reduce the impacts of the development
Mining operations	The carrying out of mining, including the extraction, processing, stockpiling and transportation of mineral ore and extractive materials on the site and the associated removal, storage and/or emplacement of vegetation, topsoil, overburden, tailings and reject material
Mining products	Includes all saleable mining products produced at the site, but excludes tailings and other wastes and rehabilitation material
Minister	NSW Minister for Planning and Public Spaces, or delegate
Minor	Not very large, important or serious

Mitigation	Activities associated with reducing the impacts of the development
Negligible	Small and unimportant, such as to be not worth considering
Night	The period from 10pm to 7am on Monday to Saturday, and 10pm to 8am on Sundays and Public Holidays
Noise sensitive areas	Areas where mining operations are being carried out that have potential to lead to increased noise at privately-owned residences, such as elevated areas or areas near the boundary of the site
Non-compliance	An occurrence, set of circumstances or development that is a breach of this consent
'Non-road' mobile diesel equipment	Mobile equipment used in mining operations that is fitted with a diesel engine with a capacity >30 litres and that is self-propelled or transportable and primarily designed for off-road use
NP&W Act	*National Parks and Wildlife Act 1974*
NRAR	NSW Natural Resources Access Regulator
Offset areas	Means the areas shown conceptually in Appendix 4
Peppertree Quarry	Quarrying operations permitted under MP 06_0074 or any subsequent development consent for extractive industry at the Peppertree Quarry granted by the Minister (or delegate) or the Independent Planning Commission of NSW
Planning Secretary	Planning Secretary under the EP&A Act, or nominee
POEO Act	*Protection of the Environment Operations Act 1997*
Privately-owned land	Land that is not owned by a public agency or a mining, petroleum or extractive industry company (or its subsidiary or related party)
Public infrastructure	Linear and related infrastructure that provides services to the general public, such as roads, railways, water supply, drainage, sewerage, gas supply, electricity, telephone, telecommunications, etc.
Quarry products	Includes all saleable quarry products produced at the Peppertree Quarry, but excludes tailings and other wastes and rehabilitation material
Reasonable	Means applying judgement in arriving at a decision, taking into account: mitigation benefits, cost of mitigation versus benefits provided, community views and the nature and extent of potential improvements
Registered Aboriginal Parties	As described in the *National Parks and Wildlife Regulation 2009*
Rehabilitation	The restoration of land disturbed by the development to a good condition, to ensure it is safe, stable and non-polluting
Residence	Existing or approved dwelling at the date of grant of this consent
Resources Regulator	NSW Resources Regulator
RFS	NSW Rural Fire Service
Site	The land defined in Appendix 1
SOE	Southern Overburden Emplacement as shown in Figure 1 in Appendix 2
TfNSW	Transport for NSW
TSS	Total suspended solids
WOE	Western Overburden Emplacement as shown in Figure 1 in Appendix 2

SCHEDULE 2

PART A ADMINISTRATIVE CONDITIONS

OBLIGATION TO MINIMISE HARM TO THE ENVIRONMENT

A1. In addition to meeting the specific performance measures and criteria established under this consent, the Applicant must implement all reasonable and feasible measures to prevent, and if prevention is not reasonable and feasible, minimise, any material harm to the environment that may result from the construction and operation of the development, and any rehabilitation required under this consent.

TERMS OF CONSENT

A2. The development may only be carried out:

(a) in compliance with the conditions of this consent;

(b) in accordance with all written directions of the Planning Secretary;

(c) generally in accordance with the EIS; and

(d) generally in accordance with the Development Layout in Appendix 2.

A3. If there is any inconsistency between the above documents, the most recent document must prevail to the extent of the inconsistency. However, the conditions of this consent must prevail to the extent of any inconsistency.

A4. The Applicant must comply with any requirement/s of the Planning Secretary arising from the Department's assessment of:

(a) any strategies, plans or correspondence that are submitted in accordance with this consent;

(b) any reports, reviews or audits commissioned by the Department regarding compliance with this consent; and

(c) the implementation of any actions or measures contained in these documents.

LIMITS OF CONSENT

Mining operations

A5. Mining operations may be carried out on the site, within the approved disturbance area, until 31 August 2051.

Notes:

- *Under this consent, the Applicant is required to decommission and rehabilitate the site and carry out other requirements in relation to mining operations. Consequently, this consent will continue to apply in all respects other than to permit the carrying out of mining operations until the rehabilitation of the site and other requirements have been carried out to the required standard.*
- *Mining operations and rehabilitation are also regulated under the Mining Act 1992.*

Extraction and Transportation

A6. A maximum of 4 million tonnes of limestone may be extracted from the site in any financial year.

A7. A maximum of 200,000 tonnes of clay/shale may be extracted from the site in any financial year.

A8. A maximum of 4.2 million tonnes of limestone and clay/shale (combined) may be processed on the site in any financial year.

A9. A maximum of 1 million tonnes of manufactured sand may be transported to Peppertree Quarry in any financial year.

A10. A maximum of 150,000 tonnes of quarry products may be transported from Peppertree Quarry to the shared road sales stockpiling area[a] in any financial year.

[a] *The shared road sales stockpiling area is shown in Figure 1 in Appendix 2.*

A11. A maximum of 720,000 tonnes of limestone, clay/shale and quarry products (combined) may be transported from the site by road in any financial year.

A12. A maximum of 133 laden trucks may be dispatched from the site[a,b] in any 24-hour period.

[a] *Excludes any truck movements to or from the Peppertree Quarry authorised under conditions A9 and A10 or for the transportation of overburden as described in the EIS*

[b] *Excludes any truck movements which may be authorised under separate development consent/s for the Peppertree Quarry*

A13. A maximum of six laden trains may leave the site in any 24-hour period.

Hours of Operation

A14. The Applicant may undertake mining operations 24 hours a day, 7 days a week.

***Notes**:*

- *For limitations on blasting operations see condition B13.*

Mining Depth

A15. The Applicant must not carry out any extraction or excavation below 335 m AHD.

Identification of Approved Disturbance Area

A16. Within three months of commencement of development under this consent, or other timeframe agreed by the Planning Secretary, the Applicant must provide to the Department a survey plan of the boundaries of the approved disturbance areas.

NOTIFICATION OF COMMENCEMENT

A17. The date of commencement of each of the following phases of the development must be notified to the Department in writing, at least two weeks before that date:

(a) commencement of development under the consent;

(b) commencement of construction under the consent;

(c) commencement of mining operations under the consent;

(d) cessation of mining operations (i.e. mine closure); and

(e) any period of suspension of mining operations (i.e. care and maintenance).

A18. If the phases of the development are to be further staged, the Department must be notified in writing at least two weeks prior to the commencement of each stage, of the date of commencement and the development to be carried out in that stage.

SURRENDER OF EXISTING CONSENTS OR APPROVALS

A19. Within 12 months of the date of commencement of development under this consent, or other timeframe agreed by the Planning Secretary, the Applicant must surrender the existing development consents dated 21 February 1972, 16 October 1974, 13 February 1995 and 22 May 1997, April 2008, 20 June 2006 and 1 March 2012 as detailed in Section 3.3.4 of the EIS, and any existing or continuing use rights for the site, in accordance with the EP&A Regulation.

A20. Upon the commencement of development under this consent, and before the surrender of existing development consents required under condition A19, the conditions of this consent prevail to the extent of any inconsistency with the conditions of those consents or approvals.

Note: *This requirement does not extend to the surrender of construction and occupation certificates for existing and proposed building works under the former Part 4A of the EP&A Act or Part 6 of the EP&A Act as applies from 1 September 2018. The surrender should not be understood as implying that works legally constructed under a valid consent or approval can no longer be legally maintained or used.*

DIVISION 7.1 CONTRIBUTIONS TO COUNCIL

A21. Under section 7.11 of the EP&A Act, an annual financial contribution must be paid to Council to be put toward the maintenance of Marulan South Road used for haulage of mining and quarry products. The contribution is to be calculated in accordance with the *Goulburn Mulwaree Section 94 Development Contributions Plan 2009* or its latest version (adjusted on a quarterly basis to account for movements in the Australian Bureau of Statistics Consumer Price Index – Building Construction (NSW).

A22. The contribution must be paid to Council within 12 months of the date notified for the commencement of development under this consent and in the same month each year and be reported in the Annual Review required under condition D11.

A23. With the approval of the Planning Secretary, the contribution required under condition A21 may be waived or reduced in lieu of road upgrading works, or other means, as may be agreed by Council.

COMMUNITY CONSULTATIVE COMMITTEE

A24. Before the commencement of development under this consent, a Community Consultative Committee (CCC) must be established for the development in accordance with the Department's *Community Consultative Committee Guidelines: State Significant Projects* (2019). The CCC must continue to operate during the life of the development, or other timeframe agreed by the Planning Secretary.

Notes:

- *The CCC is an advisory committee only.*
- *In accordance with the Guidelines, the Committee should comprise an independent chair and appropriate representation from the Applicant, Council and the local community.*

A25. With the approval of the Planning Secretary, the Applicant may combine the CCC required by this consent with any similar CCC required by a consent or approval for any adjoining mine or quarry subject to common, shared or related ownership or management.

EVIDENCE OF CONSULTATION

A26. Where conditions of this consent require consultation with an identified party, the Applicant must:

(a) consult with the relevant party prior to submitting the subject document; and

(b) provide details of the consultation undertaken, including:

(i) the outcome of that consultation, matters resolved and unresolved; and

(ii) details of any disagreement remaining between the party consulted and the Applicant and how the Applicant has addressed the matters not resolved.

STAGING, COMBINING AND UPDATING STRATEGIES, PLANS OR PROGRAMS

A27. With the approval of the Planning Secretary, the Applicant may:

(a) prepare and submit any strategy, plan or program required by this consent on a staged basis (if a clear description is provided as to the specific stage and scope of the development to which the strategy, plan or program applies, the relationship of the stage to any future stages and the trigger for updating the strategy, plan or program);

(b) combine any strategy, plan or program required by this consent (if a clear relationship is demonstrated between the strategies, plans or programs that are proposed to be combined);

(c) update any strategy, plan or program required by this consent (to ensure the strategies, plans and programs required under this consent are updated on a regular basis and incorporate additional measures or amendments to improve the environmental performance of the development); and

(d) combine any strategy, plan or program required by this consent with any similar strategy, plan or program required by an adjoining mining consent or approval, in common ownership or management.

A28. If the Planning Secretary agrees, a strategy, plan or program may be staged or updated without consultation being undertaken with all parties required to be consulted in the relevant condition in this consent.

A29. If the Planning Secretary agrees, a strategy, plan or program may be staged without addressing particular requirements of the relevant condition of this consent if those requirements are not applicable to the particular stage.

PROTECTION OF PUBLIC INFRASTRUCTURE

A30. Unless the Applicant and the applicable authority agree otherwise, the Applicant must:

(a) repair, or pay the full costs associated with repairing, any public infrastructure[a] that is damaged by carrying out the development; and

(b) relocate, or pay the full costs associated with relocating, any public infrastructure[a] that needs to be relocated as a result of the development.

[a] *This condition does not apply to any damage to roads caused as a result of general road usage or otherwise addressed by contributions required by condition A21 or to damage that has been compensated under the Mining Act 1992.*

DEMOLITION

A31. All demolition must be carried out in accordance with *Australian Standard AS 2601-2001 The Demolition of Structures* (Standards Australia, 2001).

STRUCTUAL ADEQUACY

A32. All new buildings and structures, and any alterations or additions to existing buildings and structures, that are part of the development, must be constructed in accordance with the relevant requirements of the BCA.

***Notes**:*

- *Under Part 6 of the EP&A Act, the Applicant is required to obtain construction and occupation certificates for the proposed building works.*
- *Part 8 of the EP&A Regulation sets out the requirements for the certification of the development.*

OPERATION OF PLANT AND EQUIPMENT

A33. All plant and equipment used on site, or to monitor the performance of the development must be:

(a) maintained in a proper and efficient condition; and

(b) operated in a proper and efficient manner.

COMPLIANCE

A34. The Applicant must ensure that all of its employees, contractors (and their sub-contractors) are made aware of, and are instructed to comply with, the conditions of this consent relevant to activities they carry out in respect of the development.

APPLICABILITY OF GUIDELINES

A35. References in the conditions of this consent to any guideline, protocol, Australian Standard or policy are to such guidelines, protocols, Standards or policies in the form they are in as at the date of inclusion (or later update) in the condition.

A36. However, consistent with the conditions of this consent and without altering any limits or criteria in this consent, the Planning Secretary may, in respect of ongoing monitoring and management obligations, agree to or require compliance with an updated or revised version of such a guideline, protocol, Standard or policy, or a replacement of them.

CROWN LAND

A37. The Applicant must consult with DPIE – Crown Lands prior to undertaking any development on Crown Land or Crown Roads.

***Notes**:*

- *Under section 265 of the Mining Act 1992, the Applicant is required to enter into a compensation agreement with DPIE – Crown Lands prior to undertaking any mining operations or related activities on Crown land or Crown roads within a mining lease.*
- *Under section 141 of the Mining Act 1992, the Applicant is required to enter into an access arrangement with DPIE – Crown Lands prior to undertaking any prospecting operations on Crown land or Crown roads within an exploration licence.*

PART B SPECIFIC ENVIRONMENTAL CONDITIONS

NOISE

Noise Criteria

B1. The Applicant must ensure that the noise generated by the development does not exceed the criteria in Table 1 at any residence on privately-owned land.

Table 1: *Noise criteria dB(A)*

Noise Assessment Location[a]	***Day*** $L_{Aeq\ (15\ min)}$	***Evening*** $L_{Aeq\ (15\ min)}$	***Night*** $L_{Aeq\ (15\ min)}$	***Night*** L_{AFmax}
R9	40	36	36	52
Other privately-owned residences	40	35	35	52

[a]*The Noise Assessment Locations referred to in Table 1, are shown in Appendix 3.*

B2. Noise generated by the development must be monitored and measured in accordance with the relevant procedures and exemptions (including certain meteorological conditions) of the *NSW Noise Policy for Industry* (EPA, 2017).

B3. The noise criteria in Table 1 do not apply if the Applicant has an agreement with the owner/s of the relevant residence or land to exceed the noise criteria, and the Applicant has advised the Department in writing of the terms of this agreement.

Temporary Construction Noise Limits

B4. With the written agreement of the Planning Secretary, the Applicant may seek temporary construction noise limits above the noise criteria in Table 1, including for construction works outside of standard hours. In order to seek a temporary construction noise limit, the Applicant must develop a Construction Noise Protocol to the satisfaction of the Planning Secretary. This protocol must:

(a) be prepared in consultation with the EPA and any residents who may be affected by the noise generated by these works;

(b) specify the construction works to which the temporary construction noise limits would apply and provide justification for these limits; and

(c) address the relevant requirements of the *Interim Construction Noise Guideline* (DECC, 2009).

B5. The Applicant must continue to operate in accordance with the noise criteria in Table 1 until and unless a Construction Noise Protocol for the specified construction works is approved by the Planning Secretary.

B6. The Applicant must implement any Construction Noise Protocol approved by the Planning Secretary.

Noise Operating Conditions

B7. The Applicant must:

(a) take all reasonable steps to minimise noise from construction and operational activities, including low frequency noise and other audible characteristics, as well as road and on-site rail noise associated with the development;

(b) implement reasonable and feasible noise attenuation measures on all plant and equipment that will operate in noise sensitive areas;

(c) take all reasonable steps to minimise the noise impacts of the development in noise sensitive areas during the evening and night;

(d) operate a noise management system to guide the day to day planning of mining operations, and the implementation of both proactive and reactive noise mitigation measures to ensure compliance with the relevant conditions of this consent;

(e) take all reasonable steps to minimise the noise impacts of the development during noise-enhancing meteorological conditions;

(f) only use locomotives and rolling stock that are approved to operate on the NSW rail network in accordance with the noise limits in any relevant rolling stock operator's EPL and use reasonable endeavours to ensure that rolling stock is selected to minimise noise;

(g) carry out regular attended noise monitoring (at least once a month, unless otherwise agreed by the Planning Secretary) to determine whether the development is complying with the relevant conditions of this consent; and

(h) regularly assess the noise monitoring data and modify operations on the site to ensure compliance with the relevant conditions of this consent.

Noise Management Plan

B8. The Applicant must prepare a Noise Management Plan for the development to the satisfaction of the Planning Secretary. This plan must:

(a) be prepared by a suitably qualified and experienced person/s whose appointment has been endorsed by the Planning Secretary;

(b) describe the measures to be implemented to ensure:

(i) compliance with the noise criteria and operating conditions of this consent;

(ii) best practice management is being employed; and

(iii) noise impacts of the development are minimised during noise-enhancing meteorological conditions;

(c) describe the measures to minimise development related road traffic noise generated on public roads;

(d) describe the noise management system in detail; and

(e) include a monitoring program that:

(i) uses a combination of attended and unattended monitoring to evaluate the performance of the development;

(ii) monitors noise at locations representative of the most affected residences;

(iii) adequately supports the noise management system;

(iv) includes a protocol for distinguishing noise emissions of the development from any neighbouring developments; and

(v) includes a protocol for identifying any noise-related exceedance, incident or non-compliance and for notifying the Department and relevant stakeholders of any such event.

B9. The Noise Management Plan must be approved by the Planning Secretary within 3 months of the date of this consent, unless otherwise agreed by the Planning Secretary.

B10. The Applicant must implement the Noise Management Plan as approved by the Planning Secretary.

BLASTING

Blasting Criteria

B11. The Applicant must ensure that blasting on the site does not cause exceedances of the criteria at the locations in Table 2.

Table 2: *Blasting criteria*

Location	***Airblast overpressure (dB(Lin Peak))***	***Ground vibration (mm/s)***	***Allowable exceedance***
Residence on privately-owned land[a]	120	10	0%
	115	5	5% of the total number of blasts over a financial year
Commercial receiver[a]	133	25	0%
Electricity Transmission Lines		50	0%
Public Roads		100	0%
All other infrastructure		50 *(or a limit determined by the structural design methodology in AS 2187.2 - 2006, or its latest version, or other alternative limit for public infrastructure, to the satisfaction of the Planning Secretary)*	0%

[a] *The locations referred to in Table 2 are shown in Appendix 3.*

B12. The blasting criteria in Table 2 do not apply if the Applicant has an agreement with the owner/s of the relevant residence or infrastructure to exceed the blasting criteria, and the Applicant has advised the Department in writing of the terms of this agreement.

Blasting Hours

B13. The Applicant must only carry out blasting on the site between 9 am and 5 pm (Monday to Friday inclusive). No blasting is allowed on weekends, public holidays or any other time without the prior written approval of the Planning Secretary.

Blasting Frequency

B14. The Applicant may carry out a maximum of 1 single blast event[a] per day.

B15. Condition B14 does not apply to single blast events[a] that generate ground vibration of 0.5 mm/s or less at any residence on privately-owned land, or to blast misfires or blasts required to ensure the safety of the mine, its workers or the general public.

[a] *Within conditions B14 and B15, 'single blast event' means a blast which involves either a single detonation or a number of individual blasts fired in quick succession in a discrete area of the development. Should an additional blast be required after a blast misfire, this additional blast and the blast misfire are counted as a single blast event.*

Property Inspections

B16. If the Applicant receives a written request from the owner of any privately-owned land within 2 kilometres of any approved open cut mining pit on the site for a property inspection to establish the baseline condition of any buildings and structures on their land, or to have a previous property inspection updated, then within 2 months of receiving this request the Applicant must:

(a) commission a suitably qualified, experienced and independent person, whose appointment is acceptable to both parties to:

(i) establish the baseline condition of any buildings and other structures on the land, or update the previous property inspection report; and

(ii) identify measures that should be implemented to minimise the potential blasting impacts of the development on these buildings and structures; and

(b) give the landowner a copy of the new or updated property inspection report.

B17. If there is a dispute over the selection of the suitably qualified, experienced and independent person, or the Applicant or the landowner disagrees with the findings of the property inspection report, either party may refer the matter to the Planning Secretary for resolution.

Property Investigations

B18. If the owner of any privately-owned land within 2 kilometres of any approved open cut mining pit on the site or any other landowner where the Planning Secretary is satisfied an investigation is warranted, claims in writing that buildings or structures on their land have been damaged as a result of blasting on the site, then within 2 months of receiving this written claim the Applicant must:

(a) commission a suitably qualified, experienced and independent person, whose appointment is acceptable to both parties to investigate the claim; and

(b) give the landowner a copy of the property investigation report.

B19. If this independent property investigation confirms the landowner's claim, and both parties agree with these findings, then the Applicant must repair the damage to the satisfaction of the Planning Secretary.

B20. If there is a dispute over the selection of the suitably qualified, experienced and independent person, or the Applicant or the landowner disagrees with the findings of the independent property investigation, then either party may refer the matter to the Planning Secretary for resolution.

Blast Operating Conditions

B21. The Applicant must:

(a) take all reasonable steps to:

(i) ensure the safety of people and livestock from blasting impacts of the development;

(ii) protect public and private infrastructure and property in the vicinity of the site from blasting damage associated with the development; and

(iii) minimise blast-related dust and fume emissions;

(b) ensure that blasting on the site does not damage heritage items[a], except in accordance with predictions in the document/s listed in condition A2(c), and develop specific measures to protect heritage items from any blasting damage associated with the development;

(c) operate a comprehensive blast management system that uses a combination of meteorological forecasts and predictive blast modelling to guide the planning of blasts to minimise blasting impacts;

(d) operate a suitable system to enable interested members of the public to get up-to-date information on the proposed blasting schedule on the site and any associated road closures, including notification via SMS message of the blasting schedule and any variations to that schedule;

(e) use all reasonable efforts to co-ordinate the timing of blasting at the site with Peppertree Quarry to minimise cumulative blasting impacts; and

(f) carry out regular blast monitoring to determine whether the development is complying with the relevant conditions of this consent.

[a]The locations of the heritage items referred to in paragraph (b) are shown in Appendix 5.

B22. The Applicant must not undertake blasting on the site within 500 metres of any public road or any land outside the site not owned by the Applicant, unless the Applicant has:

(a) a written agreement with the relevant infrastructure owner or landowner to allow blasting to be carried out closer to the public road or land, and the Applicant has advised the Department in writing of the terms of this agreement; or

(b) demonstrated, to the satisfaction of the Planning Secretary, that the blasting can be carried out closer to the public road or land without compromising the safety of people or livestock or damaging the road or other buildings and structures, and updated the Blast Management Plan to include specific mitigation measures to be implemented while blasting is being carried out within 500 metres of the road or land.

Blast Management Plan

B23. The Applicant must prepare a Blast Management Plan for the development to the satisfaction of the Planning Secretary. This plan must:

(a) be prepared by a suitably qualified and experienced person/s whose appointment has been endorsed by the Planning Secretary;

(b) describe the blast management system and the measures that will be implemented to ensure compliance with the blasting criteria and conditions of this consent;

(c) include a Blast Fume Management Strategy for:

(i) minimising blast fume emissions;

(ii) rating and recording blast fume events; and

(iii) reporting significant blast fume events to the Department and the EPA;

(d) identify any agreed alternative ground vibration limits for public or private infrastructure in the vicinity of the site (if relevant);

(e) include a strategy to monitor, mitigate and manage the effects of blasting on heritage items[a];

(f) include a monitoring program for evaluating and reporting on compliance with the relevant conditions of this consent;

(g) include a protocol for identifying any blast-related exceedance, incident or non-compliance and for notifying the Department, the EPA and relevant stakeholders of these events;

(h) include public notification procedures to enable members of the public, particularly surrounding residents, to get up-to-date information on the proposed blasting schedule; and

(i) include a protocol for investigating and responding to blast-related complaints.

[a]The locations of the heritage items are shown in Appendix 5.

B24. The Applicant must not undertake any blasting under this consent until the Blast Management Plan is approved by the Planning Secretary.

B25. The Applicant must implement the Blast Management Plan as approved by the Planning Secretary.

AIR QUALITY AND GREENHOUSE GAS

Odour

B26. The Applicant must ensure that no offensive odours, as defined under the POEO Act, are emitted from the site.

Air Quality Criteria

B27. The Applicant must ensure that all reasonable and feasible avoidance and mitigation measures are employed so that particulate matter emissions generated by the development do not cause exceedances of the criteria listed in Table 3 at any residence on privately-owned land.

Table 3: *Air quality criteria*

Pollutant	*Averaging period*	*Criterion*
Particulate matter < 10 µm (PM_{10})	Annual	[a, c] 25 µg/m^3
	24 hour	[b] 50 µg/m^3
Particulate matter < 2.5 µm ($PM_{2.5}$)	Annual	[a, c] 8 µg/m^3
	24 hour	[b] 25 µg/m^3
Total suspended particulate (TSP) matter	Annual	[a, c] 90 µg/m^3

Notes:

[a] *Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources).*

[b] *Incremental impact (i.e. incremental increase in concentrations due to the development on its own).*

[c] *Excludes extraordinary events such as bushfires, prescribed burning, dust storms, fire incidents or any other activity agreed by the Planning Secretary.*

B28. The air quality criteria in Table 3 do not apply if the Applicant has an agreement with the owner/s of the relevant residence or land to exceed the air quality criteria, and the Applicant has advised the Department in writing of the terms of this agreement.

Mine-owned Land

B29. Particulate matter emissions generated by the development must not exceed the criteria listed in Table 3 at any occupied residence on mine-owned land (including land owned by another mining or quarry company) unless:

(a) the tenant and landowner (if the residence is owned by another mining or quarry company) have been notified of any health risks associated with such exceedances in accordance with the notification requirements under PART C of this consent;

(b) the tenant of any land owned by the Applicant can terminate their tenancy agreement without penalty at any time, subject to giving 14 days' notice;

(c) air quality monitoring is regularly undertaken to inform the tenant and landowner (if the residence is owned by another mining company) of the likely particulate matter emissions at the residence; and

(d) data from this monitoring is presented to the tenant and landowner in an appropriate format for a medical practitioner to assist the tenant and landowner in making informed decisions on the health risks associated with occupying the property.

Air Quality Operating Conditions

B30. The Applicant must:

(a) take all reasonable steps to:

(i) minimise odour, fume and particulate matter (including PM_{10} and $PM_{2.5}$) emissions of the development, paying particular attention to minimising wheel-generated haul road emissions;

(ii) improve energy efficiency and reduce greenhouse gas emissions of the development;

(iii) minimise any visible off-site air pollution generated by the development; and

(iv) minimise the extent of potential dust generating surfaces exposed on the site at any given point in time;

(b) ensure that all 'non-road' mobile diesel equipment used in undertaking the development includes reasonable and feasible diesel emissions reduction technology;

(c) operate an air quality management system to guide the day to day planning of mining operations and implementation of both proactive and reactive air quality mitigation measures to ensure compliance with the relevant conditions of this consent;

(d) minimise the air quality impacts of the development during adverse meteorological conditions and extraordinary events (see Note c to Table 3 above);

(e) use all reasonable efforts to co-ordinate air quality management on the site with the air quality management at Peppertree Quarry to minimise cumulative air quality impacts;

(f) carry out regular air quality monitoring to determine whether the development is complying with the relevant conditions of this consent; and

(g) regularly assess meteorological and air quality monitoring data, and modify operations on the site to ensure compliance with the relevant conditions of this consent.

Air Quality and Greenhouse Gas Management Plan

B31. The Applicant must prepare an Air Quality and Greenhouse Gas Management Plan for the development to the satisfaction of the Planning Secretary. This plan must:

(a) be prepared by a suitably qualified and experienced person/s whose appointment has been endorsed by the Planning Secretary;

(b) be prepared in consultation with the EPA;

(c) describe the measures to be implemented to ensure:

(i) compliance with the air quality criteria and operating conditions of this consent;

(ii) best practice management is being employed to:

- minimise the development's air quality impacts;
- minimise the development's Scope 1 and 2 greenhouse gas emissions; and
- improve the development's energy efficiency; and

(iii) the air quality impacts of the development are minimised during adverse meteorological conditions and extraordinary events;

(d) describe the air quality management system in detail; and

(e) include an air quality monitoring program, undertaken in accordance with the *Approved Methods for Sampling and Analysis of Air Pollutants in New South Wales* (DEC, 2007), that:

(i) uses monitors to evaluate the performance of the development against the air quality criteria in this consent and to guide day to day planning of mining operations;

(ii) adequately supports the air quality management system; and

(iii) includes a protocol for identifying any air quality-related exceedance, incident or non-compliance and for notifying the Department and relevant stakeholders of these events.

B32. The Air Quality and Greenhouse Gas Management Plan must be approved by the Planning Secretary within 3 months of the date of this consent, unless otherwise agreed by the Planning Secretary.

B33. The Applicant must implement the Air Quality and Greenhouse Gas Management Plan as approved by the Planning Secretary.

METEOROLOGICAL MONITORING

B34. Prior to the commencement of development under this consent, and for the life of the development, the Applicant must ensure that there is a suitable meteorological station operating in the vicinity of the site that:

(a) complies with the requirements in the *Approved Methods for Sampling and Analysis of Air Pollutants in New South Wales* (DEC, 2007); and

(b) is capable of measuring meteorological conditions in accordance with the *NSW Noise Policy for Industry* (EPA, 2017),

unless a suitable alternative is approved by the Planning Secretary following consultation with the EPA.

WATER

Water Supply

B35. The Applicant must ensure that it has sufficient water for all stages of the development, and if necessary, adjust the scale of the development to match its available water supply.

B36. The Applicant must report on water extracted from the site each year (direct and indirect) in the Annual Review, including water taken under each water licence.

Note: *Under the Water Act 1912 and/or the Water Management Act 2000, the Applicant is required to obtain all necessary water licences for the development, including during rehabilitation and post mine closure.*

Compensatory Water Supply

B37. The Applicant must provide a compensatory water supply to any landowner of privately-owned land whose rightful water supply is adversely and directly impacted (other than an impact that is minor or negligible) as a result of the development, in consultation with DPIE Water, and to the satisfaction of the Planning Secretary.

B38. The compensatory water supply measures must provide an alternative long-term supply of water that is equivalent, in quality and volume, to the loss attributable to the development. Equivalent water supply should be provided (at least on an interim basis) as soon as practicable after the loss is identified, unless otherwise agreed with the landowner.

B39. If the Applicant and the landowner cannot agree on whether the loss of water is attributed to the development or the measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Planning Secretary for resolution.

B40. If the Applicant is unable to provide an alternative long-term supply of water, then the Applicant must provide compensation, to the satisfaction of the Planning Secretary.

***Notes**:*

- *The Water Management Plan (see condition B45) is required to include trigger levels for investigating potentially adverse impacts on water supplies.*

Water Discharges

B41. The Applicant must ensure that all surface discharges from the site comply with:

(a) discharge limits (both volume and quality) set for the development in any EPL; or

(b) relevant provisions of the POEO Act.

Groundwater Management

B42. Within 12 months of the commencement of development under this consent, or other timeframe as agreed by the Planning Secretary, the Applicant must install a groundwater level and quality monitoring network within and adjacent to the Mt Frome Middle Limestone, or a suitable alternative location, in consultation with DPIE Water and to the satisfaction of the Planning Secretary.

Water Management Performance Measures

B43. The Applicant must ensure that the development complies with the performance measures in Table 4.

***Table 4:** Water management performance measures*

Feature	***Performance Measure***
Water management – General	• Maintain separation between clean, dirty (i.e. sediment-laden) and mine water management systems • Minimise the use of clean and potable water on the site • Maximise water recycling, reuse and sharing opportunities • Minimise the use of make-up water from external sources • Design, install, operate and maintain water management systems in a proper and efficient manner • Minimise risks to the receiving environment and downstream water users
Barbers Creek, Bungonia Creek and Shoalhaven River alluvial aquifers	• Negligible impacts to alluvial aquifers as a result of the development, beyond those predicted in the document/s listed in condition A2(c), including: - negligible change in groundwater levels; - negligible change in groundwater quality; and - negligible impact to other groundwater users
Groundwater springs	• Negligible impacts to groundwater springs as a result of the development, beyond those predicted in the document/s listed in condition A2(c), including: - negligible change in groundwater supply; and - negligible change in groundwater quality
Aquatic and riparian ecosystems	• Negligible environmental consequences beyond those predicted in the document/s listed in condition A2(c) • Negligible decline in baseline channel stability • Develop site-specific in-stream water quality objectives in accordance with the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ, 2000) and *Using the ANZECC Guidelines and Water Quality Objectives in NSW* (DEC, 2006)
Marulan Creek Dam	• Negligible impacts on the quality and quantity of downstream flows and geomorphic processes in Marulan Creek and Barbers Creek as a result of the development, beyond those predicted in the document/s listed in condition A2(c) • Design, install and maintain dam infrastructure in accordance with the guidance series for *Controlled Activities on Waterfront Land* (DPI Water, 2012)

Feature	*Performance Measure*
Erosion and sediment control works	• Design, install and maintain erosion and sediment controls in accordance with the guidance series *Managing Urban Stormwater: Soils and Construction* including *Volume 1: Blue Book (Landcom, 2004), Volume 2A: Installation of Services (DECC, 2008), Volume 2C: Unsealed Roads (DECC,2008), Volume 2D: Main Road Construction (DECC, 2008) and Volume 2E: Mines and Quarries (DECC, 2008)* • Design, install and maintain any creek crossings in accordance with the *Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management* (DPI, 2013) and *Why Do Fish Need To Cross The Road*? *Fish Passage Requirements for Waterway Crossings* (NSW Fisheries 2003) • Design, install and maintain any new infrastructure within 40 metres of watercourses in in accordance with the guidance series for *Controlled Activities on Waterfront Land* (DPI Water, 2012)
Clean water diversions and storage infrastructure	• Design, install and maintain the clean water system to capture and convey the 100 year ARI flood • Maximise, as far as reasonable, the diversion of clean water around disturbed areas on the site, except where clean water is captured for use on the site
Sediment dams	• Design, install and maintain sediment dams in accordance with the guidance series *Managing Urban Stormwater: Soils and Construction – Volume 1 (Landcom, 2004) and 2E Mines and Quarries (DECC, 2008)* and the requirements under the POEO Act
Chemical and hydrocarbon storage	• Chemical and hydrocarbon products to be stored in bunded areas in accordance with the relevant Australian Standard
Overburden emplacements	• Design, install and maintain emplacements to encapsulate and prevent migration of acid forming and potentially acid forming materials, and saline and sodic material • Design, install and maintain out-of-pit emplacements to prevent and/or manage long term saline seepage

B44. The performance measures in Table 4 do not apply to water management structures which were lawfully constructed prior to the commencement of development under this consent.

Water Management Plan

B45. The Applicant must prepare a Water Management Plan for the development to the satisfaction of the Planning Secretary. This plan must:

(a) be prepared by a suitably qualified and experienced person/s whose appointment has been endorsed by the Planning Secretary;

(b) be prepared in consultation with WaterNSW, DPIE Water, Fisheries NSW and the EPA;

(c) describe the measures to be implemented to ensure that the Applicant complies with the water management performance measures (see Table 4);

(d) utilise existing local data and build on existing monitoring programs, where practicable;

(e) include a:

(i) **Site Water Balance** that includes details of:

- predicted annual inflows to and outflows from the site;
- sources and security of water supply for the life of the development (including authorised entitlements and licences);
- water storage capacity;
- water use and management on the site, including any water transfers or sharing with neighbouring mines;
- licensed discharge points and limits; and
- reporting procedures, including the annual preparation of an updated site water balance;

(ii) **Erosion and Sediment Control Plan** that:

- is consistent with the requirements of *Managing Urban Stormwater: Soils and Construction - Volume 1: Blue Book* (Landcom, 2004) and *Volume 2E: Mines and Quarries* (DECC, 2008);
- identifies activities that could cause soil erosion, generate sediment or affect flooding;
- includes a program to periodically review sheet, rill and gully erosion risks, particularly in relation to emplacement areas;

- includes a program to monitor the geomorphological stability of emplacement areas, in consultation with WaterNSW;
- describes measures to minimise soil erosion and the potential for the transport of sediment to downstream waters, and manage flood risk;
- describes the location, function, and capacity of erosion and sediment control structures; and
- describes what measures would be implemented to maintain (and if necessary decommission) the structures over time;

(iii) **Surface Water Management Plan** that includes:

- detailed baseline data on surface water flows and quality of watercourses and/or water bodies potentially impacted by the development, including:
  - stream and riparian vegetation health;
  - channel stability (geomorphology); and
  - water supply for other surface water users;
- a detailed description of the surface water management system, including consideration of mitigation measures to manage downstream risks associated with alkalinity, TSS and settling agents;
- details of the water licensing requirements for all water storages (i.e. exempt, harvestable rights or licenced);
- detailed plans, design objectives and performance criteria for water management infrastructure, including:
  - water run-off diversions and catch drains;
  - water storages (excluding Marulan Creek Dam) and sediment dams;
  - emplacement areas; and
  - backfilled pits and any final voids for the development;
- surface water performance criteria, including trigger levels for identifying and investigating any potentially adverse impacts (or trends) associated with the development, for:
  - water supply for other water users;
  - downstream surface water flows and quality, including (but not limited to) specific trigger levels for TSS, metals, alkalinity, bicarbonate alkalinity and settling agents, which are informed by baseline data, having regard to the sensitivity of downstream waters;
  - downstream flooding impacts;
  - stream and riparian vegetation heath; and
  - post-mining water pollution from rehabilitated areas of the site;
- a program to monitor and evaluate:
  - compliance with the relevant performance measures listed in Table 4 and the performance criteria in this plan;
  - controlled and uncontrolled discharges and seepage/leachate from the site;
  - impacts on water supply for other water users;
  - surface water inflows, outflows and storage volumes, to inform the Site Water Balance; and
  - the effectiveness of the surface water management system and the measures in the Erosion and Sediment Control Plan;
- reporting procedures for the results of the monitoring program, including notifying other water users of any elevated results; and
- a trigger action response plan to respond to any exceedances of the relevant performance measures or performance criteria, and repair, mitigate and/or offset any adverse surface water impacts of the development;

(iv) **Marulan Creek Dam Management Plan** that includes:

- detailed plans, design objectives and performance criteria for the dam infrastructure;
- detailed measures to ensure compliance with the relevant performance measures in Table 4;
- performance criteria, including trigger levels for identifying and investigating any potentially adverse impacts (or trends) associated with the development with respect to:
  - downstream geomorphic processes;
  - sediment transmission;
  - ecological function; and

- water quality;

- a program to monitor and evaluate compliance with the relevant performance measures in Table 4, including justification for proposed monitoring frequencies and parameters;
- reporting procedures for the results of the monitoring program;
- a remediation and rehabilitation strategy for areas of Marulan Creek both above and below the dam up to the entry to the Barber's Creek gorge, which has been prepared by a suitably qualified and experienced fluvial geomorphologist, having regard to *A Rehabilitation Manual for Australian Streams* (Land and Water Resources Research and Development Corporation, 2000); and
- a trigger action response plan to respond to any exceedances of the relevant performance measures or performance criteria, and repair, mitigate and/or offset any adverse impacts on downstream flows and/or ecological processes;

(v) **Groundwater Management Plan** that includes:

- detailed baseline data of groundwater levels, yield and quality for groundwater resources and groundwater dependent ecosystems potentially impacted by the development, including groundwater supply for other water users;
- a detailed description of the groundwater management system;
- groundwater performance criteria, including trigger levels for identifying and investigating any potentially adverse groundwater impacts (or trends) associated with the development, on:
  - regional and local aquifers (alluvial and hardrock);
  - groundwater springs; and
  - groundwater supply for other water users such as licensed privately-owned groundwater bores;
- a program to monitor and evaluate:
  - compliance with the relevant performance measures listed in Table 4 and the performance criteria in this plan;
  - water loss/seepage from water storages into the groundwater system, including from any final voids;
  - groundwater inflows, outflows and storage volumes, to inform the Site Water Balance;
  - the hydrogeological setting of any nearby alluvial aquifers and the likelihood of any indirect impacts from the development;
  - impacts on groundwater dependent ecosystems;
  - impacts on groundwater supply for other water users;
  - the effectiveness of the groundwater management system;
- reporting procedures for the results of the monitoring program, including notifying other water users of any elevated results;
- a trigger action response plan to respond to any exceedances of the relevant performance measures and groundwater performance criteria, and repair, mitigate and/or offset any adverse groundwater impacts of the development;
- a program to periodically validate the groundwater model for the development, including an independent review of the model every 3 years (unless otherwise agreed by the Planning Secretary), and comparison of monitoring results with modelled predictions; and

(vi) a protocol to report on the measures, monitoring results and performance criteria identified above, in the Annual Review referred to in condition D11.

B46. The Water Management Plan must be approved by the Planning Secretary within 3 months from the date of this consent, unless otherwise agreed by the Planning Secretary.

B47. The Applicant must implement the Water Management Plan as approved by the Planning Secretary.

B48. The Applicant must commission an independent audit of the long-term geomorphological stability of the WOE and SOE. This audit must:

(a) be conducted by a suitably qualified and experienced person/s whose appointment has been endorsed by the Planning Secretary;

(b) be carried out in consultation with WaterNSW;

(c) be undertaken within three months of the completion of the surface water management systems for the WOE and SOE in Stage 4 of the development, or other timeframe agreed by the Planning Secretary;

(d) assess whether the surface water management system has been constructed in accordance with the conditions of this consent and is geomorphologically stable;

(e) recommend appropriate measures or actions to ensure the long-term stability of the WOE and SOE (if required); and

(f) be conducted and reported to the satisfaction of the Planning Secretary.

B49. Within three months of commissioning the independent audit required under condition B48, or other timeframe agreed by the Planning Secretary, the Applicant must submit a copy of the Audit Report to the Planning Secretary and to WaterNSW, together with its response to any recommendations contained in the audit report and a timetable for the implementation of its recommendations.

B50. The Applicant must implement the recommendations of the Audit Report to the satisfaction of the Planning Secretary.

BIODIVERSITY

Biodiversity Credits Required

B51. Prior to commencing construction under this consent, or other timeframe agreed by the Planning Secretary, the Applicant must retire the biodiversity credits specified in ***Table 5***. The retirement of credits must be carried out in consultation with BCD and in accordance with the Biodiversity Offsets Scheme of the BCT Act, to the satisfaction of the BCT.

B52. The retirement of credits must be carried out in consultation with BCD and in accordance with the Biodiversity Offsets Scheme of the BC Act, to the satisfaction of the BCT.

Table 5: *Biodiversity credit requirements*

Credit Type	***Credits Required***
Ecosystem Credits	
PCT 1334 Yellow Box – Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands[a, b]	1,038
PCT 778 Coast Grey Box – stringybark dry woodland on slopes of the Shoalhaven Gorges – Southern Sydney Basin	885
PCT 1150 – Silvertop Ash – Blue-leaved Stringybark shrubby open forest on ridges, north east South Eastern Highlands Bioregion	260
PCT 731 Broad-leaved Peppermint – Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion	325
Species Credits	
Solanum celatum	2
Koala[b]	2,454
Large-eared Pied Bat[b]	3,836

[a] *Commensurate with White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC under the EPBC Act*

[b] *Under clause 6.6A of the Biodiversity Conservation Regulation 2017, variation rules do not apply to the identified species or community and the required credits must be retired on a like-for-like basis*
basis

B53. The Applicant must implement the Biodiversity Offset Strategy in consultation with BCD, the BCT and MEG.[a]

[a] *Consultation with MEG is only required in respect of land-based biodiversity offsets*

Biodiversity Management Plan

B54. The Applicant must prepare a Biodiversity Management Plan to the satisfaction of the Planning Secretary. This plan must:

(a) be prepared by a suitably qualified and experienced person/s whose appointment has been endorsed by the Planning Secretary;

(b) be prepared in consultation with BCD;

(c) describe the short, medium, and long-term measures to be undertaken to manage the remnant vegetation and fauna habitat on the site and within the offset areas;

(d) describe how biodiversity management would be integrated with similar measures within other management plans, including the Rehabilitation Management Plan referred to in condition B82;

(e) include detailed performance and completion criteria for evaluating the performance of the Biodiversity Offset Strategy and include triggers for remedial action, where these performance or completion criteria are not met;

(f) describe how the Biodiversity Offset Strategy will be implemented and secured;

(g) describe the measures to be implemented within the approved disturbance areas to:

(i) minimise the amount of clearing;

(ii) minimise impacts on fauna, including undertaking pre-clearance surveys and measures to minimise the risk of vehicle strike;

(iii) provide for the salvage, transplanting and/or propagation of any threatened flora found during pre-clearance surveys, in accordance with the *Guidelines for the Translocation of Threatened Plants in Australia* (Vallee et al., 2004); and

(iv) maximise the salvage of resources, including tree hollows, vegetation and soil resources, for beneficial reuse, including fauna habitat enhancement;

(h) describe the measures to be implemented on the site to:

(i) minimise impacts to *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC* including potential edge effects within identified buffer zones, and contribute to conservation strategies for this CEEC;

(ii) minimise impacts on fauna habitat resources such as hunting and foraging areas, habitat trees, fallen timber and hollow-bearing trees;

(iii) enhance the quality of vegetation, vegetation connectivity and wildlife corridors including through the assisted regeneration and/or targeted revegetation of appropriate canopy, sub-canopy, understorey and ground strata;

(iv) introduce naturally scarce fauna habitat features such as nest boxes and salvaged tree hollows and promote the use of these introduced habitat features by threatened fauna species;

(v) manage any potential conflicts with Aboriginal heritage values;

(vi) protect vegetation and fauna habitat outside of the approved disturbance areas;

(vii) manage the collection and propagation of seed from the local area;

(viii) control weeds, including measures to avoid and mitigate the spread of weeds;

(ix) control feral pests and diseases with consideration of actions identified in relevant threat abatement plans;

(x) control erosion;

(xi) manage any grazing and agriculture;

(xii) control access to vegetated or revegetated areas; and

(xiii) manage bushfire hazards;

(i) include a seasonally-based program to monitor and report on the effectiveness of the above measures, progress against the detailed performance indicators and completion criteria, and identify improvements that could be implemented to improve biodiversity outcomes;

(j) identify the potential risks to the successful implementation of the Biodiversity Management Plan, and include a description of the contingency measures to be implemented to mitigate against these risks; and

(k) include details of who would be responsible for monitoring, reviewing, and implementing the plan.

B55. The Applicant must not clear any vegetation described in the document/s listed in condition A2(c) until the Biodiversity Management Plan is approved by the Planning Secretary.

B56. The Applicant must implement the Biodiversity Management Plan as approved by the Planning Secretary.

HERITAGE

Protection of Aboriginal Heritage

B57. The Applicant must ensure that the development does not cause any direct or indirect impact on any identified heritage items located outside the approved disturbance area, beyond those predicted in the document/s listed in condition A2(c).

Note: *Identified heritage items are shown in the figures in Appendix 5.*

B58. If suspected human remains are discovered on the site, then all work surrounding the area must cease, and the area must be secured. The Applicant must immediately notify NSW Police Force and Heritage NSW, and work must not recommence in the area until authorised by NSW Police Force and Heritage NSW.

B59. The Applicant must ensure that all known Aboriginal objects or Aboriginal places on the site and within the offset areas are properly recorded, and those records are kept up to date, in the Aboriginal Heritage Information Management System (AHIMS) Register.

Aboriginal Cultural Heritage Management Plan

B60. The Applicant must prepare an Aboriginal Cultural Heritage Management Plan for the development. The plan must:

(a) be prepared by suitably qualified and experienced persons whose appointment has been endorsed by the Planning Secretary;

(b) be prepared in consultation with Heritage NSW and Registered Aboriginal Parties;

(c) describe the measures to be implemented on the site or within the offset areas to:

(i) comply with the heritage-related operating conditions of this consent;

(ii) ensure all workers receive suitable Aboriginal cultural heritage training/inductions prior to carrying out any activities which may cause impacts to Aboriginal objects or Aboriginal places, and that suitable records are kept of these inductions;

(iii) protect, monitor and manage identified Aboriginal objects and Aboriginal places (including any proposed archaeological investigation of potential subsurface objects, collection and salvage of objects within the approved disturbance area) in accordance with the commitments made in the document/s listed in condition A2(c);

(iv) protect Aboriginal objects and Aboriginal places located outside the approved disturbance area from impacts of the development;

(v) manage the discovery of suspected human remains and any new Aboriginal objects or Aboriginal places, including provisions for burials, over the life of the development;

(vi) maintain and manage reasonable access for relevant Aboriginal stakeholders to Aboriginal objects and Aboriginal places (outside of the approved disturbance area); and

(vii) facilitate ongoing consultation and involvement of Registered Aboriginal Parties in the conservation and management of Aboriginal cultural heritage on the site;

(d) include a strategy for the care, control and storage of Aboriginal objects salvaged on the site, both during the life of the development and in the long term; and

(e) in relation to the women's cultural heritage site along Marulan Creek, include:

(i) an assessment of the potential impacts of the Marulan Creek dam and associated flow regime on the site, prepared by an intangible cultural heritage specialist in consultation with the identified knowledge holders; and

(ii) assessment of whether mitigation to any negative impacts should occur through periodic cultural flows.

B61. The Applicant must not disturb any heritage item until the Aboriginal Cultural Heritage Management Plan is approved by the Planning Secretary.

B62. The Applicant must implement the Aboriginal Cultural Heritage Management Plan approved by the Planning Secretary.

Historic Heritage Management Plan

B63. The Applicant must prepare a Historic Heritage Management Plan for the development, in respect of all non-Aboriginal cultural heritage items, to the satisfaction of the Planning Secretary. This plan must:

(a) be prepared by a suitably qualified and experienced person/s whose appointment has been endorsed by the Planning Secretary;

(b) be prepared in consultation with Council and in accordance with the relevant Heritage NSW guidelines;

(c) describe how the historic heritage values of the site would be recorded and preserved;

(d) identify all heritage items in the vicinity of the site and include a statement of significance for each item;

(e) describe the measures to be implemented on the site or within the offset areas to:

(i) ensure all workers on the site receive suitable heritage training/inductions prior to carrying out any activities which may cause impacts to historic heritage, and that suitable records are kept of these inductions;

(ii) protect heritage items located outside the approved disturbance area from impacts of the development, beyond those predicted in the document/s listed in condition A2(c);

(iii) undertake photographic/archival recording of any items of heritage significance predicted to be impacted by the development, prior to disturbance; and

(iv) manage any new heritage items discovered during the life of the development; and

(f) include a strategy for the care, control and storage of heritage relics salvaged from the site.

B64. The Applicant must not disturb any heritage item until the Historic Heritage Management Plan is approved by the Planning Secretary.

B65. The Applicant must implement the Historic Heritage Management Plan as approved by the Planning Secretary.

VISUAL

Visual Amenity and Lighting

B66. The Applicant must:

(a) take all reasonable steps to minimise the visual and off-site lighting impacts of the development;

(b) take all reasonable steps to minimise views of mining operations and associated equipment from privately-owned residences, public roads and the Bungonia Lookdown;

(c) ensure no fixed outdoor lights shine directly above the horizontal or above the building line or any illuminated structure;

(d) ensure no in-pit mobile lighting rigs shine directly above the pit wall and other mobile lighting rigs do not shine directly above the horizontal (except where required for emergency safety purposes);

(e) ensure that all external lighting associated with the development complies with relevant Australian Standards including the latest version of *Australian Standard AS4282 (INT) 1997 – Control of Obtrusive Effects of Outdoor Lighting*;

(f) ensure that the visual appearance of any new buildings, structures, facilities or works (including paint colours and specifications) is aimed at blending as far as possible with the surrounding landscape.

B67. The Applicant must take all reasonable steps to minimise the night lighting impacts associated with road transport along Marulan South Road. This may include, but not be limited to, the construction of earth bunds within the realigned Marulan South Road reserve, in consultation with Council.

WASTE

B68. The Applicant must:

(a) take all reasonable steps to minimise the waste generated by the development;

(b) classify all waste in accordance with the *Waste Classification Guidelines* (EPA, 2014);

(c) dispose of all waste at appropriately licensed waste facilities;

(d) manage on-site sewage treatment and disposal in accordance with the requirements of Council; and

(e) monitor and report on the effectiveness of the waste minimisation and management measures in the Annual Review referred to in condition D11.

B69. Except as expressly permitted in an applicable EPL, specific resource recovery order or exemption under the *Protection of the Environment Operations (Waste) Regulation 2014*, the Applicant must not receive waste at the site for storage, treatment, processing, reprocessing or disposal.

B70. Prior to commencing development under this consent, the Applicant must prepare a Contaminated Materials Protocol to the satisfaction of the Planning Secretary. This protocol must describe the procedures to be implemented in the event that potentially contaminated material is identified during construction, including:

(a) procedures for the testing, removal and disposal of potentially contaminated material; and

(b) measures to ensure compliance with the requirements of SafeWork NSW and relevant guidelines.

B71. The Applicant must implement the Contaminated Materials Protocol as approved by the Planning Secretary.

DANGEROUS GOODS

B72. The Applicant must ensure that the storage, handling, and transport of:

(a) dangerous goods is done in accordance with the relevant Australian Standards, particularly *AS1940* and *AS1596*, and the *Dangerous Goods Code*; and

(b) explosives are managed in accordance with the requirements of the Resources Regulator.

BUSHFIRE MANAGEMENT

B73. The Applicant must:

(a) ensure that the development:

(i) provides for asset protection in accordance with the relevant requirements in *the Planning for Bushfire Protection* (RFS, 2019) guideline; and

(ii) ensure that there is suitable equipment to respond to any fires on the site; and

(b) assist the RFS and emergency services to the extent practicable if there is a fire in the vicinity of the site.

B74. Prior to commencing development under this consent, the Applicant must prepare a Bushfire Management Plan for the development, in consultation with RFS. This plan must include a:

(a) contact person and 24-hour contact phone number;

(b) schedule and description of proposed bushfire mitigation works, including:

(i) location of managed and unmanaged vegetation within the site;
(ii) location of water supply; and
(iii) internal access roads;

(c) plan identifying the location and storage of bulk flammable liquids and materials;

(d) 'hot works' management plan, including:
(i) circumstances when 'hot works' are limited or prohibited; and
(ii) safety measures to be implemented when 'hot works' are being conducted; and

(e) emergency/evacuation plan in accordance with the *Guidelines for the* Preparation *of Emergency/Evacuation* Plans (RFS) and Australian Standard *AS3745 Planning for Emergencies in Facilities.*

B75. The Applicant must implement the Bushfire Management Plan in consultation with RFS.

REHABILITATION

Rehabilitation Objectives

B76. The Applicant must rehabilitate the site in accordance with the conditions imposed on the mining lease(s) associated with the development under the *Mining Act 1992*. This rehabilitation must be generally consistent with the proposed rehabilitation strategy described in documents listed in condition A2(c) and shown in Appendix 6, and must comply with the objectives in Table 6.

Table 6: *Rehabilitation objectives*

Feature	***Objective***
All areas of the site affected by the development	• Safe, stable and non-polluting • Fit for the intended post-mining land use/s • Establish the final landform and post-mining land use/s as soon as practicable after cessation of mining operations • Minimise post-mining environmental impacts
Areas proposed for native ecosystem re-establishment	• Establish/restore self-sustaining native woodland ecosystems • Establish local plant community types, with a particular focus on species commensurate with *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC* • Establish: - riparian habitat within any retained water features; - habitat, feed and foraging resources for threatened fauna species (including the Koala); and - vegetation connectivity and wildlife corridors, as far as is reasonable and feasible
Final Landform	• Stable and sustainable for the intended post-mining land use/s • Integrated with surrounding natural landforms and other mine rehabilitated landforms, to the greatest extent practicable • Incorporate micro-relief and drainage features that mimic natural topography and mitigate erosion, to the greatest extent practicable • Maximise surface water drainage to the natural environment i.e. free draining (excluding final void catchment) • Minimise visual impacts, where practicable
Final void	• Designed as long term groundwater sink to prevent the release of saline water into the surrounding environment, unless further mine planning and final landform design processes identify a more suitable outcome for the final void (see condition B79) • Minimise to the greatest extent practicable: - the size and depth; - the drainage catchment; - any high wall instability risk; and - the risk of flood interaction • Maximise potential for beneficial reuse, where practicable
Surface infrastructure of the development (excluding Marulan Creek Dam)	• To be decommissioned, removed and rehabilitated, unless the Resources Regulator agrees otherwise
Water quality	• Water retained on the site is fit for the intended post-mining land use/s • Water discharged from the site is suitable for receiving waters and fit for aquatic ecology and riparian vegetation

Feature	*Objective*
Community	• Ensure public safety • Minimise adverse socio-economic effects associated with mine closure

B77. The rehabilitation objectives in Table 6 apply to the entire site, including all landforms which were lawfully constructed prior to the commencement of development under this consent. The Applicant is not required to retrospectively incorporate micro-relief and drainage features that mimic natural topography and mitigate erosion on landforms that have been approved and constructed under the previous consents, however, further erosion control works may be required to these landforms to address long term stability issues (if identified).

Progressive Rehabilitation

B78. The Applicant must rehabilitate[a] the site progressively, that is, as soon as reasonably practicable following disturbance. All reasonable steps must be taken to minimise the total area exposed at any time. Interim stabilisation and temporary vegetation strategies must be employed when areas prone to dust generation, soil erosion and weed incursion cannot be permanently rehabilitated.

[a]This condition does not prevent further disturbance at some later stage of the development of areas that have been rehabilitated.

Rehabilitation Strategy

B79. The Applicant must prepare a Rehabilitation Strategy for all land disturbed by the development to the satisfaction of the Planning Secretary. This strategy must:

(a) be prepared by a suitably qualified and experienced person/s whose appointment has been endorsed by the Planning Secretary;

(b) be prepared in consultation with DPIE Water, BCD, Resources Regulator and Council;

(c) build upon the Rehabilitation Objectives in Table 6, describe the overall rehabilitation outcomes for the site, and address all aspects of rehabilitation including mine closure, final landform (including final voids), post-mining land use/s and water management;

(d) align with strategic rehabilitation and mine closure objectives and address the principles of the *Strategic Framework for Mine Closure* (ANZMEC and MCA, 2000);

(e) describe how the rehabilitation measures would be integrated with the measures in the Biodiversity Management Plan referred to in condition B54;

(f) describe how rehabilitation will be integrated with the mine planning process, including a plan to address premature or temporary mine closure;

(g) include indicative mine plans and scheduling for life-of-mine rehabilitation showing each rehabilitation domain;

(h) include details of target vegetation communities and species to be established within the proposed revegetation areas;

(i) investigate opportunities to refine and improve the final landform and final void outcomes over time;

(j) include a post-mining land use strategy to investigate and facilitate post-mining beneficial land uses for the site (including the final void), that:

  (i) align with regional and local strategic land use planning objectives and outcomes;

  (ii) support a sustainable future for the local community;

  (iii) utilise existing mining infrastructure, where practicable; and

  (iv) avoid disturbing self-sustaining native ecosystems, where practicable;

(k) include a stakeholder engagement plan to guide rehabilitation and mine closure planning processes and outcomes;

(l) investigate ways to minimise adverse socio-economic effects associated with rehabilitation and mine closure; and

(m) include a program to periodically review and update this strategy at least every three years.

B80. The Rehabilitation Strategy must be approved by the Planning Secretary within 6 months from the date of this consent, unless otherwise agreed by the Planning Secretary .

B81. The Applicant must implement the Rehabilitation Strategy approved by the Planning Secretary.

Rehabilitation Management Plan

B82. The Applicant must prepare a Rehabilitation Management Plan for the development, in accordance with the conditions imposed on the mining lease(s) associated with the development under the *Mining Act 1992*. This plan must:

(a) be prepared in consultation with the Department and Council;

(b) be prepared in accordance with any relevant Resources Regulator Guidelines;

(c) include detailed performance indicators and completion criteria for each rehabilitation domain, and triggers for remedial actions;

(d) include an overview of the identified risks to achieving successful rehabilitation;

(e) describe the measures to be implemented on the site to achieve the Rehabilitation Objectives in Table 6, the requirements of the Rehabilitation Strategy referred to in condition B79 and the criteria in paragraph (c);

(f) include detailed mine plans and scheduling for progressive rehabilitation to be initiated, undertaken and/or completed over the next three years, or other suitable time period as agreed with the Resources Regulator;

(g) include a program to monitor, independently audit and report on progress against the criteria in paragraph (c) and the effectiveness of the measures in paragraph (e);

(h) describe any further studies, work, research or consultation that will be undertaken to expand the site-specific rehabilitation knowledge base, reduce uncertainty and improve rehabilitation outcomes; and

(i) outline intervention and adaptive management techniques to ensure rehabilitation remains on a trajectory of achieving the Rehabilitation Objectives, Rehabilitation Completion Criteria and the Final Landform in the Rehabilitation Management Plan as soon as reasonably practical.

TRANSPORT

Monitoring of Product Transport

B83. The Applicant must:

(a) keep accurate records[a] of the:

(i) amount of mining products and quarry products transported from the site (on a daily basis); and

(ii) date and time of each laden train and truck movement generated by the development; and

(b) publish these records in the Annual Review.

[a] *Records must contain sufficient details to demonstrate compliance with conditions A6 to A13 of this consent.*

Transport Operating Conditions

B84. Until such time as the eastern end of Marulan South Road is de-proclaimed, the Applicant must:

(a) make suitable arrangements to ensure the safety of public road users (including traffic signals, signage or other traffic control measures), to the satisfaction of Council; and

(b) ensure that any traffic signals on public roads are designed, installed and operated to the satisfaction of TfNSW.

B85. The Applicant must:

(a) ensure that all laden trucks entering or exiting the site have their loads covered;

(b) ensure that all laden trucks exiting the site are cleaned of material that may fall from vehicles, before leaving the site;

(c) take all reasonable steps to minimise traffic safety issues and disruption to local road users; and

(d) take all reasonable steps to ensure that appropriate signage is displayed on all trucks used to transport quarry products from the development so they can be easily identified by other road users.

Road Realignment

B86. Unless otherwise agreed by Council, the Applicant must construct the new alignment of Marulan South Road as described in the documents listed in A2 (c), to the following standard:

(a) 7 m wide sealed carriageway, comprising two 3.5 m wide travel lanes;

(b) 1.5 m wide shoulders (1 m sealed) on both sides of the road;

(c) 3 m wide cleared zone; and

(d) Wide Centre Line Treatment, with retroreflective pavement markers, edge-line markers and guideposts as agreed by Council,

in accordance with relevant Austroads guidelines and to the satisfaction of Council.

***Notes**:*

- *The upgrade works identified above include all road furniture and safety requirements required to meet relevant road standards, to the satisfaction of the relevant roads authority.*
- *If there is a dispute between the relevant parties about the implementation of this condition, then any party may refer the matter to the Planning Secretary for resolution.*

B87. The Applicant must ensure that public access is maintained along the existing alignment of Marulan South Road until the new alignment (as required under condition B86) is constructed and dedicated to Council.

Road Restrictions

B88. Unless otherwise agreed by Council, the Applicant must not dispatch more than 75 laden trucks per day or 5 laden trucks per hour from the site, until Marulan South Road is upgraded as described in the documents listed in A2 (c), to the following standard:

(a) 7 m wide sealed carriageway, comprising two 3.5 m wide travel lanes;

(b) 1.5 m wide shoulders (1 m sealed) on both sides of the road;

(c) 3 m wide cleared zone; and

(d) Wide Centre Line Treatment, with retroreflective pavement markers, edge-line markers and guideposts as agreed by Council,

in accordance with relevant Austroads guidelines and to the satisfaction of Council. The requirements of condition B88 do not apply to the section of road which is to be realigned under condition B86 above.

***Notes**:*

- *The upgrade works identified above include all road furniture and safety requirements required to meet relevant road standards, to the satisfaction of the relevant roads authorities.*
- *If there is a dispute between the relevant parties about the implementation of this condition, then any party may refer the matter to the Planning Secretary for resolution.*

B89. The design standard required under condition B88 may be varied with the agreement of Council.

Traffic Management Plan

B90. The Applicant must prepare a Traffic Management Plan for the development to the satisfaction of the Planning Secretary. This plan must:

(a) be prepared by suitably qualified and experienced person/s whose appointment has been endorsed by the Planning Secretary;

(b) be prepared in consultation with TfNSW and Council;

(c) include details of all transport routes and traffic types to be used for development-related traffic;

(d) describe the measures to be implemented to ensure compliance with conditions B84 and B85 above;

(e) include details of the measures to be implemented to minimise traffic safety issues and disruption to local road users, including minimising potential for conflict with school buses and stock movements;

(f) include a Drivers' Code of Conduct that includes procedures to ensure that drivers:

(i) adhere to posted speed limits or other required travelling speeds;

(ii) adhere to designated transport routes; and

(iii) implement safe and quiet driving practices;

(g) describe the measures to be put in place to ensure compliance with the Drivers' Code of Conduct; and

(h) propose measures to minimise the transmission of dust and tracking of material onto the surface of public roads from vehicles exiting the site.

B91. The Traffic Management Plan must be approved by the Planning Secretary within 3 months from the date of this consent, unless otherwise agreed by the Planning Secretary.

B92. The Applicant must implement the Traffic Management Plan as approved by the Planning Secretary.

PART C ADDITIONAL PROCEDURES

NOTIFICATION OF LANDOWNERS/TENANTS

C1. Within one month of the date of this consent, the Applicant must:

(a) notify in writing the owner of any privately-owned land within 2 kilometres of any approved open cut mining pit on the site that they are entitled to ask the Applicant for an inspection to establish the baseline condition of any buildings or structures on their land, or to have a previous property inspection report updated;

(b) notify the tenants of any mine-owned land of their rights under this consent; and

(c) send a copy of the fact sheet entitled *"Mine Dust and You"* (NSW Health, 2017) to the owners and/or existing tenants of any land (including mine-owned land) where the predictions in the document/s listed in condition A2(c) identify that dust emissions generated by the development are likely to be greater than the relevant air quality criteria identified in condition B27 at any time during the life of the development.

C2. Prior to entering into any tenancy agreement for any land owned by the Applicant that is predicted to experience exceedances of the recommended dust and/or noise criteria, the Applicant must:

(a) advise the prospective tenants of the potential health and amenity impacts associated with living on the land, and give them a copy of the fact sheet entitled *"Mine Dust and You"* (NSW Health, 2017); and

(b) advise the prospective tenants of the rights they would have under this consent,

to the satisfaction of the Planning Secretary.

NOTIFICATION OF EXCEEDANCES

C3. As soon as practicable and no longer than 7 days after obtaining monitoring results showing an exceedance of any noise, blasting or air quality criterion in PART B of this consent, the Applicant must provide the details of the exceedance to any affected landowners, tenants and the CCC.

C4. For any exceedance of any air quality criterion in PART B of this consent, the Applicant must also provide to any affected land owners and/or tenants a copy of the fact sheet entitled "*Mine Dust and You"* (NSW Health, 2017).

INDEPENDENT REVIEW

C5. If a landowner considers the development to be exceeding any relevant noise, blasting or air quality criterion in PART B of this consent, they may ask the Planning Secretary in writing for an independent review of the impacts of the development on their residence or land.

C6. If the Planning Secretary is not satisfied that an independent review is warranted, the Planning Secretary will notify the landowner in writing of that decision, and the reasons for that decision, within 21 days of the request for a review.

C7. If the Planning Secretary is satisfied that an independent review is warranted, within 3 months, or other timeframe agreed by the Planning Secretary and the landowner, of the Planning Secretary's decision, the Applicant must:

(a) commission a suitably qualified, experienced and independent person, whose appointment has been approved by the Planning Secretary, to:

(i) consult with the landowner to determine their concerns;

(ii) conduct monitoring to determine whether the development is complying with the relevant criterion in PART B of this consent; and

(iii) if the development is not complying with the relevant criterion, identify measures that could be implemented to ensure compliance with the relevant criterion; and

(b) give the Planning Secretary and landowner a copy of the independent review; and

(c) comply with any written requests made by the Planning Secretary to implement any findings of the review.

PART D ENVIRONMENTAL MANAGEMENT, REPORTING AND AUDITING

ENVIRONMENTAL MANAGEMENT

Environmental Management Strategy

D1. The Applicant must prepare an Environmental Management Strategy for the development to the satisfaction of the Planning Secretary. This strategy must:

(a) provide the strategic framework for environmental management of the development;

(b) identify the statutory approvals that apply to the development;

(c) set out the role, responsibility, authority and accountability of all key personnel involved in the environmental management of the development;

(d) set out the procedures to be implemented to:

(i) keep the local community and relevant agencies informed about the operation and environmental performance of the development;

(ii) receive record, handle and respond to complaints;

(iii) resolve any disputes that may arise during the course of the development;

(iv) respond to any non-compliance and any incident;

(v) respond to emergencies; and

(e) include:

(i) references to any strategies, plans and programs approved under the conditions of this consent; and

(ii) a clear plan depicting all the monitoring to be carried out under the conditions of this consent.

D2. The Environmental Management Strategy must be approved by the Planning Secretary within 3 months from the date of this consent, unless otherwise agreed by the Planning Secretary

D3. The Applicant must implement the Environmental Management Strategy as approved by the Planning Secretary.

Adaptive Management

D4. The Applicant must assess and manage development-related risks to ensure that there are no exceedances of the criteria and performance measures in this consent. Any exceedance of these criteria or performance measures constitutes a breach of this consent and may be subject to penalty or offence provisions under the EP&A Act or EP&A Regulation.

Where any exceedance of these criteria or performance measures has occurred, the Applicant must, at the earliest opportunity:

(a) take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur;

(b) consider all reasonable and feasible options for remediation (where relevant) and submit a report to the Department describing those options and any preferred remediation measures or other course of action; and

(c) implement reasonable remediation measures as directed by the Planning Secretary.

Management Plan Requirements

D5. Management plans required under this consent must be prepared in accordance with relevant guidelines, and include:

(a) summary of relevant background or baseline data;

(b) details of:

(i) the relevant statutory requirements (including any relevant approval, licence or lease conditions);

(ii) any relevant limits or performance measures and criteria; and

(iii) the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;

(c) any relevant commitments or recommendations identified in the document/s listed in condition A2(c);

(d) a description of the measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria;

(e) a program to monitor and report on the:

(i) impacts and environmental performance of the development; and

(ii) effectiveness of the management measures set out pursuant to condition D4(c);

(f) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;

(g) a program to investigate and implement ways to improve the environmental performance of the development over time;

(h) a protocol for managing and reporting any:

(i) incident, non-compliance or exceedance of any impact assessment criterion or performance criterion);

(ii) complaint; or

(iii) failure to comply with other statutory requirements;

(i) public sources of information and data to assist stakeholders in understanding environmental impacts of the development; and

(j) a protocol for periodic review of the plan.

Note: *The Planning Secretary may waive some of these requirements if they are unnecessary or unwarranted for particular management plans.*

D6. The Applicant must ensure that management plans prepared for the development are consistent with the conditions of this consent and any EPL issued for the site.

REVISION OF STRATEGIES, PLANS AND PROGRAMS

D7. Within three months of:

(a) the submission of an incident report under condition D9;

(b) the submission of an Annual Review under condition D11;

(c) the submission of an Independent Environmental Audit under condition D12;

(d) the approval of any modification of the conditions of this consent (unless the conditions require otherwise); or

(e) notification of a change in development phase under condition A17;

the suitability of existing strategies, plans and programs required under this consent must be reviewed by the Applicant.

D8. If necessary, to either improve the environmental performance of the development, cater for a modification or comply with a direction, the strategies, plans and programs required under this consent must be revised, to the satisfaction of the Planning Secretary. Where revisions are required, the revised document must be submitted to the Planning Secretary for approval within six weeks of the review.

Note: *This is to ensure strategies, plans and programs are updated on a regular basis and to incorporate any recommended measures to improve the environmental performance of the development.*

REPORTING AND AUDITING

Incident Notification

D9. The Applicant must immediately notify the Department and any other relevant agencies immediately after it becomes aware of an incident. The notification must be in writing through the Department's Major Projects Website and identify the development (including the development application number and name) and set out the location and nature of the incident.

Non-Compliance Notification

D10. Within seven days of becoming aware of a non-compliance, the Applicant must notify the Department of the non-compliance. The notification must be in writing through the Department's Major Projects Website and identify the development (including the development application number and name), set out the condition of this consent that the development is non-compliant with, why it does not comply and the reasons for the non-compliance (if known) and what actions have been, or will be, undertaken to address the non-compliance.

Note*: A non-compliance which has been notified as an incident does not need to also be notified as a non-compliance.*

Annual Review

D11. By the end of July each year after the commencement of development, or other timeframe agreed by the Planning Secretary, a report must be submitted to the Department reviewing the environmental performance of the development, to the satisfaction of the Planning Secretary. This review must:

(a) describe the development (including any rehabilitation) that was carried out in the previous financial year, and the development that is proposed to be carried out over the current financial year;

(b) include a comprehensive review of the monitoring results and complaints records of the development over the previous financial year, including a comparison of these results against the:

(i) relevant statutory requirements, limits or performance measures/criteria;

(ii) requirements of any plan or program required under this consent;

(iii) monitoring results of previous years; and

(iv) relevant predictions in the document/s listed in condition A2(c);

(c) identify any non-compliance or incident which occurred in the previous financial year, and describe what actions were (or are being) taken to rectify the non-compliance and avoid reoccurrence;

(d) evaluate and report on:

(i) the effectiveness of the noise and air quality management systems; and

(ii) compliance with the performance measures, criteria and operating conditions of this consent;

(e) identify any trends in the monitoring data over the life of the development;

(f) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and

(g) describe what measures will be implemented over the next financial year to improve the environmental performance of the development.

D12. Copies of the Annual Review must be submitted to Council and made available to the CCC and any interested person upon request.

Independent Environmental Audit

D13. Within one year of commencement of development under this consent, and every three years after, unless the Planning Secretary directs otherwise, the Applicant must commission and pay the full cost of an Independent Environmental Audit of the development. The audit must:

(a) be led by a suitably qualified, experienced and independent auditor whose appointment has been endorsed by the Planning Secretary;

(b) be conducted by a suitably qualified, experienced and independent team of experts (including any expert in field/s specified by the Planning Secretary) whose appointment has been endorsed by the Planning Secretary;

(c) be carried out in consultation with the relevant agencies and the CCC;

(d) assess the environmental performance of the development and whether it is complying with the relevant requirements in this consent, water licences and mining leases for the development (including any assessment, strategy, plan or program required under these approvals);

(e) review the adequacy of any approved strategy, plan or program required under the abovementioned approvals and this consent;

(f) recommend appropriate measures or actions to improve the environmental performance of the development and any assessment, strategy, plan or program required under the abovementioned approvals and this consent; and

(g) be conducted and reported to the satisfaction of the Planning Secretary.

D14. Within three months of commencing an Independent Environmental Audit, or other timeframe agreed by the Planning Secretary, the Applicant must submit a copy of the audit report to the Planning Secretary, and any other NSW agency that requests it, together with its response to any recommendations contained in the audit report, and a timetable for the implementation of the recommendations. The recommendations must be implemented to the satisfaction of the Planning Secretary.

Monitoring and Environmental Audits

D15. Any condition of this consent that requires the carrying out of monitoring or an environmental audit, whether directly or by way of a plan, strategy or program, is taken to be a condition requiring monitoring or an environmental audit under Division 9.4 of Part 9 of the EP&A Act. This includes conditions in respect of incident notification, reporting and response, non-compliance notification, compliance report and independent audit.

For the purposes of this condition, as set out in the EP&A Act, “monitoring” is monitoring of the development to provide data on compliance with the consent or on the environmental impact of the development, and an “environmental audit” is a periodic or particular documented evaluation of the development to provide information on compliance with the consent or the environmental management or impact of the development.

D16. Noise, blast and/or air quality monitoring under this consent may be undertaken at suitable representative monitoring locations instead of at privately-owned residences or other locations listed in Part B, providing that these representative monitoring locations are set out in the respective management plan/s.

ACCESS TO INFORMATION

D17. Before the commencement of development under this consent until the completion of all rehabilitation required under this consent, the Applicant must:

(a) make the following information and documents (as they are obtained, approved or as otherwise stipulated within the conditions of this consent) publicly available on its website:

(i) the documents listed in condition A2(c);

(ii) all current statutory approvals for the development;

(iii) all approved strategies, plans and programs required under the conditions of this consent;

(iv) minutes of CCC meetings;

(v) regular reporting on the environmental performance of the development in accordance with the reporting requirements in any plans or programs approved under the conditions of this consent;

(vi) a comprehensive summary of the monitoring results of the development, reported in accordance with the specifications in any conditions of this consent, or any approved plans and programs;

(vii) a summary of the current phase and progress of the development;

(viii) contact details to enquire about the development or to make a complaint;

(ix) a complaints register, updated monthly;

(x) the Annual Reviews of the development;

(xi) audit reports prepared as part of any Independent Environmental Audit of the development and the Applicant's response to the recommendations in any audit report; and

(xii) any other matter required by the Planning Secretary; and

(b) keep such information up to date, to the satisfaction of the Planning Secretary.

APPENDIX 1 SCHEDULE OF LAND

Lot	DP	Tenure	Landowner
1	1124189	Freehold	Boral Cement Limited
2	1124189	Freehold	Boral Cement Limited
12	881240	Freehold	Boral Resources (NSW) Pty Ltd
23	867667	Freehold	Boral Resources (NSW) Pty Ltd
3	203290	Freehold	Boral Resources (NSW) Pty Ltd
4	203290	Freehold	Boral Resources (NSW) Pty Ltd
282	750029	Crown	Crown Land
24	867667	Freehold	Boral Resources (NSW) Pty Ltd
22	867667	Freehold	Boral Limited
1	261615	Freehold	Boral Cement Limited
1	860561	Freehold	Boral Cement Limited
2	860561	Freehold	Boral Cement Limited
1	106569	Freehold	Boral Cement Limited
2	527500	Freehold	Boral Cement Limited
1	527500	Freehold	Boral Cement Limited
2	106569	Freehold	Boral Cement Limited
100	1064794	Freehold	Boral Cement Limited
12	570616	Freehold	Boral Resources (NSW) Pty Ltd
16	111641	Freehold	Boral Cement Limited
14	111641	Freehold	Boral Cement Limited
15	111641	Freehold	Boral Cement Limited
7	111641	Freehold	Boral Cement Limited
6	111641	Freehold	Boral Cement Limited
111	830458	Freehold	Boral Resources (NSW) Pty Ltd
114	830458	Freehold	Boral Limited
112	830458	Freehold	Boral Cement Limited
113	830458	Freehold	Boral Cement Limited
2	1186554	Freehold	Boral Cement Limited
1	617992	Freehold	Boral Cement Limited
9	111645	Freehold	Boral Cement Limited
1	132244	Freehold	Boral Cement Limited
2	132244	Freehold	Boral Cement Limited
3	106569	Freehold	Boral Cement Limited
3	527501	Freehold	Boral Cement Limited
4	106569	Freehold	Boral Cement Limited
21	657523	Freehold	Boral Resources (NSW) Pty Ltd
3	617992	Freehold	Boral Cement Limited
114	750029	Freehold	Boral Cement Limited
82	750029	Freehold	Boral Cement Limited
32	750029	Freehold	Boral Cement Limited
7300	1149129	Crown	Crown Land
165	750029	Freehold	Boral Cement Limited
193	750029	Freehold	Boral Cement Limited
115	750029	Freehold	Boral Cement Limited
131	750029	Freehold	Boral Cement Limited
154	750029	Freehold	Boral Cement Limited
186	750029	Freehold	Boral Cement Limited
179	750029	Freehold	Boral Cement Limited
156	750029	Freehold	Boral Cement Limited
197	750029	Freehold	Boral Cement Limited
83	750029	Freehold	Boral Cement Limited
155	750029	Freehold	Boral Cement Limited
87	750029	Freehold	Boral Cement Limited
1701	610507	Freehold	Boral Cement Limited
1702	610507	Freehold	Boral Cement Limited
98	750029	Crown	Crown Land
187	750029	Freehold	Boral Cement Limited
191	750029	Freehold	Boral Cement Limited
7302	1149129	Crown	Crown Land
7301	1149129	Crown	Crown Land
7303	1149129	Crown	Crown Land

APPENDIX 2 DEVELOPMENT LAYOUT PLANS

Figure 4.10
The Project

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
ENVIRONMENTAL IMPACT STATEMENT

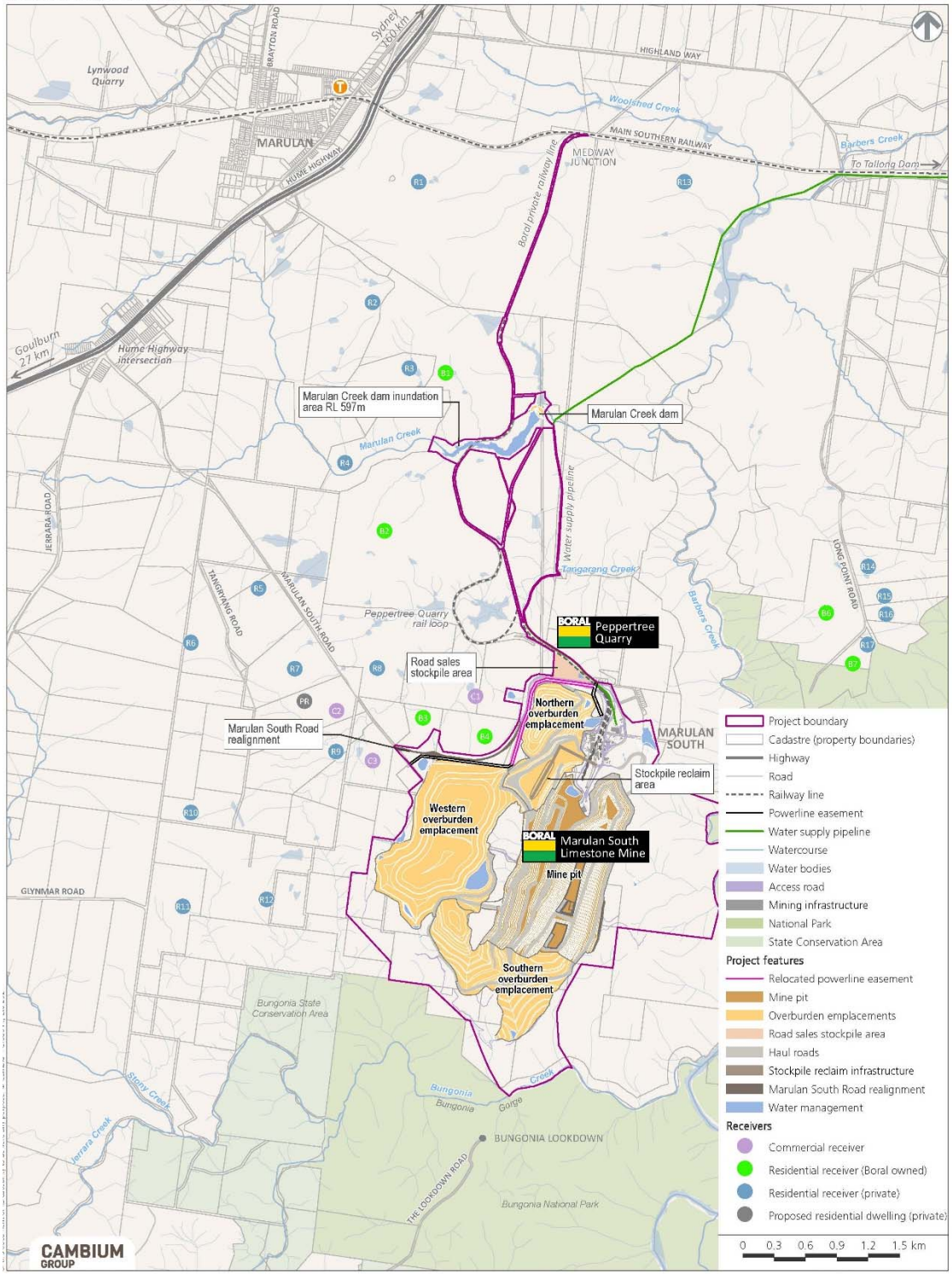


Figure 1: *Development Layout Plan*

Figure 4.11
The Project (Marulan Creek Dam)

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
SURFACE WATER ASSESSMENT

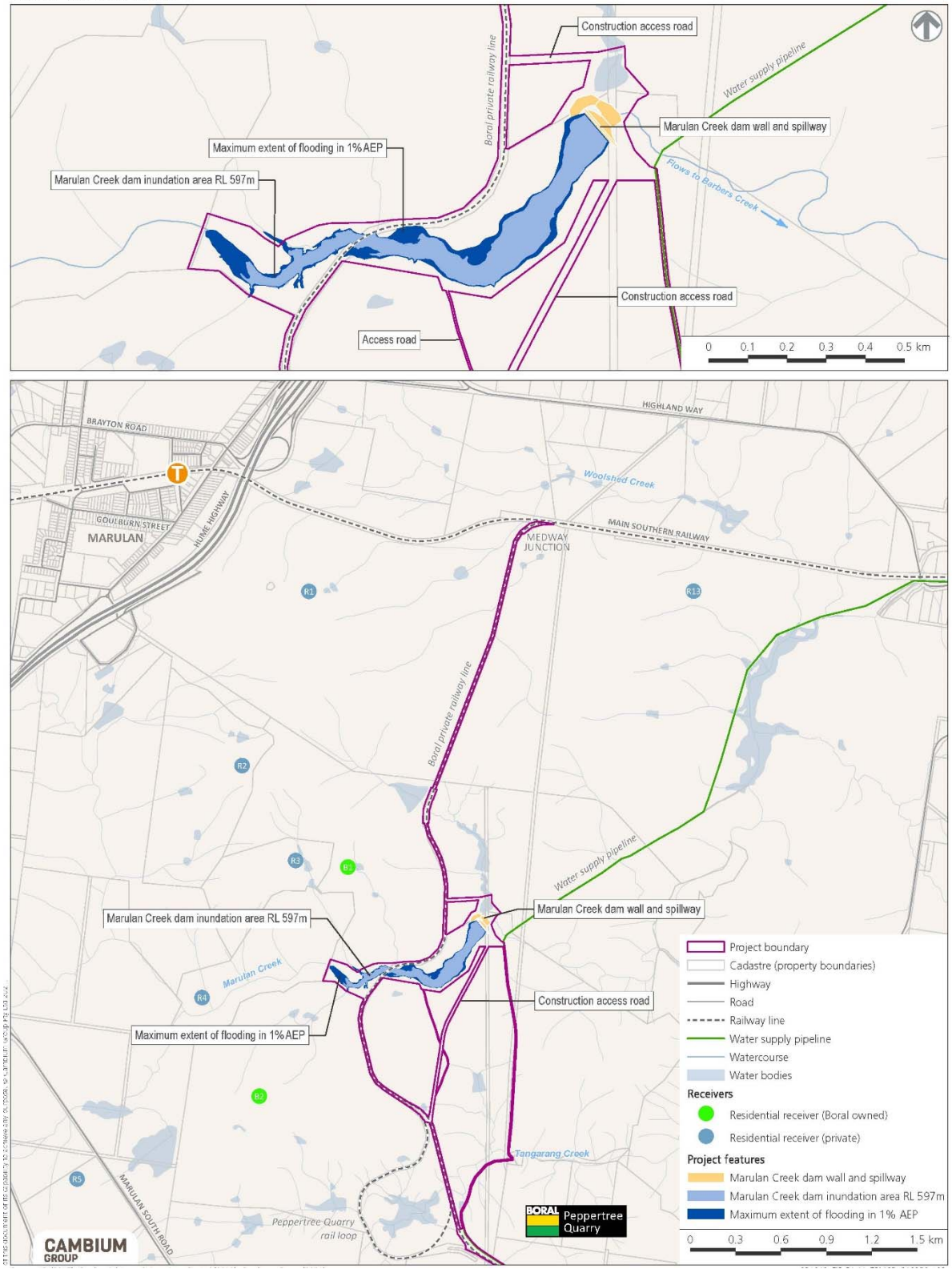


Figure 2: *Marulan Creek Dam Layout*

APPENDIX 3 RECEIVER LOCATIONS

Figure 2.9
Land ownership

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
ENVIRONMENTAL IMPACT STATEMENT

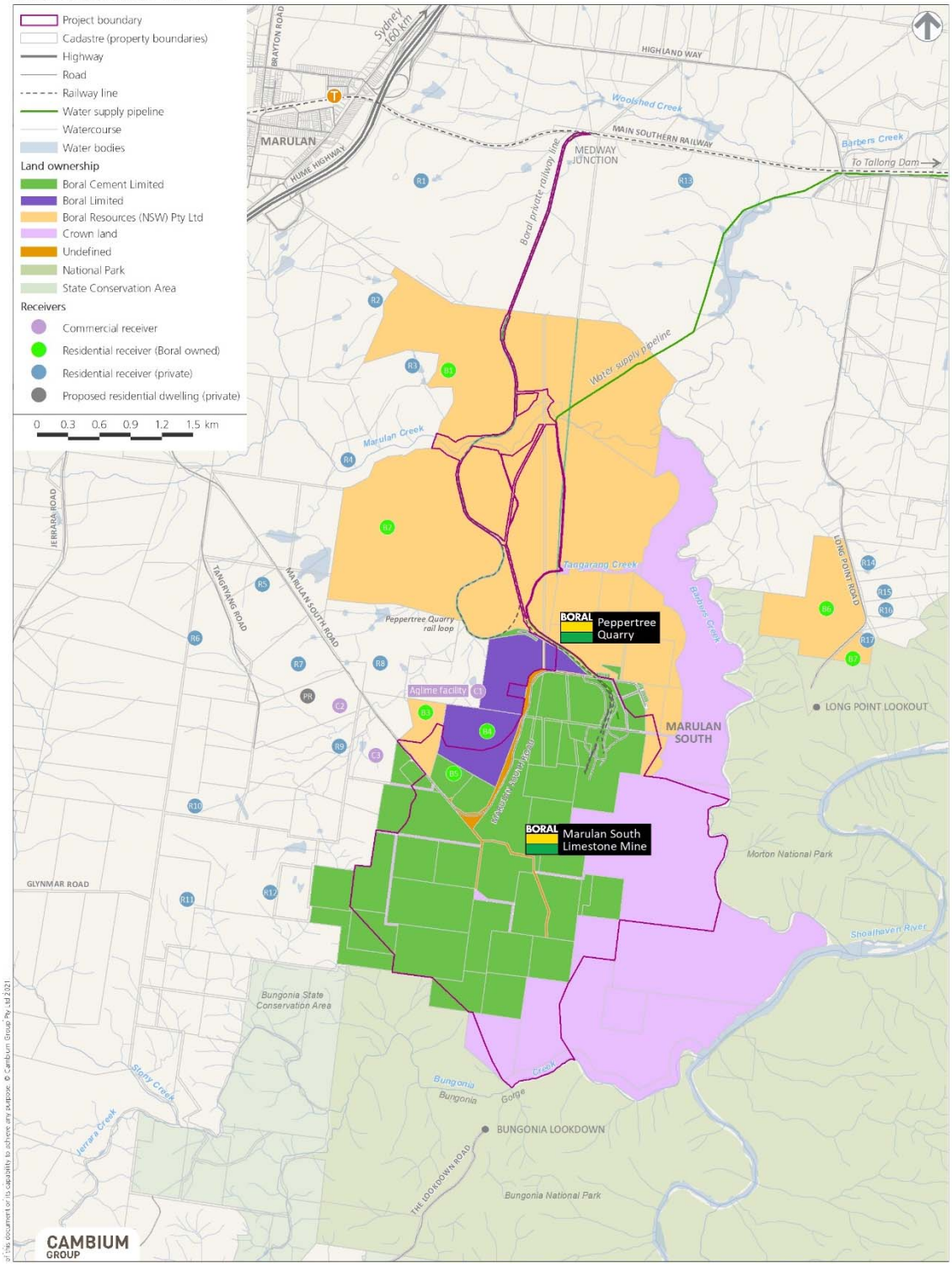


Figure 3: *Receiver Locations*

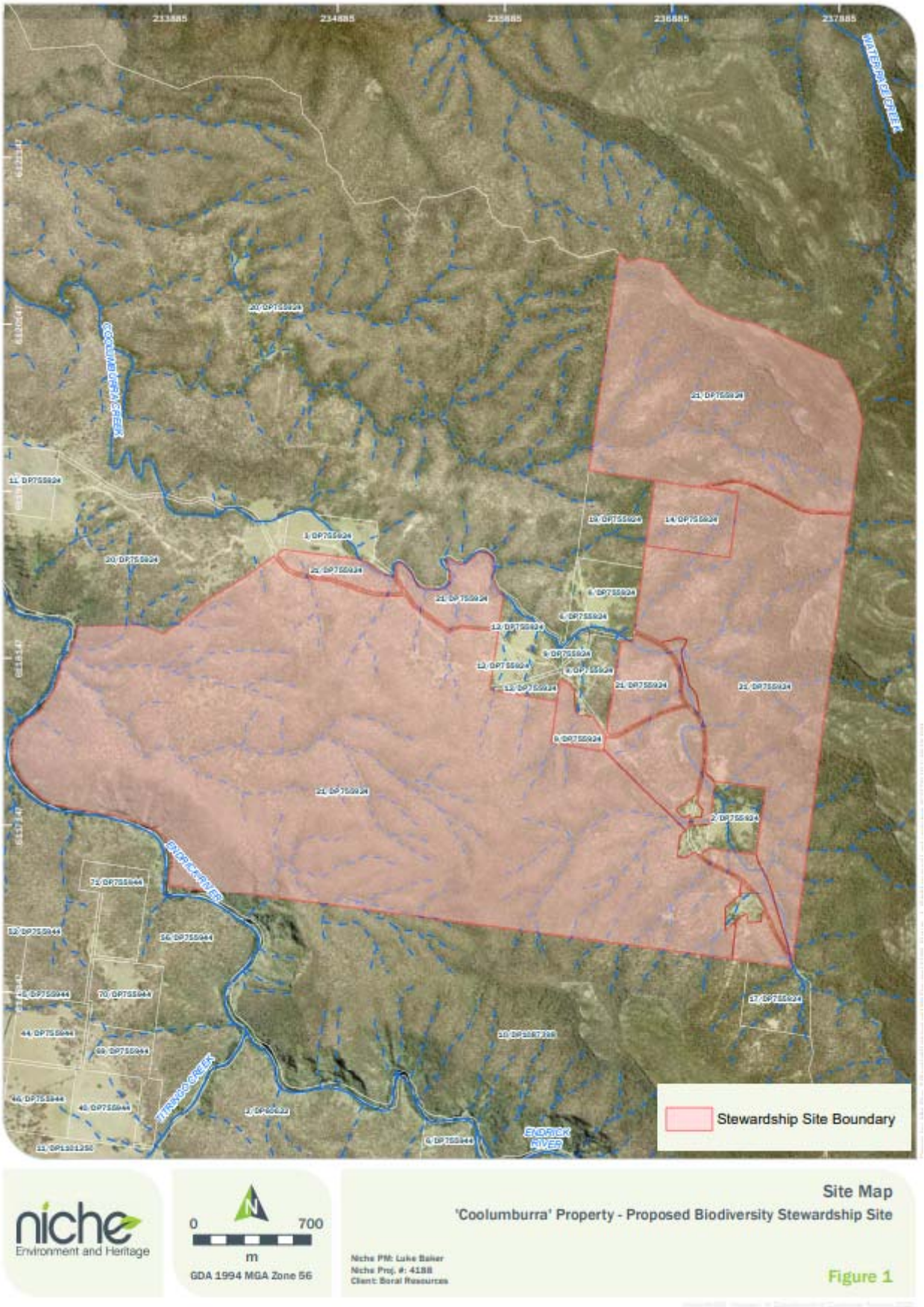


Figure 4: *Biodiversity offset area*

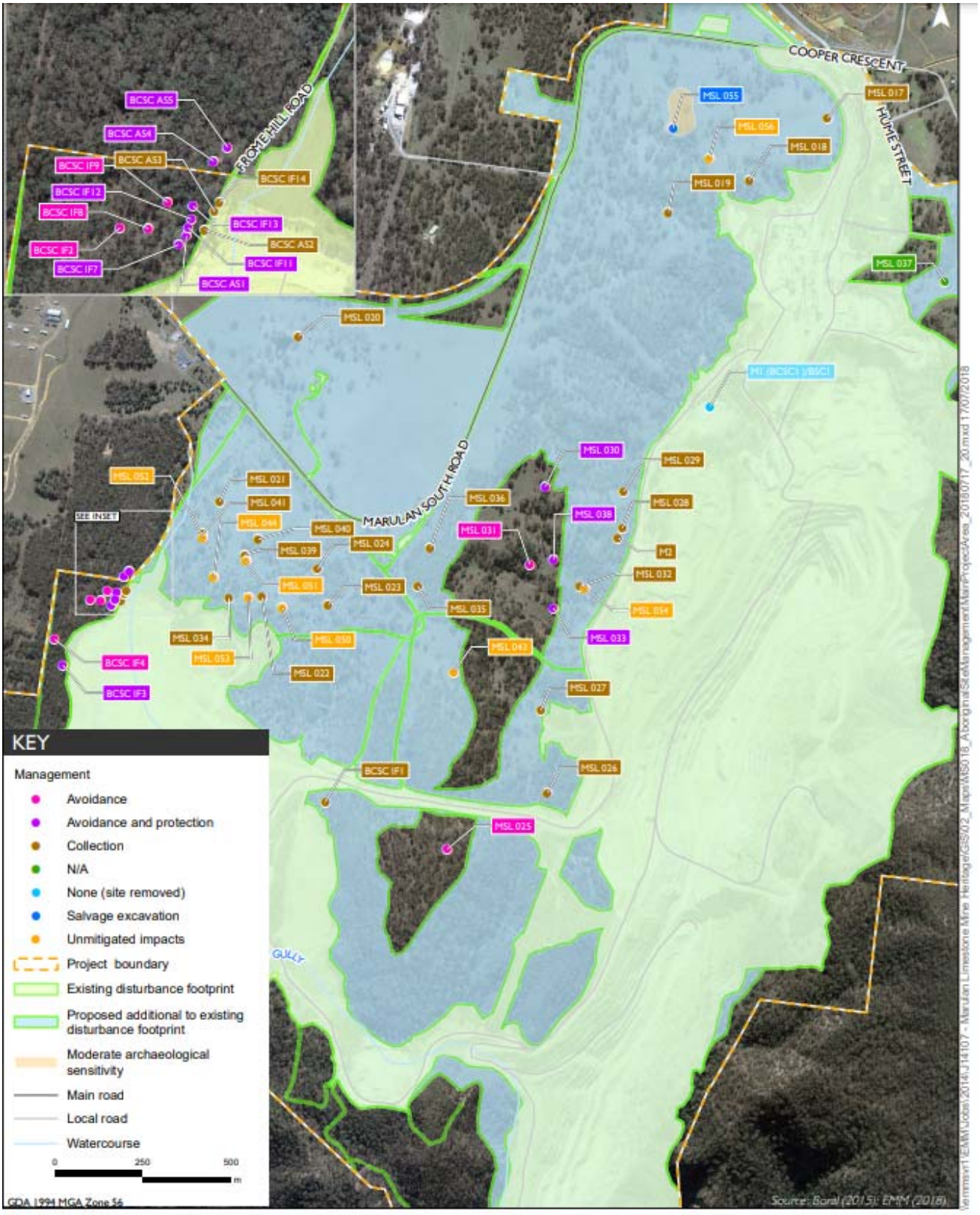


Figure 5: *Aboriginal Heritage Sites*

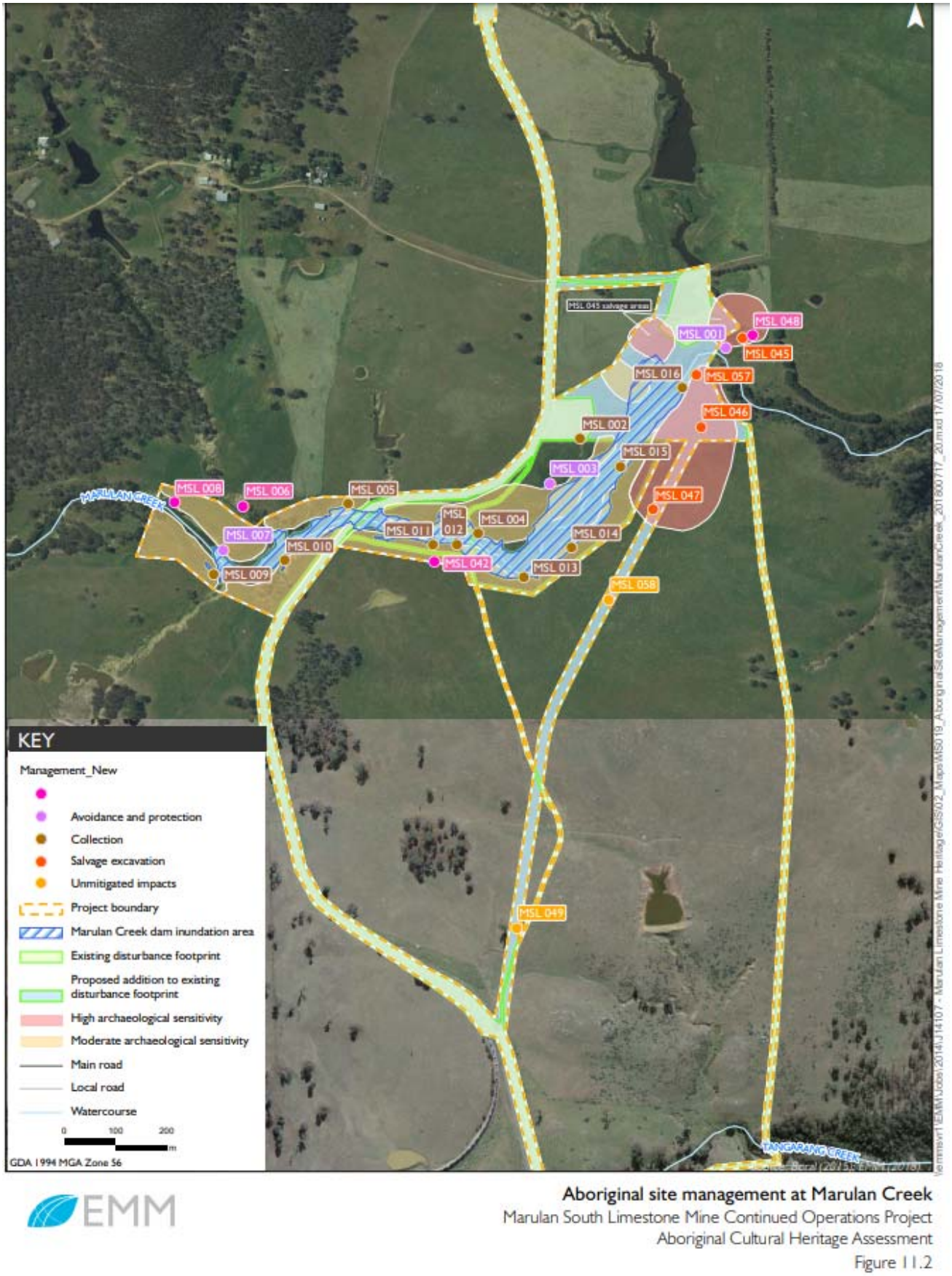


Figure 6: *Aboriginal Heritage Sites (Marulan Creek Dam)*

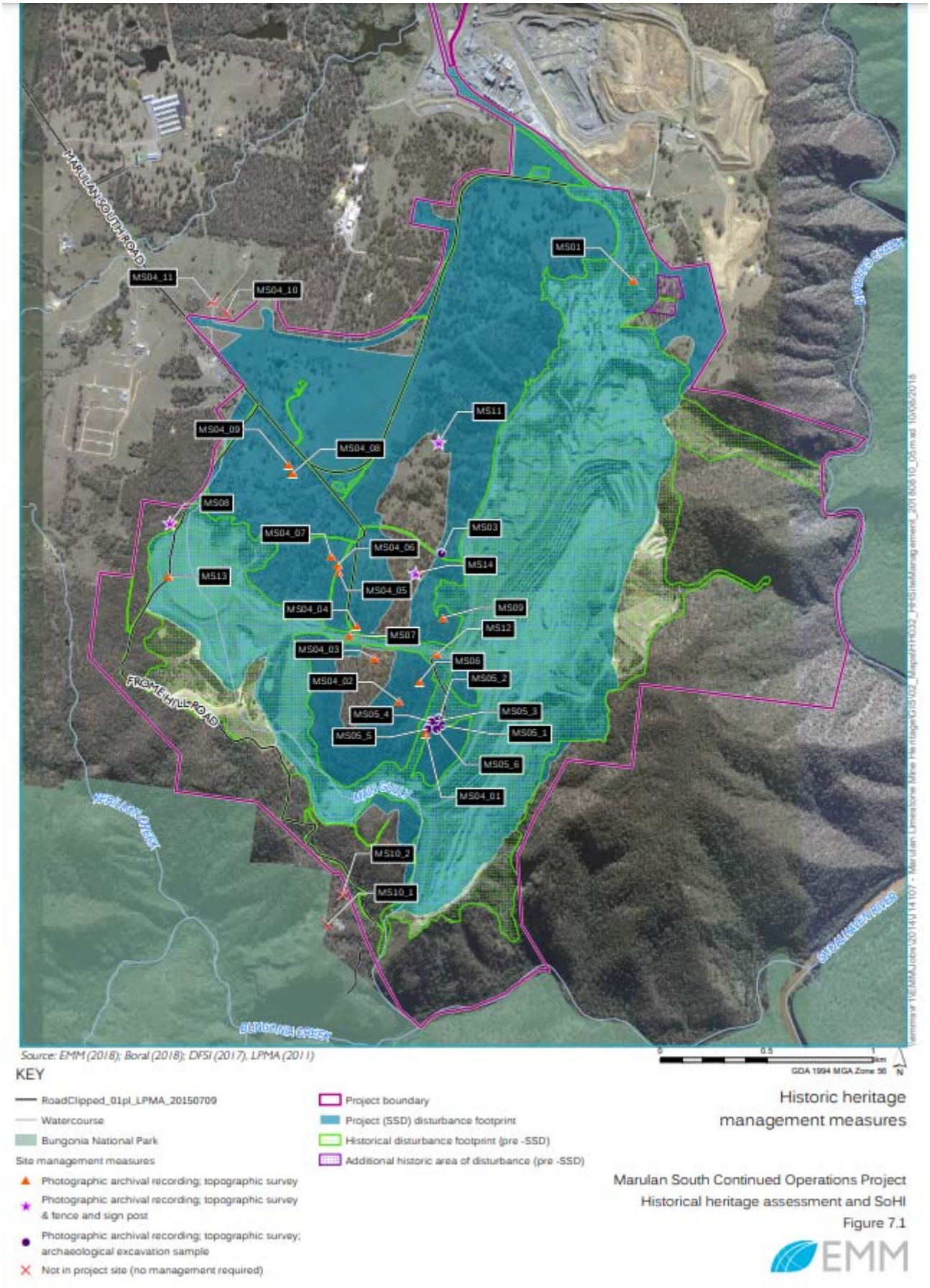


Figure 7: *Historic Heritage Sites*

APPENDIX 6 REHABILITATION PLANS

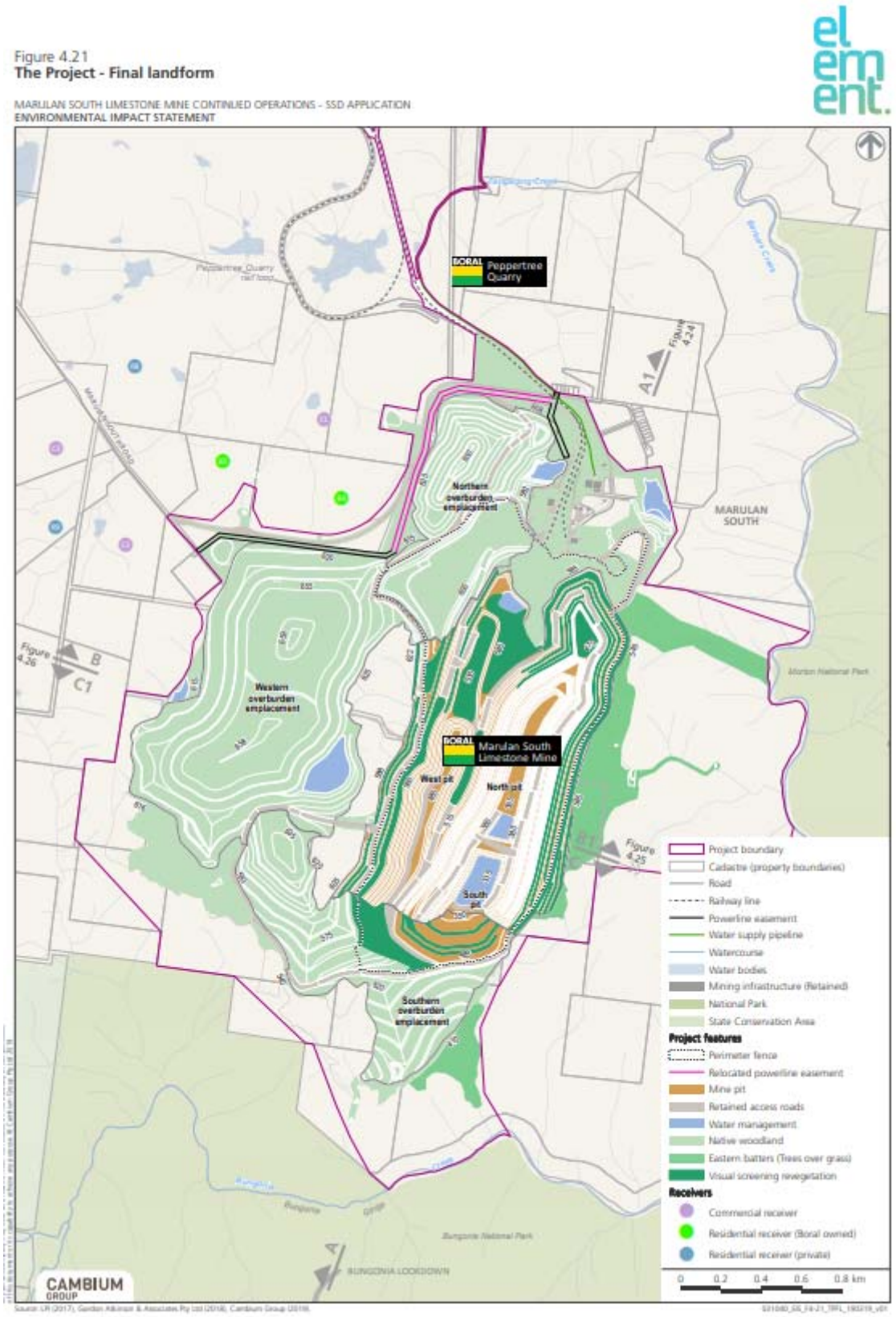


Figure 8: *Conceptual Final Landform*

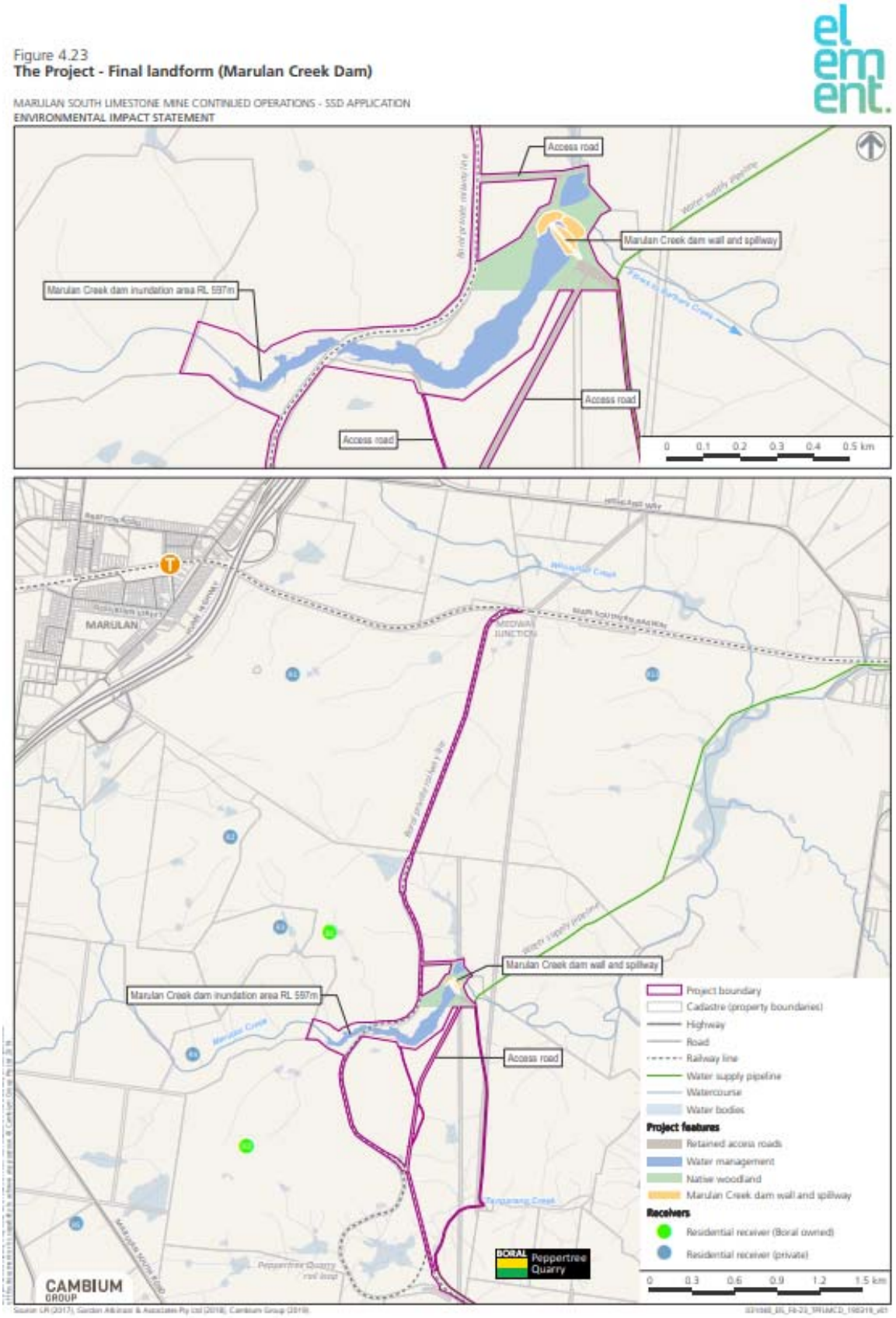


Figure 9: *Conceptual Final Landform (Marulan Creek Dam)*

APPENDIX C - Ecosystem Function Analysis

Marulan South Limestone Mine

Ecosystem Function Analysis
Rehabilitation Monitoring

January 2023

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1. INTRODUCTION

1.1 Background

Boral's Marulan South Limestone Mine (the Mine) has been operational since the 1830s, consisting of a limestone mine and processing plant. It is located directly to the north of Bungonia Gorge and approximately 35km east of Goulburn NSW, with lands covering 650 hectares of a significant limestone and granodiorite deposit. Resources over a total of 616.5 hectares of land are to be extracted under current approvals.

In accordance with the 2018-2023 Mining Operations Plan (MOP) the Mine has committed to progressive rehabilitation of identified disturbed land as part of the Progressive Rehabilitation Strategy. The strategy centres on completed slopes of the waste emplacements and external batters of the mining area. These are shaped according to the final landform design, top dressed, contour ripped and sown. Soil testing and characterisation is undertaken to determine any amelioration needed while sowing time is generally governed by available soil moisture.

International Environmental Consultants has been engaged by Boral to undertake a rehabilitation monitoring program at the Mine based on the CSIRO developed Ecosystem Function Analysis (EFA) method (Tongway & Hindley, 2004). The method assesses a variety of soil and vegetation-based parameters which are assigned numeric values that are converted into percentages indicating ecosystem functionality. Over time, these percentages can be compared to control sites to indicate if the rehabilitation is progressing toward the desired self-sustaining ecosystem.

1.2 Objectives

1.2.1 Rehabilitation Strategy

The key rehabilitation goal discussed in the Rehabilitation Strategy is to "re-establish vegetation on the disturbed areas (excluding the voids) to as closely as practical to represent the pre-mining vegetation communities". The three main rehabilitation objectives of the strategy are:

- Achievement of acceptable post-disturbance land use suitability: to create a stable landform with land use capability and/or suitability similar to that prior to disturbance, unless other beneficial land uses are pre-determined and agreed. This is achieved by setting clear rehabilitation success criteria and outlining the monitoring requirements that assess whether or not these criteria are being accomplished.
- Creation of stable post-disturbance landform: disturbed land will be rehabilitated to a condition that is self-sustaining or one where maintenance requirements are consistent with the agreed post-mining land use(s).
- Preservation of downstream water quality: surface and groundwater that leave the mining leases are not degraded to a significant extent. Current and future water quality will be maintained at levels that are acceptable for users downstream of the site.

Rehabilitation progression at the Mine is identified in Domain 4 and in Domain 7 as detailed in the 2018-2023 MOP and comprise the southern slopes of the western overburden emplacement and the eastern batter areas including the former Bryce's Gully to the north, Barber's Creek (central) and the south-eastern batters of the southern pit.

The majority of the Marulan South Limestone Mine is an active mining and mineral processing site with associated infrastructure and mine related disturbance. Rehabilitation and rehabilitation maintenance activities will continue within Domains 4 and 7 progressing in the overburden emplacement domain, Domain 4 from landform establishment through to ecosystem and land use establishment.

1.2.2 Ecosystem Function Analysis

An EFA survey will be conducted bi-annually to monitor rehabilitation progression at the South Marulan Mine as a means for determining if the required rehabilitation objectives are being met. Accurate and detailed site records incorporating EFA will be maintained for future reference and to provide a benchmark for evaluating the success of the rehabilitation works. EFA methods will provide the necessary records and assessment of the vegetation community health, structure, natural succession and species diversity. The objectives of this monitoring program are to:

- Track the progress of rehabilitation works using measurable ecosystem function scores to identify trends and identify success and failures;
- Identify rehabilitation programs or areas that are failing or under-achieving at an early stage, so that prompt remedial actions can be undertaken, and to provide information to guide subsequent rehabilitation works within the site; and
- Predict when rehabilitated land has become stable with self-sustaining ecosystems, such that ongoing management can cease.

The progressive indicator measurements are compared against a Rehabilitation Success Criteria to ascertain if rehabilitation objectives are being met. The nominated success criteria for the rehabilitation areas on the site have been determined based on the proposed final land use of woodland and grassland ecosystems, as presented in Table 1 below.

1.2.3 Success Criteria

The progressive indicator measurements are compared against the success criteria to ascertain if rehabilitation objectives are being met. The Project Site's success criteria (or closure criteria) for the rehabilitation areas on the site have been determined based on the proposed final land use of woodland / grassland mosaic. These have been re-produced in Table 1.1.

Table 1.1- Rehabilitation Success Criteria

Rehabilitation Element	Indicator	Criteria
Topsoil	Nutrient Cycling	Nutrient accumulation and recycling processes are occurring showing the presence of a litter layer, mycorrhizae and/or other microsymbionts. Adequate macro and micro-nutrients are present.
Vegetation	Land Use	Area remains as healthy native woodland or a sustainable grazing pasture.
	Surface Cover	Minimum of 70% vegetative cover is present (or 50% if rocks, logs or other features of cover are present). No bare surfaces >20 m2 in area or >10 m in length down slope.
	Species Composition	Subject to proposed land use, comprise a mixture of native trees, shrubs and grasses representative of regionally occurring woodland where possible OR palatable, nutritious pasture grass species are present.
	Resilience to Disturbance	Established species survive and/or regenerate after disturbance. Weeds do not dominate native species after disturbance or after rain. Pests do not occur in substantial numbers or visibly affect the development of native plant species.
	Sustainability	Species are capable of flowering and setting viable seed. Evidence of second-generation shrub and understorey species. Vegetation develops and maintains a litter layer as a consistent mass and depth of litter over subsequent seasons. More than 75% of shrubs and/or trees are healthy when ranked healthy, sick or dead.

2. ECOSYSTEM FUNCTION ANALYSIS (EFA)

2.1 Overview

The Ecosystem Function Analysis method is a rapid visual field assessment of a range of indicators (such as litter cover, bare ground, vegetative cover, vegetation height, floristic diversity, etc) to assess the biogeochemical functioning of landscapes. These features reflect the ability of the ecosystem to uptake, retain and recycle nutrient resources, which indicates the functionality of the ecosystem.

The EFA is based on numerical ratings and percentages which is a robust method to be used for statistical comparisons, allowing the function of the site to be tracked over time. This also enables the site to be compared to a reference site of an extant ecosystem. Comparisons can indicate if rehabilitation works are satisfactorily progressing an area towards becoming a self-sustaining ecosystem. It will also be possible to predict when an ecosystem has achieved sufficient functionality to become sustainable in the long term.

Analysis of EFA data will inform decisions about ongoing management and maintenance of rehabilitation areas and will identify problem or 'under-performing' areas at an early stage.

The Ecosystem Function Analysis is separated into the following three components which are designed for joint implementation:

- Landscape Function Analysis (LFA) is the original core procedure.
- Vegetation Dynamics – The functional role of vegetation structure and composition.
- Habitat Complexity – An assessment of the development of vertebrate habitat.

2.2 Reference Sites

Assessment of a 'Reference' ecosystem can be used as a useful tool as part of the monitoring program. Normally a reference site is located nearby in a fully functioning ecosystem to represent as close as possible the slope, aspect, soils, and proposed vegetation characteristics of the rehabilitation areas. Unfortunately, the vegetation surrounding the mine site has also suffered from a history of agricultural disturbance and is not truly representative of the original vegetation community that would have been present prior to European settlement.

The reference site chosen has a relatively sparse understory of native plants and a shortage of old growth canopy trees. There is a thick layer of leaf litter on the soil surface and a moderate canopy predominantly of Eucalyptus species. The midstorey is open, with a scatter of native shrubs which are dominated by *Olearia viscidula*. This site has been described as being Brittle Gum Stringybark Forest.

The reference site provides helpful data for the LFA component of this study, although improved vegetation dynamics would be expected for the rehabilitated sites.

2.3 Landscape Function Analysis (LFA)

Landscape function refers to the ability of the biophysical landscape to capture and retain resources such as soil, water and nutrients. Landscapes with a higher functional value can capture and conserve resources to be used within the system.

2.3.1 Landscape Organisation Index

The landscape organisation index (LOI) records data for a site along a 50m long transect running directly downslope in the direction of water flow, which is used as a representative of the site. The transect is marked with stakes and the same line is used on each monitoring occasion.

A continuous record of the patch and interpatch lengths, widths and types is recorded along the transect. A patch can be defined as a long-lived feature in which resources tend to accumulate. Patch types can include grass swards, rocks > 10 cm, or tree branches in contact with the soil. The term interpatch refers to the bare ground between patches, where the resources flow more freely and can be lost.

The Landscape Organisation index is then recorded by dividing the length of patches by the length of the transect (50m).

2.3.2 Soil Surface Assessment (SSA)

The quality of patch and interpatch types are measured by a Soil Surface Assessment. The following eleven soil surface assessment indicators are tested at each patch/ interpatch type:

1. Rain splash Protection- is an assessment of the amount of physical surface and plant cover to prevent the effect of raindrops impacting the soil. This indicator relates to the Stability Index.
2. Perennial Vegetation Cover- is an estimation of the basal cover of perennial grass and canopy cover of shrubs and trees. This indicates the below-ground biomass and its contribution to nutrient cycling and water infiltration.
3. Litter Cover- The percent of cover litter and depth (when 100% cover) is assessed and relates to the nutrient cycling index. The origin of the litter is then classed as local or transported, and the degree of decomposition/incorporation is classed as nil, slight, moderate or extensive.
4. Cryptogram Cover- refers to the percentage cover of algae, fungi, lichen, moss and liverworts. This indicator relates to both soil stability and nutrient cycling.
5. Crust brokenness- is ranked as a class 0 to 4. A broken crust is more available for erosion.
6. Soil Erosion Type and Severity- is a measure of the type and severity of recent soil loss. Erosion present can be classed as rills/gullies, terracettes, sheeting, scalding or pedestalling.
7. Deposited Materials- is a measure of the amount and type of recently transported material deposited. This can include litter, soil and gravel and is an indicator of soil stability.

8. Soil Surface Roughness- allows for the soil to capture and retain resources such as water, propagules, topsoil and organic matter which is linked to infiltration and nutrient cycling.
9. Surface Resistance to Disturbance– measured by mechanically disturbing the soil to observe the ease of disturbance. This shows the ease of release of erodible material.
10. Slake Test- assesses the stability of soil fragments to rapid wetting. Stable soil fragments will maintain cohesion when wet.
11. Soil Texture- is classified as a combination of silt, clay and loam which is related to permeability and thus infiltration.

A detailed methodology of the soil surface assessment indicators is provided in the LFA Manual (Tongway and Hindley, 2004). The soil surface indicators are all classed as ranks, which are used to calculate the three key landscape function indices, being stability, infiltration and nutrient cycling.

2.4 Vegetation Composition and Dynamics

Vegetation is crucial for habitat, food and shelter for native fauna, and plays a functional role in the control and cycling of resources. Similar to the LFA, the vegetation dynamics is assessed using numerical values, often percentages, for ease of comparison and statistical analyses.

Vegetation data is recorded using the same transects as the LFA. A grid is formed by spacing 2m each side of the transect at 5m intervals, making a total of ten 4x5m quadrants. Within each quadrant, a $1m^2$ grid is used in the top left and bottom right corner to calculate the following:

- % cover of combined lower stratum vegetation (all plants with height < 0.5m);
- % cover of combined lower stratum vegetation (all plants with height 0.5m-1.0m);
- % cover of litter; and
- % cover of bare ground.

2.4.1 Lower Stratum

The lower stratum is defined as 0 to 1m from ground level. Within each quadrant, the following lower stratum data is recorded:

- Inventory of all species;
- List key species; and
- Growth type (annual/perennial) of all species.

2.4.2 Middle and Upper Strata

The middle stratum is defined as 1 to 3m from ground level, and the upper stratum is defined as above 3m. These two vegetation levels will be combined during the EFA. The following parameters is recorded in each quadrant to provide an estimate of the canopy cover, height and composition of the transect:

- Record of all species present;
- Count stem densities per species;
- Canopy cover presence/absence, and if present
  - Species contribution; and
  - Mid or upper stratum.

2.5 Habitat Complexity

The Habitat Complexity module surveys the extent of available niches (habitat and shelter) for various vertebrate fauna. The greater the diversity, or complexity of habitat, the greater the range of fauna species likely to utilise the habitat, and the greater the robustness of the ecosystem. Habitat complexity is scored from 0 to 3 on the following five features:

- Canopy Cover;
- Shrub Cover;
- Ground Vegetation Cover;
- Amount of litter, fallen logs, rocks; and
- Free water availability

The area assessed is 10 to 20m in radius based on sight distance, centred at the middle of the 50m transect used for the LFA and Vegetation Dynamics. The total score of the five features indicates the final Habitat Complexity Score which can be compared across sites and time.

3. PHOTOGRAPHIC MONITORING

Photographic monitoring is recorded during each survey at the beginning of each transect. The photo is taken from the same position, with the camera leaning on the top of the star picket looking down the transect at a ground to sky ratio of 5:1. This enables visual comparisons to be made across survey periods. Photos of each patch-interpatch type is also be recorded to allow for consistency of descriptions over time.

The photographic record for each site is provided below.

3.1 Photographic Record Site 1

July 2020

Monitoring of Site 1 was discontinued in April 2021 due to the proposed expansion of the Western Overburden Emplacement.

3.2 Photographic Record Site 2

July 2020

April 2021

December 2021

May 2022

January 2023

3.3 Photographic Record Site 3

July 2020

April 2021

December 2021

May 2022

January 2023

3.4 Photographic Record Site 4

July 2020

April 2021

December 2021

May 2022

January 2023

3.5 Photographic Record Site 5

April 2021

December 2021

May 2022

January 2023

3.6 Photographic Record Reference Site

July 2020

April 2021

December 2021

May 2022

January 2023

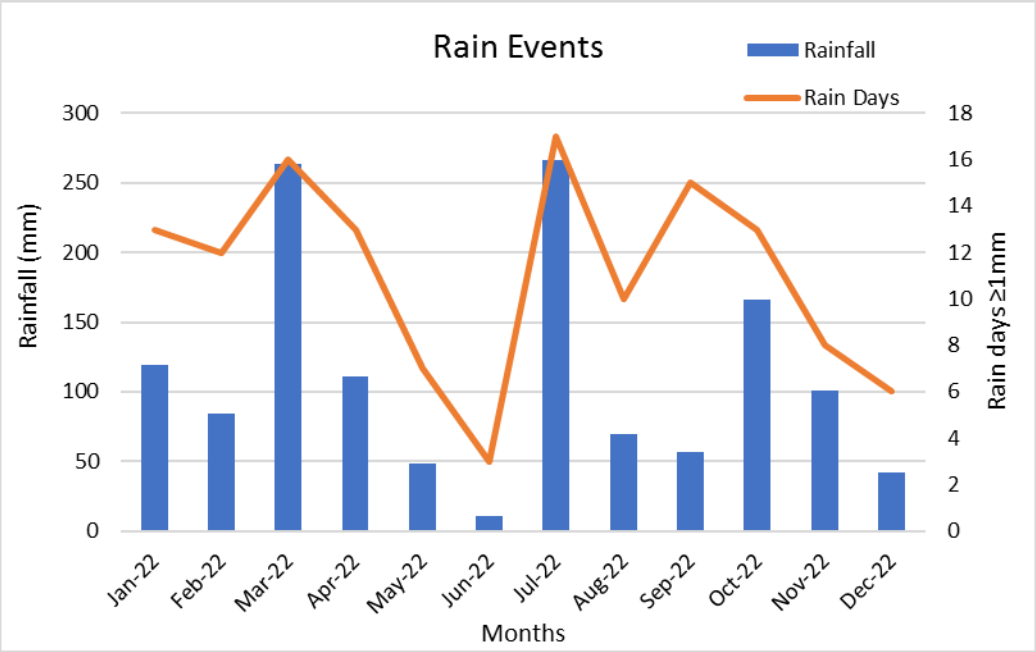
4. RESULTS AND DATA ANALYSIS

4.1 Geographic Setting

The Marulan South Limestone Mine has been operational since the 1830s, consisting of a limestone mine and processing plant. It is located directly to the north of Bungonia Gorge and approximately 35km east of Goulburn NSW, with lands covering 650 hectares of a significant limestone and granodiorite deposit. The site is characterised into two key vegetation communities namely, native Brittle Gum Stringybark Forest located to the west, and Coastal Grey Box Forest Red Gum Woodland situated to the east.

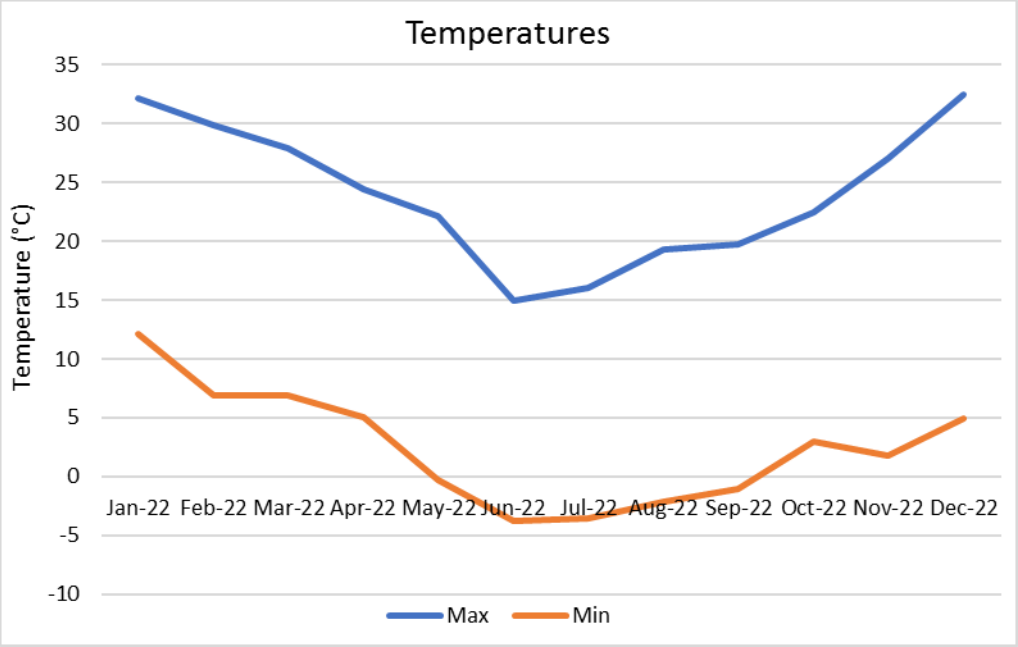
4.2 Weather

Weather data is obtained from the Marulan South Meteorological Station. Annual rainfall data is presented in Graph 1. The site is located in Australia's cool, temperate climatic region. The site received total of 1340mm of rain over the 12-month period with 133 rain days. The total rainfall was higher than that received in the previous calendar year 2021 with 21 additional rain days and an excess of 438mm rainfall. Rainfall was highest during July 2022 with 266.5mm of rain and was the lowest in June 2022 with 11mm over 3 rain days. The number of rain days ranged from 3-17 days per month.



Graph 1- Monthly rainfall and number of rain days

Temperatures were hottest in Summer months with the highest maximum of 32.5°C in December 2022 and were coldest during the winter months with a lowest minimum of -3.8°C in June 2022 (Graph 2). The average maximum and minimum temperatures for the reporting period were 24.1°C and 2.5°C respectively, which were similar maximums and minimums than recorded in the previous period.



Graph 2– Monthly Minimum and Maximum Temperatures

4.3 Rehabilitation Monitoring Sites

Below in Table 4.1 is a description of the monitoring locations which are shown in Plan 1.

Table 4.1- Transect Description

Transect	Landscape Position	Comments
Reference 1 (R1)	South-West of the WOE	Has not been disturbed by mining activities
T1	Located at the northern end of the WOE, Domain 4.1w in the 2018-2023 MOP	Monoculture of *acacia* species with juvenile *Eucalypts*. Rehabilitated in 2005 and 2008. Discontinued due to expansion of the west overburden emplacement.
T2	South of the active area within the WOE, Domain 7.1w in the 2018-2023 MOP	Flat ground with groundcover of weed species and older monoculture of *Acacia*. Rehabilitated in 2005.
T3	Far south of the WOE Domain 7.1w in the 2018-2023 MOP	Rehabilitation occurred in 2017. Many *Acacia* with juvenile *Eucalyptus* and *Allocasuarina.* Many weeds present.
T4	Second bench of Bryces Dump Domain 7.3e in the 2018-2023 MOP	Stable slope, high vegetation cover is mostly weeds, moss and dying serrated tussock. Rehabilitated in 2019/2020
T5	WOE - first bench, Domain 4.1w in the 2018-2023 MOP	Transect established April 2021. Rehabilitation trial conducted January 2019. High grass and broadleaf weed density with increased *Acacias* down low.

4.3.1 Site 1

Monitoring of Site 1 was discontinued in April 2021 due to the proposed expansion of the WOE.

4.3.2 Site 2

The transect at Site 2 (T2) is located immediately to the south of the WOE and is directly below the active rehabilitation areas. The site is mainly comprised of very gently inclined to gently inclined land (3-10%) with a stable soil surface and no visible erosion. This rehabilitated zone is approximately 0.85 ha and the transect is positioned in the centre of the area in a NW to SE direction.

Rehabilitation was conducted in 2005, in which the area was sprayed to control weeds and deep ripped prior to direct tree seeding. The seed mix was treated with heat, scarified, dried and mixed with fertiliser before use.

The vegetation can now be described as a monoculture of *Acacia mearnsii* which appear to be heading toward the end of their lifespan, and some older trees had fell over during January 2023. Groundcover is dominated by a dense layer of broadleaf weeds and grasses, particularly *Echium plantagineum* (Paterson's Curse), *Onopordum acanthium* (Scotch Thistle) and *Plantago lanceolata* (Ribwort Plantain).

4.3.3 Site 3

The transect at Site 3 (T3) is positioned on a bank at the far south of the WOE, adjacent to the native woodlands. The transect spans from the dirt road at the top of the bank to the edge of the native woodlands at the bottom. This transect is representative of the rehabilitation conducted on the western overburden emplacement in February 2017. Revegetation was done by direct seeding. This involved hydroseeding using the following mix:

- Mulch Wood fibre cellulose 2 tonnes/ha
- Seed
  - Cover Crop of Rye corn / Jap Millet 35kg/ha
  - Acacia species 7kg/ha
  - Eucalyptus Species 3kg/ha
- Fertilizer Dynamic lifter 250kg/ha
- Binder Envirotack 40kg/ha

Bundles of large fallen logs, bark and other organic material were positioned on the slope to improve habitat complexity. This area is comprised mostly of *A. decurrens* with a scatter of other acacia species, juvenile eucalypts and allocasuarina species. The lower half of the transect down-slope is dominated by weed species, particularly *Hirschfeldia incana* (Shortpod Mustard). Weed cover is slowly taking over the bare patches on the lower half of the site. A small amount of rilling is present although no sediment problems are evident.

4.3.4 Site 4

This site is the only site currently located on the eastern side of the mining area, and therefore will be rehabilitated to a native Coastal Grey Box Forest Red Gum Woodland community. Transect 4 (T4) is located on the first bench of Bryce's Gully in a NE to SW direction. This site is exceptionally steep, with an average incline of 56 to 100% (classed steep to very steep) and benches with a slope range of 32-56% (moderately inclined to steep). The embankments are stable with little sedimentation evident from runoff and clear drainage lines.

Rehabilitation was conducted during the 2019-2020 reporting period. Activities included weed spraying with a focus on *Nassella trichotoma* (Serrated Tussock), direct seeding and tubestock planting on the benches. Tubestock were fenced to prevent grazing and are watered using an irrigation system. Spraying of noxious weeds occurs when required, and hand pulling of weeds competing with the tubestock in the cages is conducted annually. So far approximately 50% of the tubestock have survived although show signs of disease or possible stress from too much water or nutrient deficient. There is good vegetation cover at this site with lots of annual weeds holding the soil together, limited perennial weeds and some native ground covers emerging.

Manual seeding focussed on the drainage lines and gullies in which a mix of the following pasture species were used:

- Japanese Millet
- Ryecorn/Oats
- Rhodes grass
- Couch Grass
- Wimmera Ryegrass
- White Clover
- Lucerne
- Sub Clover

The tubestock species planted included:

- *Lomandra longifolia*
- *Eucalyptus Viminalis*
- *Eucalyptus macrochyncha*
- *Eucalyptus Eugenoides*
- *Eucalyptus melliodora*
- *Eucalyptus bosistoana*
- *Allocasuarina littoralis*

4.3.5 Site 5

The Transect at Site 5 (T5) was established in April 2021 and is situated on the next completed bench to the northwest of Site 2 on the southern side of the WOE. This area was ripped and sprayed with a standard hydro-mulch fibre spray media including sterile ryegrass and couch cover seed mix (see Table 4.2) to improve the soil conditions and enhance the microclimate. No additional topsoil was spread on this area, although a small amount of topsoil may exist from when the site had previously been subject to unsuccessful revegetation efforts. These rehabilitation works were commenced in January 2019.

Currently, the top half of the transect has a dense cover of grass and weed species. The predominant species are *Chloris gayana* (Rhodes Grass) and *Cynodon dactylon* (Couch Grass), and the dominant weeds include *Hirschfeldia incana* (Shortpod Mustard)and *Plantain lanceolata* (Ribwort Plantain). Further downslope in the southern direction, dense *Acacia mearsii* (Black Wattle) are growing up to approximately 3 metres tall. More rehabilitation work

is planned for this site, including planting of native tubestock of a range of Eucalypt and Casuarina species.

A total of three rehabilitation trials have been conducted along this bench, with two additional trials conducted to the west of T5. Work at these two sites was more recently conducted during mid-2020. These sites may be included in the monitoring program once the rehabilitation work progresses in these trials.

The trial site (5b) directly to the west of T5 was ripped in Spring 2020 and treated with a hydro-mulch using *proganics dual* with ryegrass and couch cover seed mix as per Table 2 below. The majority of this area was spread with topsoil some time before the trial, although there is a smaller area to the west where there was no topsoil added.

The furthest trial site (5c) along the bench in a north-west direction was sprayed with hydro-mulch using Flexterra FGM with ryegrass and couch cover seed mix (see Table 4.2) in August 2020. No ripping or topsoil was added to this area. At present, a dense layer of grass and weed cover is maintaining a stable bench to prevent loss of organic matter and moisture.

Table 4.2 Ryegrass and Couch Cover Seed Mix

Seed Type	Species Name	Amount (Weight)
Grasses	Austrodanthonia spp	2kg
	Microlaena stipoides	2kg
	Chloris spp	2kg
	Themeda australis	2kg
Shrubs	Acacia falcata	0.3kg
	Acacia decora	0.5kg
	Acacia decurrens	0.5kg
	Acacia mearnsii	2kg
	Acacia rubida	1kg
	Acacia ulicifolia	0.3kg
	Dodonaea viscosa	1kg
	Hardenbergia violacea	0.5kg
	Indigofera australis	2kg
	Leptospermum obovatum	0.1kg
	Kunzea parvifolium	0.1kg
	Daviesia ulicifolia	0.2kg
Trees	Eucalyptus blakelyii	0.3kg
	Eucalyptus melliodora	0.3kg
	Eucalyptus mannifera	0.3kg
	Eucalyptus viminalis	0.3kg
	Allocasuarina littoralis	0.3kg

4.3.6 Reference Site

The Reference site is situated to the South-West of the WOE. The transect is situated in an ESE to WNW direction. This area has not been disturbed by mining activities, however the quality of this vegetation community has been compromised by an assumed history of disturbance which occurred approximately 25 years ago. This has led to a relatively sparse understory of native plants and a lack of old growth canopy trees. There is a thick layer of leaf litter on the soil surface and a moderate canopy predominantly of Eucalyptus species. The

midstorey is open, with a scatter of native shrubs, predominantly *Olearia viscidula*. This site has been described as being Brittle Gum Stringybark Forest. The site is characteristic of a closed woodland with a sparse shrub layer and dominated by *Eucalypt obliqua.* The site contains a complete layer of litter and provides good ground habitat with logs, branches and very little weeds present. The soil is stable with full organic matter and humic in nature with good ground biology including ants, termites, mushrooms and liches. There is previous evidence of a cooler burning fire on tree bark and evidence of regrowth in the shrub layer. Older large trees are present with hollows suitable for habitat of larger birds and arboreal mammals. No erosion is evident whatsoever at the reference site.

4.4 Landscape Function Analysis

4.4.1 Patch/interpatch Types and Descriptions

Shrub (S) patches ranged up to 1.5m in height and were characteristic of native plant growth. This category also includes native juvenile tubestock.

Weed (W) comprised individual and thickets of exotic species which were not planted during rehabilitation.

Niche (N) patches included fallen logs, piles of bark and debris which can enhance habitat structure.

A Log (L) patch differs from a Niche, as it includes a single log, often partially buried in the soil which has not accumulated additional debris, as in T5.

Patches of moss (M) have been present in T2, T4 and the reference site

Leaf litter (LL) varied from Acacia leaves, Eucalypt leaves, small branches and dead and decomposing tussock grass in T4.

Grass patches (G) were observed at all rehabilitated sites. These patches were often reflective of improved pasture species which had been sown as a cover crop.

Bare ground (BG) is an interpatch type which consists of overburden material. A high composition of rocks is evident and hydro-mulching material has been added to the surface to improve soil structure at some sites.

4.5 Landscape Function Analysis (LFA) Results

Field surveys involved the collection of patch/interpatch and soil surface condition data for each transect. This data is used to calculate the landscape organisation, soil stability, infiltration and nutrient cycling indices. The landscape organisation and soil surface assessments are most useful when compared over time, during subsequent monitoring surveys.

4.5.1 Landscape Organisation Index (LOI)

The summary statistics for the LOI method are presented in Table 4.3. Not every patch type was present in each selected transect site. For example, niche patches were present in Transect 3, although grass patches were not. Niche patches were only present in Transect 3 and the reference site. The reference site had the greatest variety including 6 different patch types in total.

Bare patches were predominantly absent from the transects in January 2023, with no bare patches in T2, and only 1-2 bare patches in T4, T5 and the refence site. Although reduced from 2022, bare patches were still quite prevalent in T3, which accounted for 23% of the landscape. The reduction of bare patches resulted in overall higher Landscape Organisation Indices (LOI) across all sites. The highest possible LOI was calculated for rehabilitated Site 2, closely followed by LOI of 0.98 at Sites 4 and 5. This suggests that these sites represent highly functional landscapes.

The breaking of the drought has resulted in more consistent rainfall and favourable conditions for weed growth. The transects are now typically composed of a higher proportion of weed cover and grasses which minimises the proportion of bare ground to produce a high index. Minor annual herbaceous ground cover weeds are not considered overly concerning as they will not compete with the growth of native plant species, they will add to the organic biomass following their death, and they protect the soil from erosive forces. Increased weed cover has grown following the high rainfall over the past twelve months, further improving the LOI for these sites in January 2023. Perennial weeds or persistent annual weed infestations can however provide a risk to the establishment of native groundcovers and shrubs.

Transect 5 had the largest patch area and patch area index. This is because the areas of grass and weed cover spanned for increased widths, over 10 metres in some cases. Transect 5 has an average of 3.2 patch zones over 10 metres, which was a smaller number of patch zones compared to transects at other rehabilitated sites.

The percentage of weed patches increased at T2, T3 and T4 over the past 6 months. There has also been an increase in leaf litter at sites T2, T4 and T5. Since patches are known to retain resources, a high total patch area (m^2) can indicate that there are large areas within a site which are capable of conserving water, nutrients and soil. Such patches can be called ‘fertile zones’.

The average interpatch length is an important calculation as it represents the distance of unobstructed resource transport as runoff. The average interpatch length declined considerably at all rehabilitated sites over the past six months due to increased herbaceous weed and grass growth.

The average interpatch length was lower than the reference transect at all rehabilitated sites, except for T3. The average interpatch length at the reference site was 0.75 and distances lower than this would imply that the momentum of overland flow is low, and resources will not be transported far out of the site. Shorter interpatches suggests that there are more patches available to capture resources. The shorter interpatch lengths would prevent increased erosive forces.

Table 4.3- Summary of LOI Results

July 2020	**T1**	**T2**	**T3**	**T4**		**Reference**
Patch Zones (number/10m)	12.2	11.6	3.2	8.6		9.0
Number Patch Types	6	3	4	6		6
Total Patch Area (m²)	236.4	45.4	149.3	42.4		176.8
Patch Area Index	0.47	0.09	0.3	0.08		0.35
Mean Interpatch Length (m)	0.97	1.04	2.29	0.83		0.63
Interpatch Range (m)	0.1-7.7	0.1-5.0	0.5-7.0	0.5-1.5		0.3-1.3
Landscape Organisation Index	0.5	0.85	0.36	0.9		0.772
April 2021		**T2**	**T3**	**T4**	**T5**	**Reference**
Patch Zones (number/10m)		5.6	3.2	11.4	6.0	6.4
Number Patch Types		3	4	6	3	6
Total Patch Area (m²)		116.3	295.9	27.9	97.2	198.2
Patch Area Index		0.24	0.59	0.06	0.19	0.4
Mean Interpatch Length (m)		0.60	2.78	1.10	1.08	0.82
Interpatch Range (m)		0.1-3.0	0.4-7.6	0.3-2.5	0.2-5.0	0.1-1.8
Landscape Organisation Index		0.93	0.33	0.87	0.66	0.92
December 2021		**T2**	**T3**	**T4**	**T5**	**Reference**
Patch Zones (number/10m)		6.4	3.6	13.8	8.4	6.4
Number Patch Types		4	4	5	4	6
Total Patch Area (m²)		258.9	242.8	54.3	131.1	182.9
Patch Area Index		0.52	0.49	0.11	0.26	0.37
Mean Interpatch Length (m)		0.10	2.13	0.42	0.78	0.80
Interpatch Range (m)		0.4-7.5	0.7-5.0	0.2-0.6	0.2-2.2	0.5-1.0
Landscape Organisation Index		1.0	0.45	0.96	0.78	0.92
May 2022		**T2**	**T3**	**T4**	**T5**	**Reference**
Patch Zones (number/10m)		8.0	6.6	10.4	7.4	7.0
Number Patch Types		5	4	5	5	6
Total Patch Area (m²)		69.4	121.1	59.4	174.1	179.2
Patch Area Index		0.14	0.24	0.12	0.35	0.35
Mean Interpatch Length (m)		0	0.90	0	0.52	0.78
Interpatch Range (m)		0	0.2-2.5	0	0.1-1.1	0.1-1.5
Landscape Organisation Index		1.00	0.73	1.00	0.90	0.96
January 2023		**T2**	**T3**	**T4**	**T5**	**Reference**
Patch Zones (number/10m)		4.6	5.6	5.8	3.2	3.8
Number Patch Types		4	4	4	5	6
Total Patch Area (m²)		161.7	260.6	211.9	636.1	210.0
Patch Area Index		0.32	0.52	0.42	1.68	0.80
Mean Interpatch Length (m)		0	1.05	0.40	0.7	0.75
Interpatch Range (m)		0	0.2-2.6	0.5-1.7	0.7-1.3	0.5-1.0
Landscape Organisation Index		1	0.77	0.98	0.98	0.94

4.5.2 Soil Surface Assessment (SSA)

Minimal changes to soil characteristics were measured in January 2023. Soil structure takes many years to develop and it takes many years for a soil type to change its composition.

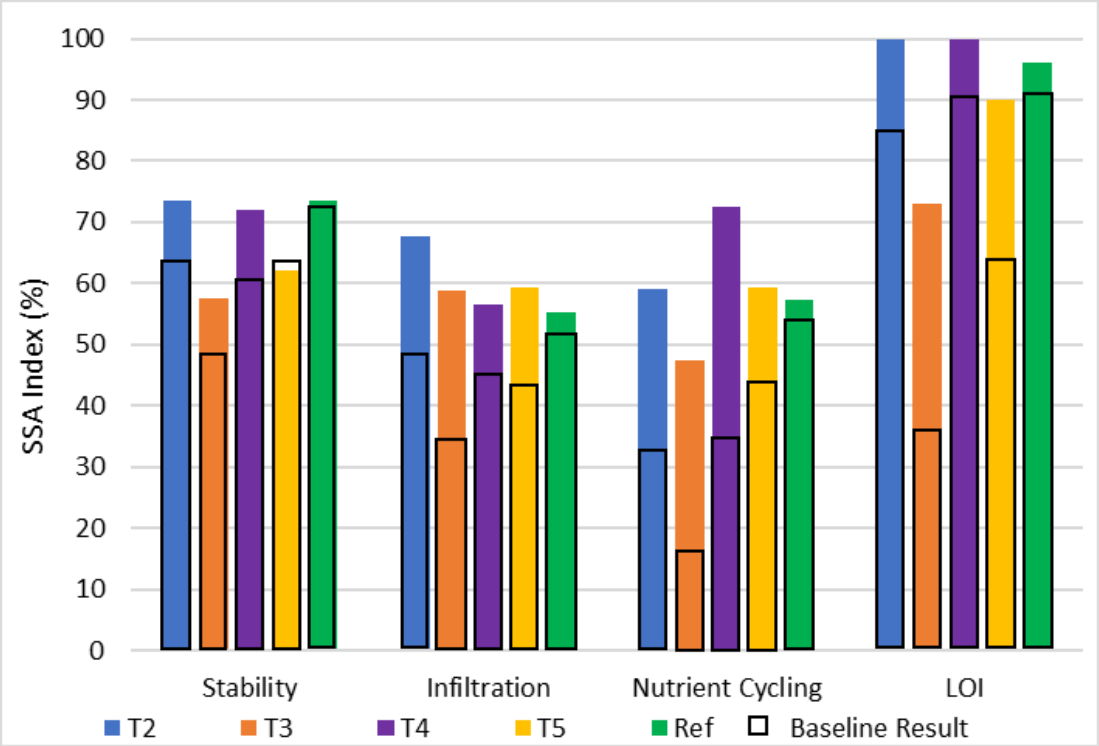
Patches of grass, moss and weeds presented the highest soil stability index. They act as obstructions for slowing down and capturing overland flow, providing soils with physical stability and thus preventing subsequent erosion. Bare ground patches had the lowest stability index predominantly due to the absence of rain splash protection. The stability indices of each site were strongly associated with the proportion of different patch types.

Site 2 and 4 had the highest stability index with scores of 72 and 73 respectively (Graph 3). These sites are characterised by an extensive, localised layer of litter, high rain splash protection and a high presence of vegetative and biological cover. Site 3 had a lower stability rating of 58.6% due to the lack of cover (vegetation, litter and biological) and evidence of erosion. Moss was identified for the first time on Site 3, and it is expected that it will have a positive contribution to the soils biological crust cover rating in years to come.

A high infiltration index was predominantly characterised by litter cover and decomposition, basal vegetation cover and physical soil attributes (texture, slake, dry coherence). Naturally, vegetation and litter patches contributed to the highest scores. Infiltration scores improved considerably at Site 3, reaching 60% due to acacias continuing to fill out in the first half and increased density of weeds in the second half of the transect in January 2023. Scores across all sites were similar to, or higher than the reference site (55%), although since this is a relatively low score, it is expected that Infiltration can still be improved further at the rehabilitated sites.

The highest nutrient cycling SSA indices were achieved by vegetated patches including grasses, shrubs, weeds, moss and litter, which will contribute to soil surface nutrients when broken down. Localised litter cover with a high decomposition improved the score because nutrients are effectively being returned to the soil. Low basal cover including bare ground and rock allows for resources to be lost in contrary to being filtered into the substrate. Only small improvements in nutrient cycling indices were recorded in January 2023, since only little changes were recorded for the overall soil assessment.

The LOI is a good indication of vegetation cover and is related to the SSA parameters. The proportion of bare ground is now negligible at all sites apart from Site 3 due to increased native ground cover, annual weed growth and increase leaf litter. Although improvements have been observed at Site 3, it is recommended that the LOI is improved to reach a similar score to the reference site (Graph 3). This can be done by minimising the proportion of bare ground on the site by increasing vegetation cover through planting and seeding methods.



Graph 3- Soil Surface Assessment Index (%) Baseline result= July 2020 (April 21 for T5)

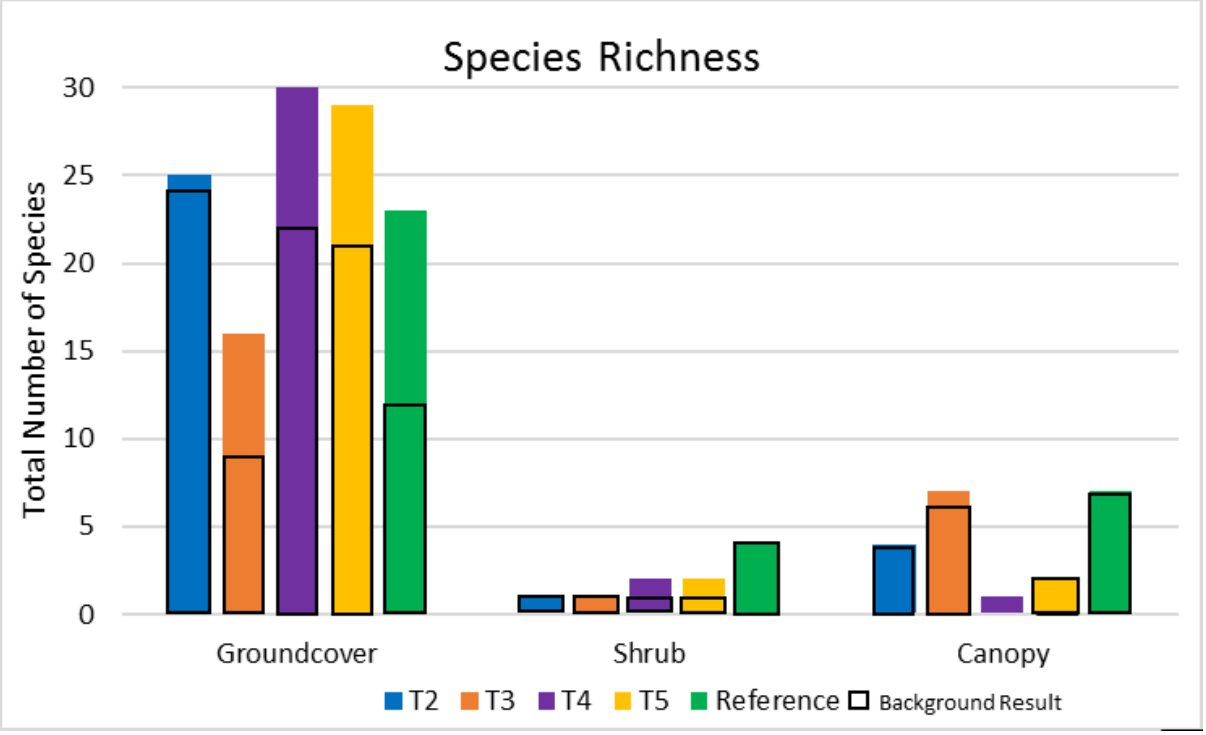
4.6 Vegetation Composition and Dynamics

The number of groundcover species was the highest strata level for each site, with species numbers ranging from 16 to 30 groundcover species per transect (Graph 4). The majority of groundcover plant species (57% to 95%) were weeds as shown on Table 3 below. Across all sites, the most common weed species were *Hirschfeldia incana, Plantago lanceolate, Nassella trichotoma* and *Cirsium vulgare*. Common pasture species included *Trifolium* sp, *Cynodon* sp, *Phallaris* sp and *Lomandra*. As expected, the reference site had the highest number of native groundcover species, including *Pomax umbellate, Patersonia occidentalis,* and *Vicia tetrasperma*. Site 4 had the highest diversity of groundcover, with a total of 30 species. Species richness has also improved at Site 3 over the past year. As previously discussed, herbaceous weed species will not have detrimental effects on the ecosystem.

The reference site shows that the native vegetation resembles an open woodlands ecosystem where mid-storey cover is sparse. Only four middle storey species were present in the reference transect, while one or two species were present in each of the rehabilitated transects. The middle storey of the reference transect was dominated by *Olearia viscidula.* Species richness of the reference site did not entirely represent a Brittle Gum Stringybark Forest as the middle and lower stories were disturbed. The reference site provides helpful data for the LFA component of this study, although improved vegetation dynamics would be expected for the rehabilitated sites.

The upper canopy at the reference site is characterised by mature *Eucalyptus mannifera* and *E. bosistoana* with the emergence of few juvenile *Acacia* and *Casuarina*. Meanwhile, Site 2 is comprised of a dense canopy of *A. decurrens* and *A. mearsii,* with the emergence of *E. cinerea.* Transect 3 and 5 are comprised of the same species, however rehabilitation work in these sites was more recent and all species are still at a juvenile stage. The dense

monoculture of *Acacia* trees does not reflect the natural reference site, and more care should be taken with species selection. It is suggested that planting of Eucalypt tubestock in these areas would improve diversity and species richness of canopy species to represent the reference site. This could be done progressively as the short lived Acacias naturally die off.



Graph 4- Species Richness at three levels of vegetation strata Baseline result= July 2020 (April 21 for T5)

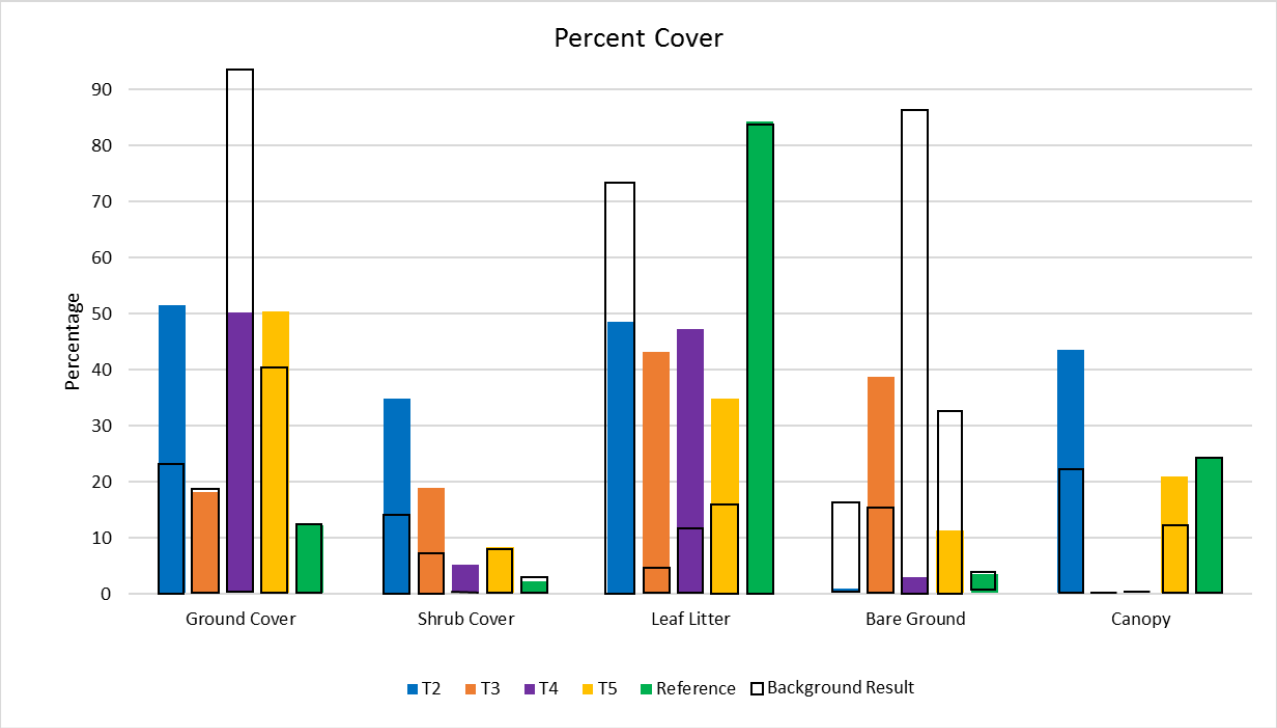
Percent cover is important for several reasons as it covers both ecological systems and physical protection. This category does not distinguish between weed cover and native vegetation as it is not necessarily a factor in protecting soil from erosion. Organic matter is important in the development of soil structure and fertility, and it is not necessarily relevant whether this material comes from native or non-native species. It also doesn't distinguish between species diversity and structure, however for long term sustainability the structural components should still match the reference vegetation community.

As shown on Graph 5, the reference site has a high canopy cover, but less ground and shrub cover and includes a significant proportion of leaf litter. Site 4 however, is predominantly ground cover and leaf litter, with vegetation increasing into the shrub layer, and has minimal tree layer at this stage. Over time as trees emerge, the groundcover will reduce, and the leaf litter layer will increase. There has been a reduction of groundcover at T4 due to die off of *Nassella trichotoma* which has contributed to a higher percentage of leaf litter.

Conversely, Site 3 is in the early stage of rehabilitation and shows little ground cover and leaf litter cover, although percent cover has been increasing over time. Site 2 is an older rehabilitated area and has a higher canopy and leaf litter approaching the proportions observed in the reference site. There was greater shrub cover at T2, however this was predominantly weeds including *Cirsium vulgare*. A lowered percent canopy cover was also recorded at T2, as some acacias had started to fall as they reach the end of their lifespan. It is evident that the timing of rehabilitation of Site 5 lies between Site 3 and Site 2, with a fair

amount of bare ground gradually being covered by lower storey species and litter, while the middle and upper storeys are still somewhat lacking.

It appears that over the past 6 months there has been a reduction in bare ground across all the rehabilitated sites, as ground cover species emerge and the leaf litter layer develops further. The Landscape Function Analysis has deemed that the proportion of bare ground is not negligible at all sites excluding Site 3.



Graph 5- Average ground, shrub, litter and bare cover percentages Baseline result= July 2020 (April 21 for T5)

Table 4.4- Transect Species List

Transect 2	Transect 3	Transect 4	Transect 5	Reference
Weed species				
Sonchus asper	*Plantain lanceolata*	*Verbena brasiliensis*	*Hirschfeldia incana*	*Euphorbia maculata*
Plantago lanceolata	*Medicago minima*	*Stachys byzantina*	*Sonchus arvensis*	*Euphorbia peplus*
Erigeron bonariensis	*Hirschfeldia incana*	*Erigeron canadensis*	*Sinapis arvensis*	*Gamochaeta sp*
Centaurea Melitensis	*Euphorbia peplus*	*Solanum nigrum*	*Plantago lanceolata*	*Hypochaeris glabra*
Lactuca serriola	*Hypochaeris glabra*	*Cirsium vulgare*	*Dittrichia graveolens*	*Asclepias fascicularis*
Cirsium vulgare	*Geranium molle*	*Sonchus asper*	*Erigeron bonariensis*	*Nassella trichotoma*
Hirschfeldia incana	*Atractylis cancellata*	*Marrubium vulgare*	*Sonchus Asper*	*Daucus carota*
Silybum marianum	*Modiola caroliniana*	*Dittrichia graveolens*	*Hypochaeris glabra*	*Erigeron bonariensis*
Rumex acetosella	*Erigeron bonariensis*	*Geranium dissectum*	*Lythrum salicaria*	*Portulaca oleracea*
Hypochaeris glabra	*Erigeron canadaensis*	*Erigeron sumatrensis*	*Cirsium vulgare*	*Euchiton japonicus*
Erodium moschatum	*Sonchus Asper*	*Helminthotheca echioides*	*Helminthotheca echioides*	*Solanum nigrum*
Erigeron canadaensis	*Dodonaea viscosa*	*Sonchus oleraceus*	*Erigeron canadensis*	*Dichondra repens*
Erigeron sumatrensis	*Centaurea Melitensis*	*Plantain lanceolata*	*Dichondra repens*	*Verbena bonariensis*
Sonchus oleraceus	*Lactuca serriola*	*Machaeranthera tanacetifolia*	*Euchiton japonicus*	
Gamochaeta coarctata	*Cirsium vulgare*	*Scorzoneroides*	*Lythrum salicaria*	
Verbena brasiliensis		*Leontodon saxatilis*	*Erigeron canadensis*	
Dichondra repens		*Tetraneuris scaposa*	*Conyza bonariensis*	
Solanum nigrum		*Modiola caroliniana*	*Onopordum acanthium*	
Portulaca oleracea		*Andropogon virginicus*	*Anagallis arvensis*	
Oxalis dillenii		*Hypochaeris glabra*		
Ageratina adenophora		*Anagallis arvensis*		
Tagetes minuta		*Hirschfeldia incana*		
Improved Pasture Species				
Trifolium repens	*Trifolium repens*	*Trifolium repens*	*Trifolium repens*	*Poaceae sp.*
Phallaris sp.	*Phallaris sp.*	*Heteropogon contortus*	*Dactylis glomerata*	*Poa sieberiana*
	Lolium sp.	*Paspalum dilatatum*	*Cynodon dactylon*	*Cyperaceae sp.*

Transect 2	Transect 3	Transect 4	Transect 5	Reference
	Cenchrus Clandestinus	*Cynodon dactylon*	*Phallaris minor*	*Microlena spp*
	Cynodon dactylon	*Chloris gayana*	*Chloris gayana*	
			Poa pratensis	
			Lolium	
			Festuca arundinacea	
Native Understorey Species				
		Lomandra Longifolia	*Chrysocephalum apiculatum*	*Goodenia pinnatifida*
			Unknown groundcover	*Patersonia occidentalis*
			Hardenbergia violacea	*Chrysocephalum apiculatum*
				Indigofera australis
				Hardenbergia violacea
				Vicia tetrasperma
				Vittadinia muelleri
Mid to Upper Storey Species				
Acacia decurrens	*Acacia parramattensis*	*Pittosporum multiflorum*	*Dodonaea sp*	*Hakea sp.*
Acacia mearnsii	*Acacia falciformis*	*Pittosporum undulatum*	*Acacia decurrens*	*Eucalyptus eugenioides*
Eucalyptus cinerea	*Acacia mearnsii*		*Acacia mearnsii*	*Acacia sp. (juvenile)*
Eucalyptus macrorhyncha	*Acacia longifolia*			*Eucalyptus mannifera*
	Acacia decurrens			*Eucalyptus bosistoana*
	Allocasuarina littoralis			*Ozothamnus diosmifolius*
	Eucalyptus cinerea			*Olearia viscidula*
	Acacia parramattensis			*Eucalyptus cinerea.*
	Gleditsia triacanthos			*Acacia decurrens*
				Casuarina sp. (juvenile)

4.7 Habitat Complexity

Habitat complexity examines the extent of environmental niches, shelter and food resources available for vertebrate fauna. The reference site has a high habitat complexity index with a score of 9 (Table 4.5). This was comprised of a tree canopy of 30-70%, shrub canopy <30%, sparse ground herbs <0.5m, litter >70% and a permanent water body adjacent.

The habitat complexity scores of Site 3, Site 4 and Site 5 saw no changes over the past 6 months. Site 2 has seen an improvement in habitat complexity, as the score has increased from 10 to 11 due to an increase of shrub canopy from <30% to 30-70%. This has occurred due to the increase of *Cirsium vulgare*.

The entire lower and mid strata assemblage of all sites requires active rehabilitation. The vertical vegetation structure of an ecosystem plays a significant role in many positive feedback processes including stratum diversity providing increased habitat niches for a greater diversity of vertebrate species. As for the vegetation structure observed within Sites 2 and 5, although *Acacia* species can be used for successional development in a disturbed ecosystem, other components such as a seed bank must also be provided to enable to target succession to occur.

Habitat complexity can be easily improved in rehabilitation areas by the inclusion of brush matting such as logs, branches and debris. There is evidence of this having originally occurred in some of the rehabilitation areas, and this should improve over time.

Table 4.5- Habitat Complexity Woodland Scores

July 2020	**1**	**2**	**3**	**4**	**5**	**Reference**
Tree Canopy %	2	1	0	0		2
Shrub Canopy %	0	1	2	0		1
Ground Herb %	0	0	0	2		0
Litter %	2	2	1	0		2
Water	0	1	0	0		2
Habitat Complexity Index	**4**	**5**	**3**	**2**		**7**
April 2021	**1**	**2**	**3**	**4**	**5**	**Reference**
Tree Canopy %		2	0	0	1	2
Shrub Canopy %		1	2	1	1	1
Ground Herb %		2	0	2	3	1
Litter %		2	1	1	1	3
Water		1	0	0	0	2
Habitat Complexity Index		**8**	**3**	**4**	**6**	**9**
December 2021	**1**	**2**	**3**	**4**	**5**	**Reference**
Tree Canopy %		3	0	0	1	2
Shrub Canopy %		1	2	0	2	1
Ground Herb %		3	1	3	3	1
Litter %		2	1	1	1	3
Water		1	0	1	0	2
Habitat Complexity Index		**10**	**4**	**5**	**7**	**9**
May 2022	**1**	**2**	**3**	**4**	**5**	**Reference**
Tree Canopy %		3	0	0	1	2

Shrub Canopy %		1	2	1	1	1
Ground Herb %		3	1	3	3	1
Litter %		2	1	1	1	3
Water		1	0	1	0	2
Habitat Complexity Index		**10**	**4**	**6**	**6**	**9**
January 2023	**1**	**2**	**3**	**4**	**5**	**Reference**
Tree Canopy %		3	0	0	1	2
Shrub Canopy %		2	2	1	1	1
Ground Herb %		3	1	2	3	1
Litter %		2	1	2	1	3
Water		1	0	1	0	2
Habitat Complexity Index		**11**	**4**	**6**	**6**	**9**

5. DISCUSSION AND RECOMMENDATIONS

5.1 General

This was the fifth EFA monitoring round for Marulan South Limestone Mine under the 2018-2023 MOP period. It covered both older revegetation areas, newly rehabilitated areas and the reference site which was characteristic of the surrounding native vegetation communities. During April 2021 Site 1 was discontinued and an additional Site 5 was included into the program. The mine is undertaking progressive rehabilitation in accordance with the current MOP. This document is being updated to a Rehabilitation Management Plan in accordance with Condition B82 of the State Significant Development approval (SSD 7009).

This EFA study found that overall rehabilitation activities have been successful but has identified areas of improvement and corrective action which should be considered over time. The study has also found the surrounding native vegetation communities are highly disturbed and not necessarily representative of the target ecosystem quality that should be sought in the rehabilitation areas. Further discussion and recommendations of the EFA findings can be found in the sections below.

5.2 Rehabilitation Success Criteria

The EFA program is used in accordance with the Rehabilitation Strategy to collect information of the rehabilitated sites which can be matched against the success of rehabilitation objectives and completion criteria. Table 6 below shows that more work is required before any of the sites will meet the success criteria.

Table 5- Rehabilitation Success Summary

Hierarchy of Ecosystem Succession	Targeted Ecosystem Components	Key Performance Indicators	Units	Satisfaction of the Criteria			
				Site 2	Site 3	Site 4	Site 5
Landform Establishment	Landform Function	LFA Stability	%	✓	x	✓	x
		LFA Infiltration	%	✓	x	x	x
		LFA Nutrient Cycling	%	✓	x	x	✓
Growth Medium Development	Active Erosion	Surface Area	m^2	x	x	✓	x
	Soil chemical/ Physical properties	pH	pH (6.5)	-	x	-	✓
		Organic Carbon	% (>4.5)	-	x	-	x
		Nitrate	ppm (>12.5)	-	✓	-	x
		Total Phosphorous	ppm	-	x	-	x
Ecosystem Establishment	Vegetation Density	Tree Density	Stems/area	x	x	x	x
		Shrub Density	Stems/area	x	x	x	x
	Vegetation Diversity	Native Understorey Diversity	> Species / m^2	x	x	x	x
		Exotic Understorey Diversity	< Species / m^2	✓	x	✓	✓
Ecosystem Development	Groundcover Components	Perennial Plant Cover (<0.5m)	%	✓	x	✓	✓
		Total Ground Cover	%	✓	x	✓	✓
		4-6m height class	% Cover	x	x	x	x

	Floristic Diversity	Native Species Diversity	> no. / area	x	x	x	x
		Exotic Species Diversity	> no. / area	✓	x	✓	✓
Ecological Stability	Ecosystem Health	Healthy Trees	% Population	x	x	x	✓
	Ecosystem Recruitment	Shrub / Recruitment 0-0.5m	no. / area	x	x	x	x
	Ecosystem Composition	Trees	no. / area	x	x	x	x
		Shrubs	no. / area	x	x	x	x

5.3 Site 1

Rehabilitated Site 1 is characterised as a steep bank previously used as an overburden waste emplacement. It has a low LOI (50.0) with moderate to high stability (54.6), nutrient cycling (40.6) and infiltration (50.1). The bank is quite steep and erosion rills are present in the lower half. The lower stratum is comprised of herbaceous weed species, up to 40% left litter and 60% bare ground. Canopy cover is present which is provided by the dense monoculture of *Acacia.* The middle storey is lacking in shrub species and a scatter of juvenile eucalypts are emerging among the ground stratum. Site 1 had a habitat complexity score of 4, due to improved litter and tree canopy percentages (both 30-70%).

The high density of *Acacia* species may be suppressing the growth of other plant species due to the allelopathic effects, particularly during previous dry conditions. These effects are mainly caused by high densities which outcompetes other natives for space and light and build-up of *Acacia* seed within the soil profile which exclude the germination of other native species. Under normal ecological conditions within a healthy forest community, *Acacias* act as colonisers in areas of natural disturbance. As a successional species that is generally short lived, *Acacias* for an important factor in soil stability and habitat development while the forest community recovers from disturbance. However, at site 1, there is a monoculture of *Acacias* which will successfully out-compete other successional species which inhibits ultimate species diversity and may not produce a sustainable native vegetation community.

This site has been discontinued as the new emplacement area will be expanded into this location. No recommendations are required for this area.

5.4 Site 2

The original transect was moved approximately 1.5m to the north during January 2023 because the original transect was impenetrable by *Cirsium vulgare*. This site had a high LOI of 100. The ground cover was comprised of grass and weed species, litter and moss, with no bare ground patches remaining. This area had high stability (72.5) and moderate infiltration and nutrient cycling (70.8 and 58.0 respectively). The soil surface indices have improved slightly over the past six months due to increased rainfall favouring herbaceous understorey growth. The shrub stratum was dominated by *Cirsium vulgare* and also included juvenile *Eucalyptus* species, particularly *Eucalyptus cinerea*. A lot of *Nassella trichotoma* was also present during the recent survey. Canopy cover is present which is provided by the ageing *Acacia*, although the canopy cover percent dropped slightly in January 2023 because a few *Acacia* along the transect had fallen down. Site 2 had the highest habitat complexity index of

all the rehabilitated sites, with a score of 11. This site has a stable soil surface with no visible erosion. There are no native grasses in the understory vegetation and very few native herbs.

Although the *Acacias* in this Site are progressing towards the end of their lifespan, thinning out these trees and supplementing with *Eucalypts* tubestock would aid improvement of the species diversity. Some of the weeds present including *Tagetes minuta* and *Nassella trichotoma* are persistent perennials, and do need to be managed by spot spraying.

5.5 Site 3

Site 3 had the lowest LOI of all the rehabilitated sites of 77, however this index has improved significantly due to the *acacias* filling out in the upper half of the transect, the increased density of weeds in the second half, and also the new occurrence of moss. This site had comparatively low stability, infiltration and nutrient cycling indices of 57.6, 60.9 and 48.0 respectively, however the soil surface indices have also improved slightly over the past 6 months. The amount of bare ground has reduced significantly, from previous records of 50% bare ground to a current bare ground coverage of 23%. Site 3 has the lowest number of species at all stratum levels over all transects, additionally, no canopy is present at this site, but over time the juvenile natives present are beginning to fill the upper storey. Habitat complexity is also relatively low, with a score of 4. There are no sediment problems at this site and the soil surface is quite stable. A positive action undertaken at this site is that piles of logs and sticks have been clustered among the groundcover to create micro-niches to enhance shelter for smaller animals.

This site represents more recent rehabilitation work and currently consists of juvenile *Acacias* and Eucalypts but with extensive weed infestation on the lower bank. The density of Eucalypts would indicate that a monoculture of *Acacias* is unlikely, however this would require ongoing monitoring and assessment. The development of weed growth is not a concern at this stage as they do provide stability for the bank, however it is important that the weed mass does not become an inhibitor to the ultimate development of a native forest community. Weed spraying in this area should be avoided at this stage, since this would also have the effect of suppressing Eucalypt seedlings.

Although this is not represented in the statistics above, the growth of native species on the lower half of the transect is minimal. Reseeding or planting tubestock throughout this area would be beneficial to this site.

5.6 Site 4

Site 4, known as Bryce's gully, is a difficult area to rehabilitate. It represents a steep slope on the eastern side of the mine with poor access. Despite being one of the older rehabilitation sites at the mine, it has generally only been able to support herbaceous weeds and tussock. The site is heavily grazed by both native and introduced species because historically it has been a source of food. This in turn has made it more difficult to develop native species.

During 2020, native tree and shrub species were planted along the benches and protected in fully enclosed wire cages, each with an irrigation water supply. The cages will be removed after the plants have matured to a point where grazing pressure is no longer a concern. The

irrigation system is likely to remain until root systems have developed sufficiently to ensure sustainable growth. The *Nassella trichotoma* which has been successfully treated in the past has began to regrow, it is suggested that the Tussock is sprayed again in spring. The Tussock is currently in a dormant phase, and has contributed to a high proportion of leaf litter. The site has a high LOI of 98 with minimal bare patches remaining and moderate to high soil surface indices.

The groundcover at this site is excellent, and the herbaceous weeds are gradually being outcompeted by pasture grasses. The embankments are very stable due to the high vegetation cover, and therefore there is little sedimentation evident from runoff and the drainage lines are clear. The middle and upper canopy layers are currently absent, but over time the tube stock are expected to fill these areas. The habitat complexity index is still low, but is expected to improve when the upper canopy levels fill out.

This site requires active management in order to achieve the approved objective of a stable native woodland ecosystem compatible with surrounding vegetation communities. The results of this EFA study have found that the foundations of the land use goal have been established with good groundcover and SSA indices. Adequate tree and shrub development are however in the early phase and will take some time to achieve sustainability.

These foundations could be improved with brush matting and further native planting. The success rate of tubestock planted in enclosures is currently approximately 50% and some of these plants are showing signs of disease or stress. Replacement tubestock should be used to in fill where previous plats have not survived. The addition of tree pellets to provide slow release fertiliser should be used when planting. Tubestock that have survived have reached the lid of the cages, which could be removed within the next few months.

5.7 Site 5

Site 5 is located on the second completed bench on the southern side of the Western Overburden Emplacement and represented an area of the most recent rehabilitation undertaken at the Mine. This site LOI increased by 8% to 98 in the past 6 months.

Site 5 had a relatively high stability (63), level of infiltration (59.3) and nutrient cycling index (59.4) which were similar to, or higher than the reference site. Growth of native species will result in an improvement of the shrub and tree canopy layer will result in an increased habitat complexity index (currently 6) at this site. This is expected to occur over time as species observed in juvenile stages become established.

Juvenile Eucalypts have been observed emerging in the understorey during January 2023. As observed at sites 2 and 3, the *acacia* is dominating the upper storeys, however several older trees had also fallen at this site over the past 6 months. Improving biodiversity by infilling with *eucalypts* and removing excess *acacias* as required would reflect a better representation of the reference site.

A small patch of Pampas Grass *Cortaderia selloana* is located just below the transect line which should be treated with a none-selective herbicide.

5.8 Reference Site

The reference site used in this study was located within a community identified as Brittle Gum Stringybark Forest. This site is characteristic of a closed woodland, dominated by stringybark with not a great deal of shrubs. It has a complete layer of litter, good ground habitat with an abundance of logs and branches, and very little weeds. The soil is stable with full organic matter and humic in nature with no erosion evident whatsoever. There is positive ground biology including ants, termites, mushrooms and lichen. There is previous evidence of a cooler burning fire in the tree bark. Older large trees are present with hollows perfect for bird and arboreal mammal habitat and nesting.

This site is a successful indicator of landscape organisation and soil surface levels required by the rehabilitated sites, although the vegetation dynamics and habitat complexity showed previous disturbance. It is expected that the rehabilitated sites should exceed this reference site in terms of flora density and richness, particularly in the lower stratum levels. A habitat complexity score beyond that of the reference site is also required for a healthy, sustainable rehabilitated vegetation community. It is proposed that a second reference site located within the Coastal Grey Box Forest Red Gum Woodland also present on site will be established.

This Ecosystem Function Analysis monitoring program has shown that Marulan South Limestone Mine has clear rehabilitation objectives and has selected indicators to measure rehabilitation success against a criterion. The monitoring of such indicators has highlighted that more rehabilitation work is required in the areas discussed above in order to reach a successful completion criterion.

Plan 1- EFA Monitoring Plan

APPENDIX A – LFA Raw Data January 2023

Transect 2			Transect 3			Transect 4			Transect 5			Reference		
Distance (m)	Width (cm)	Patch Type	Distance (m)	Width (cm)	Patch Type	Distance (m)	Width (cm)	Patch Type	Distance (m)	Width (cm)	Patch Type	Distance (m)	Width (cm)	Patch Type
0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
6.9	400	W	2.6	500	B	3	500	W	0.9	1000	G	2	1000	L
7.2	20	N	5	100	S	3.5	50	G	2.9	100	W	2.8	100	W
13.5	600	W	6.4	200	W	7	500	W	9.6	500	G	9.2	2000	L
14.9	200	N	8.2	500	S	7.3	50	B	12.5	1000	N	10.7	200	N
16.9	600	W	8.4	200	B	9	500	W	13.8	500	G	13	200	L
17.8	50	N	12	1000	S	9.4	50	S	14.5	300	B	13.6	100	S
27.5	400	W	12.5	100	L	12	500	W	15.7	200	W	15	1000	L
29	200	N	13.2	200	W	14.6	500	G	24	1000	N	22.2	2000	L
29.5	10	L	13.8	1000	S	15.9	500	W	25	50	W	23.6	200	S
30.5	100	N	15.2	300	W	16.3	100	G	30.5	1000	L	25.5	100	L
34	200	W	15.6	100	L	17.8	500	W	30.8	50	W	26	100	M
35.6	100	L	16.9	200	B	19.2	500	G	32.5	100	G	28	2000	L
36	150	N	18.3	300	S	20.1	150	S	36.6	1000	L	29.2	200	N
36.8	100	L	18.8	100	L	28.3	500	W	37.8	500	G	34.5	500	L
38.5	600	W	20.6	200	B	28.8	30	B	38.8	500	N	34.8	100	S
43	200	L	21.3	100	S	29.3	50	S	40.9	200	G	35.7	1000	L
44.3	200	G	22.5	100	B	30.8	500	W	49	1000	L	36.4	200	N
45	100	N	23.7	200	S	33.3	300	S	50	500		37.3	200	L
45.5	100	W	24.4	500	B	35.2	500	W				37.5	200	N
46.1	150	L	26.1	300	S	35.6	30	S				42	2000	L
48	200	N	27.6	300	B	36.9	500	W				43	100	S
49	300	W	28.2	200	N	37.2	20	S				44	100	B
50	200	G	28.8	200	B	38.6	150	L				44.5	100	S

Transect 2			Transect 3			Transect 4			Transect 5			Reference		
Distance (m)	Width (cm)	Patch Type	Distance (m)	Width (cm)	Patch Type	Distance (m)	Width (cm)	Patch Type	Distance (m)	Width (cm)	Patch Type	Distance (m)	Width (cm)	Patch Type
			29.2	100	L	39.2	100	S				45	300	L
			30	100	S	44.9	500	L				45.5	80	B
			30.8	100	B	45.1	20	S				50	200	L
			31.2	50	W	45.9	500	L						
			31.7	100	B	46.4	50	S						
			33.1	200	W	47	500	L						
			33.5	100	B	48	50	S						
			37.6	1000	W	50	500	W						
			37.9	100	M									
			38.2	1000	W									
			38.7	100	M									
			39.7	1000	W									
			40.2	100	M									
			44.8	1000	W									
			45.4	100	L									
			50	1000	W									

KEY:
B= Bare
G= Grass
L= Litter
W= Weed
N= Niche (Fallen logs, wombat hole)
M= Moss
S= Shrub (native shrub, tubestock)

APPENDIX B – SSA Raw Data January 2023

Soil Surface Assessment of individual zones

Transect 2			
Zone	Stability	Infiltration	Nutrients
Weed	77.5	70.1	56.4
Litter	62.5	72.0	57.7
Native	58.3	61.6	61.5
Moss	77.5	68.9	61.5
Grass	80.0	68.9	61.5

Transect 3			
Zone	Stability	Infiltration	Nutrients
Weed	60.5	68.5	58.1
Shrub	61.8	66.5	60.3
Litter	57.5	60.4	53.8
Niche	63.2	64.6	54.7
Bare	48.1	37.0	17.1
Moss	77.5	68.9	61.5

Transect 4			
Zone	Stability	Infiltration	Nutrients
Grass	73.3	56.7	72.4
Weed	70.6	56.7	69.8
Litter	72.6	58.5	73.5
Shrub	70.8	54.8	72.2
Bare	52.6	30.2	23.3

Transect 5			
Zone	Stability	Infiltration	Nutrients
Grass	68.0	61.3	65.6
Weed	64.5	61.6	67.0
Shrub	58.3	61.6	61.5
Litter	58.3	62.2	61.5
Bare	47.2	51.1	38.5
Niche	47.2	51.1	38.5

Reference			
Zone	Stability	Infiltration	Nutrients
Shrub	76.6	56.1	59.0
Litter	75.2	56.1	59.0
Niche	83.5	53.4	53.8
Moss	73.8	35.2	39.6
Weed	60.4	60.1	61.5
Grass	60.4	57.9	57.7
Bare	55.8	27.9	19.6

Soil Surface Assessment Individual zones contribution to the whole landscape

Transect 2			
Zone	Stability	Infiltration	Nutrients
Weed	49.0	44.3	35.7
Litter	10.0	11.5	9.2
Native	9.5	10.0	10.0
Grass	3.7	3.2	2.8
Total	**72.1**	**69.0**	**57.7**

Transect 3			
Zone	Stability	Infiltration	Nutrients
Weed	24.1	27.3	23.1
Shrub	17.6	18.9	17.1
Litter	2.8	2.9	2.6
Niche	0.8	0.8	0.7
Bare	11.1	8.6	4.0
Moss	2.0	1.8	1.6
Total	**58.3**	**60.2**	**49.1**

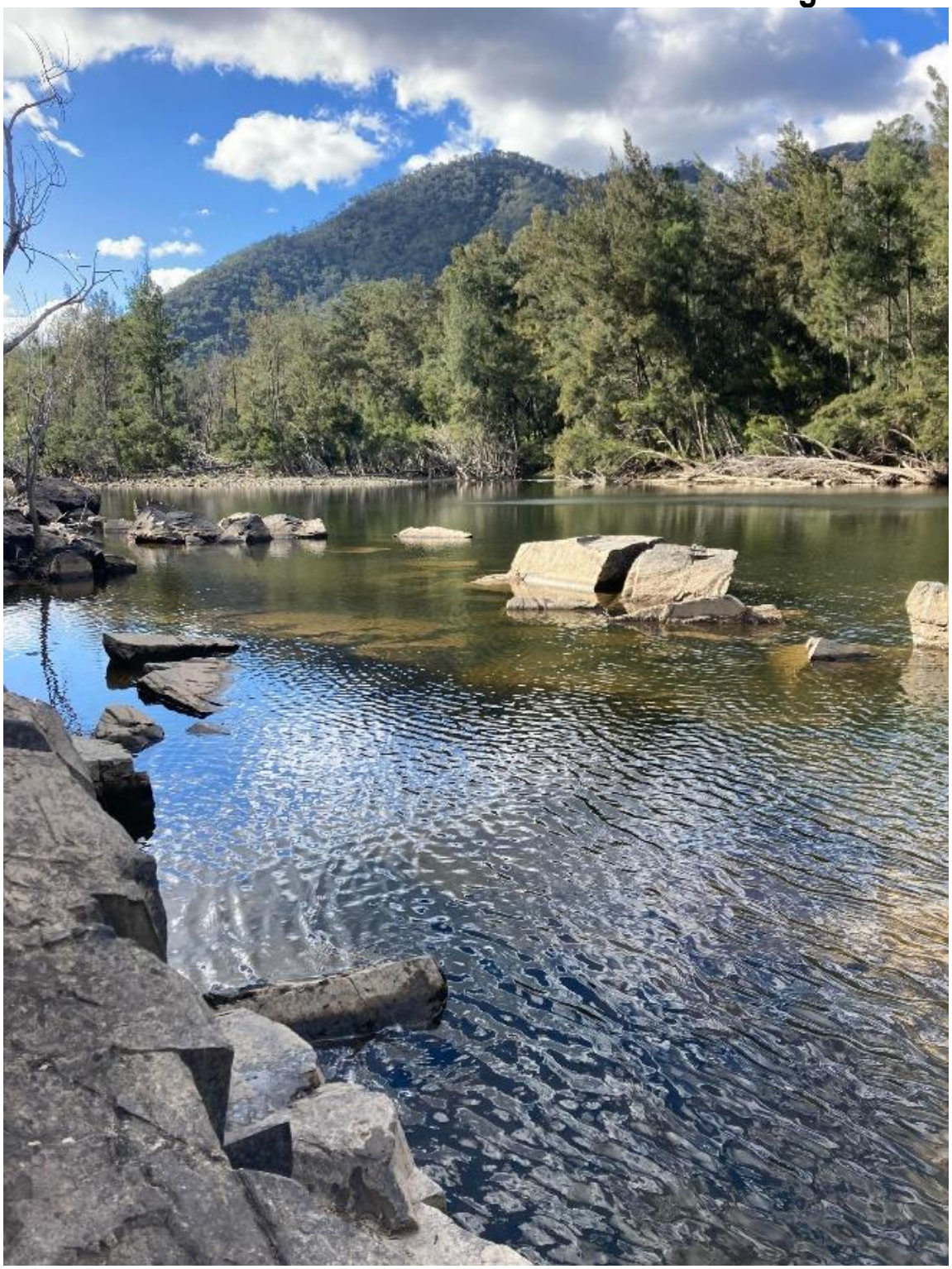
Transect 4			
Zone	Stability	Infiltration	Nutrients
Grass	7.2	5.6	7.1
Weed	40.3	32.3	39.8
Litter	12.3	9.9	12.5
Shrub	10.3	8.0	10.5
Bare	0.8	0.5	0.4
Total	**71.0**	**56.3**	**70.3**

Transect 5			
Zone	Stability	Infiltration	Nutrients
Grass	30.0	27.1	29.0
Weed	8.0	7.6	8.3
Shrub	15.5	16.4	16.4
Litter	9.0	9.6	9.5
Bare	0.7	0.7	0.5
Total	**63.2**	**61.4**	**63.7**

Reference			
Zone	Stability	Infiltration	Nutrients
Shrub	20.9	15.3	16.1
Litter	47.1	35.2	37.0
Niche	4.7	3.0	3.1
Moss	0.6	0.3	0.3
Weed	0.8	0.8	0.8
Grass	0.0	0.0	0.0
Bare	1.3	0.7	0.5
Total	**75.4**	**55.2**	**57.6**

APPENDIX D – Surface Water Monitoring and River Health

Marulan South Limestone Mine
Surface Water Monitoring and River System Health
August 2023



Prepared By:
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"Longmead"
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Table of Contents

1. Introduction

This report has been prepared by International Environmental Consultants Pty Limited (IEC) in response to conditions listed in Marulan South Limestone Mine State Significant Development approval SSD7009. Specific conditions include the Water Management Performance Measures listed in Table 4 Condition B43, Condition 45(e)(iii), Condition 45(e)(iv), Condition 45(e)(vi), and subsequent commitments made in the 2021 Water management Plan.

1.1 Background

The Marulan South Limestone Mine has been continually worked in various forms since 1833 following the identification of the significant resource in around 1826. Although the resource is large, its lateral extent is limited due to unique geological conditions which caused the deep sedimentary derived limestone deposit to be uplifted then folded and faulted to a near vertical position. The deposit is narrow with a total width of less than 670m with the higher grade deposit being less than 350 m. The total depth of the deposit is unknown and the deepest drilling to date has ended still within the limestone deposit. These local geological conditions have resulted in the current size and shape of the mine void as well as governing the life of mine design.

The geological uplift also caused the rejuvenation of the river system which has ultimately formed the current landscape. The mine is located in the headwaters of Barbers Creek and Bungonia Creek which flow into the Shoalhaven River. Both Barbers and Bungonia creeks are ephemeral while the Shoalhaven River is a permanent waterway which flows into Lake Yarrunga/Tallowa Dam and eventually to the coast east of Nowra.

Given the steep nature of the surrounding topography and the lateral extent of the deposit, there was limited room for out of pit material to be emplaced in the very early years of extraction. This resulted in some material being deposited on the steep western slopes of Barbers and Bungonia creeks. As the north/south extent was reached, extraction could continue in a westerly direction. This enabled overburden to the emplaced further to the west in an area outside the final pit limits.

The current approved mine plan covers a 30 year life. The final landform after 30 years will include a final void measuring 900 m wide by 2,000 m long by 270 m deep. The approved water management plan utilises the existing and final void area as an integral component of the surface water pollution control system. Essentially, all dirty water from the active overburden dumping areas is directed into the void where it is settled and seeps into the groundwater system.

The site currently does not possess a licensed discharge point. In the later stages of mining, the South Pit will be filled with overburden and rehabilitated. At this stage, surface water may be directed off site once runoff is considered clean.

1.2 Fluvial Systems

The geomorphology of the Bungonia National Park and associated waterways is unique. The fractured rock system consists of highly modified sedimentary strata which is caused by igneous intrusions, resulting in a complex hydrogeological system.

The mine drains into several minor ephemeral drainage lines leading to Barbers Creek to the east, and Bungonia Creek to the south of the site as shown on Figure 1.

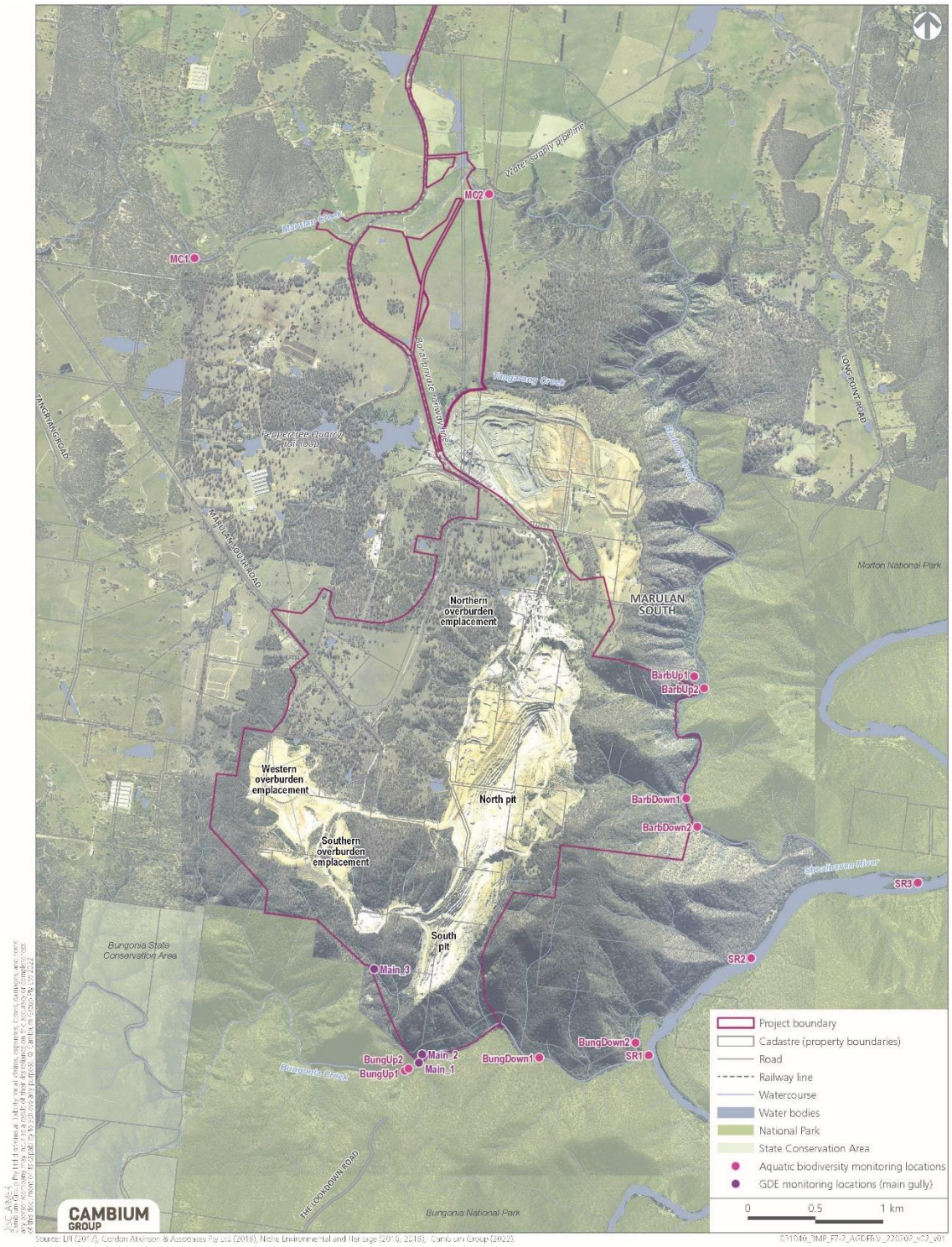


Figure 1 – Monitoring Sites

These two creeks are tributaries of the Shoalhaven River, which lies at least 1.5km from the mine. Barbers Creek and Bungonia Creek are fifth order streams at their junctions with the Shoalhaven River, based on the Strahler Stream Order System. Marulan Creek and Tangarang Creek are fourth order streams which drain into the Shoalhaven River via Barbers Creek.

The drainage patterns have been altered in some places by the mining activities. The eastern and southern sides of the mine have steep batters which have been constructed in external sections of both the North and South Pits above steep ravines below. Runoff from revegetated

eastern batters drains into Barbers Creek. The southern end of the mine area drains naturally towards Bungonia Creek. Incised gullies on the eastern and southern side of the mine drain into Barbers and Bungonia Creeks before discharging into the Shoalhaven River immediately south-east and east of the mine respectively. The two creeks are bedrock confined systems, where only minor change can occur to the geomorphology. The main factors to observe are the build up or movement of sediment across the channel, impacts to natural springs and GDEs within the gorge, and changes to alluvial aquifers in the vicinity of the Shoalhaven River.

1.3 Surface Water Issues

When considering the design of the water management system both now and in the future, the potential surface water issues can be summarised into the following categories.

- Water runoff from the emplacement areas located on the eastern side of the limestone extraction area. These are referred to as Bryce's Gully Emplacement, Barbers Creek Emplacement and the Eastern Batters area. These represent very old disturbance which have previously been rehabilitated but are still a source of runoff. These areas represent approximately 58 ha of rehabilitation on the very steep slopes leading to the Shoalhaven River.
- Runoff from rehabilitated areas, particularly the completed slopes of the overburden emplacements.
- Flood flow discharges from dirty areas not contained within the mining voids. Although upgrading of the dirty water flow paths over recent years has minimised the risk of dirty water escaping from the site even under intense rainfall events, the potential exists as an ongoing environmental risk.

The main risk areas for poor water quality leaving the site are the steep batters and emplacements on the far eastern side of the quarry which despite being previously rehabilitated, are a source of sediment caused by erosive forces. The remaining natural areas are also actively eroding so the monitoring program has been designed to determine only the contribution made by the mine.

2. Surface Water Monitoring Program

This section details the surface water monitoring program which has been designed to identify any potential impacts caused by the limestone mine as well as general river system health.

2.1 Description of River System

Barbers Creek is characteristic of a steep sided gorge for about 8km until it enters the Shoalhaven River and lies to the east of the mine site. This section is comprised of a rocky boulder-strewn channel with rock pools. The channel gradient ranges from 5% to 6%. At the confluence with the Shoalhaven River, the catchment area is about 90km^2. Vegetation surrounding the banks of Barbers Creek include a large variety of fern species, sandpaper figs and native grasses such as snow grass and Lomandra. Casuarinas (Plate 7 & 10, Appendix 1). Black she-oak also scatter the banks, although they are not as prevalent as along the Shoalhaven River.

There is a tributary flowing from Eastern Batters that enters Barbers Creek which is currently being monitored, as shown in Plate 9. This site lies between the Barbers Creek upstream and downstream monitoring locations, and an additional water sample directly upstream of the tributary in Barbers Creek is also taken for comparison (Plate 8, Appendix 1). There has been no change to the water flow or sedimentology of Barbers Creek since monitoring of the tributary commenced in December 2022. The tributary has higher levels of salt, a lower redox potential, but similar DO and pH compared to Barbers Creek in which the Tributary flows into (See Table 2).

Bungonia Creek is a similar rocky boulder-strewn channel which runs through a steep sided gorge for about 8.5km upstream from the confluence with the Shoalhaven River. The upstream and downstream monitoring sites in Bungonia Creek are established either side of the Main Gully confluence. The channel slope in Bungonia Creek between the sample sites is 4%. The catchment is 275km^2, three times larger than that of Barbers Creek and has sufficient flow during high rainfall events to completely remove coarse and fine sediments as well as mobilise large boulders.

A similar vegetation composition is observed on the banks of Bungonia Creek (Plates 4 & 6, Appendix 1). The creek has a large number of ferns and climbers, extensive stands of Casuarinas, Figs and grass trees. The gorge is also dominated by Eucalypts including *E. tereticornis, E. melliodora* and *E. macrorhyncha*.

Main Gully is a drainage line that, prior to mining, had a catchment area of 230 ha and remains the main drainage line for the southern section of the site. The majority of the Main Gully catchment has been removed due to the expanding mine void and now rarely discharges. The Main Gully sample point is located on the southwestern side of the south pit and drainage line ultimately meets Bungonia Creek just below the upstream sample site.

Downstream of Main Gully is a natural feature known as the 'Blowhole'. The Blowhole is a groundwater seep, or spring located below the elevation of South Pit. The Blowhole discharge is groundwater derived and not representative of surface water quality. It does however, influence water quality within Bungonia Creek. Samples are taken from the lower end of the Blowhole, prior to entry into Bungonia Creek.

The Shoalhaven River has a catchment area of 4,400km^2 at the confluence with Barbers Creek. The river has a wide channel between Barbers and Bungonia Creek with sandy banks scattered with Casuarina trees. The sandy banks imply that the river receives significantly lower flow velocities than the two creeks (Plates 1-3, Appendix 1). The salt content is significantly lower in the Shoalhaven River than in the two Creeks, with lower electrical conductivity, total dissolved solids and salt, as recorded in Tables 1 and 2 below.

A high rainfall event in August 2020 caused a significant impact to the river. High water flow was experienced 20-50m up the bank from the main water course, where existing shallow rooted casuarinas were uprooted and the sandy banks were washed away. Some of these areas, particularly at the upstream site 'SR1' remain exposed and unvegetated from this event (Plate 1d shows the impact in 2020).

There has been no change to the geomorphology of the Shoalhaven River for several years, and no evidence of any impacts from the mine.

2.2 Program Design

The program has two main components, the first is the collection and testing of water quality within the receiving waters while the second is a visual inspection of the riverine vegetation health and photographic record of stream morphology.

2.2.1 Water Quality Monitoring Program

The monitoring program has been designed to enable the assessment of impacts, both positive and negative, on the receiving waters over the long term. To achieve this, the monitoring and observation sites include both upstream and downstream of the mine in each of the creeks that the mine could potentially impact. This includes:

- Barbers Creek Upstream and Downstream sites, referred to as Barbers Up and Barbers Dn. This creek system is fed by a number of minor tributaries which drain the eastern side of the mine including the Bryces and Barbers Emplacements. Both these emplacements have been previously rehabilitated but due to their steep nature can erode and produce sediment which is deposited in the tributaries of Barbers Creek.

- Bungonia Creek Upstream and Downstream, referred to as Bungonia Up and Bungonia Dn. This is a significant tributary to the Shoalhaven River and flows along the southern boundary of the mine. Between the upstream and downstream sites are the Southern Western Batters area which has previously been rehabilitated but has the potential to be a source of sediment and similarly the clean water drainage discharge from the Western Overburden Emplacement area. The clean water drainage system flows down Main Gully but can also be a source of sediment during extreme rainfall events due to natural erosion of the bed and banks and potential overflows from dirty water areas. Main Gully is equipped with an automatic water sampling site.

- The Blowhole site is located above the confluence of Main Gully and Bungonia Creek. It is a natural spring which is sourced from the limestone deposit below the extraction area. It is a point where groundwater discharges to surface water and joins Bungonia Creek between the upstream and downstream sampling sites. Being groundwater derived, the water quality is

significantly different from the surface water of Bungonia Creek and has often been observed with an orange sediment present (Plate 5 in Appendix 1).

- Upstream and downstream of the main receiving waters of the Shoalhaven River. There is also a mid point sampling site as well. These sites are referred to as SR1 (Upstream Site), SR2 (Mid Site) and SR3 (Downstream Site). The Shoalhaven River is considered the final receiving waters for the mine.

Samples are taken on a quarterly basis and tested for a range of physical and chemical parameters. These include pH, conductivity, suspended and dissolved solids, dissolved oxygen, alkalinity, hardness, cations and anions. These parameters provide an overall indication of river health and can be used to compare the results with other typical river systems. Additional tests are undertaken to determine if there are any specific stressors within the river system. This includes the metals Aluminium, Beryllium, Barium, Cobalt, Copper, Manganese, Molybdenum, Nickel, Selenium, Strontium, Vanadium, Zinc, Boron, and Iron. Heavy metals including Mercury, Lead, Chromium, Cadmium, and Arsenic are also included.

Nutrients are also included in the testing regime in order to complete the river health assessment. These include Nitrogen compounds, Phosphorus, Sulphate and Potassium. These compounds are typically associated with pollution from agriculture and manufacturing processes.

2.2.2 Stream Geomorphology

A visual assessment of waterways is undertaken at each monitoring site at the time of collection of water samples. Records of quarterly photographs at each location can then be used to determine any long term changes that may occur. The records include:

- bank and bed stability;
- level of sedimentation;
- evidence of active erosion;
- vegetation health and vigour.

The visual assessment and photographic records are compared with historic results on a quarterly basis. Additional information is recorded if considered necessary based on any sudden changes that may have occurred between quarterly inspections. This may include high rainfall events or continuation of an extended dry period.

2.3 Program Results

The following section provides the results of the monitoring program up until the June 2023 reporting period.

2.3.1 Barbers Creek Water Quality Results

The pH levels at Barbers Creek upstream and downstream have ranged from 6.59 pH units to 8.28 pH units since September 2014 (Figure 1). The pH has been consistent during the same sampling period at the two sites, with average pH of 7.89 and 7.93 pH units upstream and downstream respectively. Values have been more variable since heavy rainfall and high flow conditions from 2021 onwards. The lowest pH was recorded in January 2023 which was 0.6 pH units lower than any other sample recorded.

All of the creeks being monitored are sourced within limestone bedrock systems. Although limestone is naturally alkaline, fast flowing surface water from high rainfall events would not allow sufficient time to raise the pH in normally neutral precipitation. Flow rate and duration of contact with limestone is the main factor affecting pH.

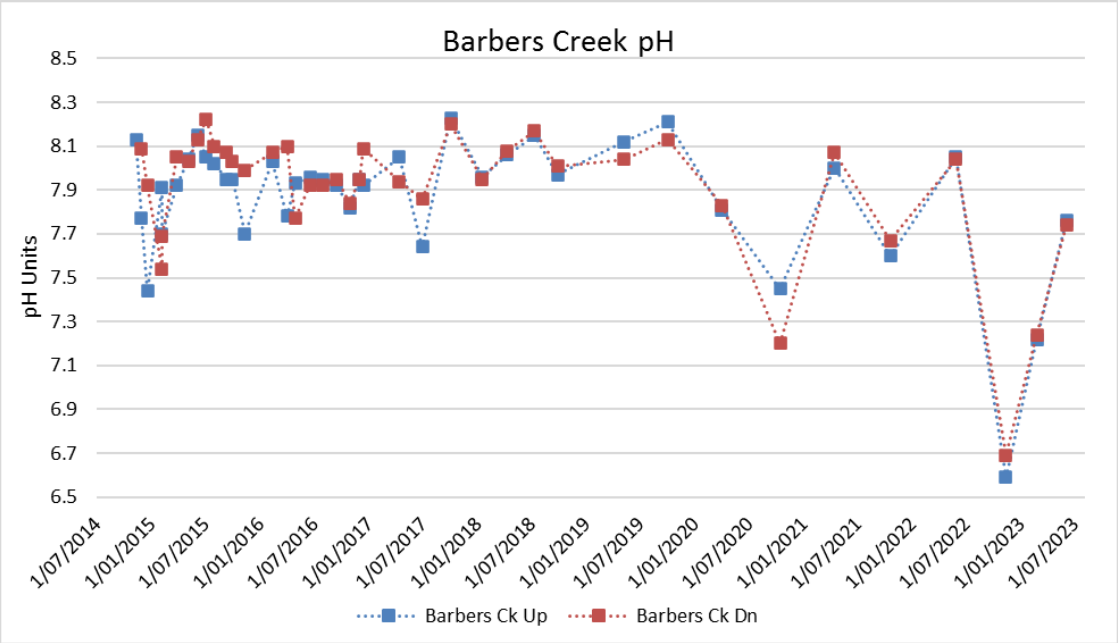


Figure 1- Barbers Creek upstream and downstream pH

The electrical conductivity levels in Barbers Creek have fluctuated from 257 µS/cm to 1120 µS/cm over the past 9 years as shown in Figure 2. The conductivity levels have remained similar at sites upstream and downstream during the same sampling periods. High levels of fluctuation were observed from 2014-2018 during drought conditions, which then plateaued at around 900 µS/cm for two years until 2020. Following higher rainfall, there has been a continued drop in conductivity to levels of 400 µS/cm which hadn't previously been recorded since late 2016.

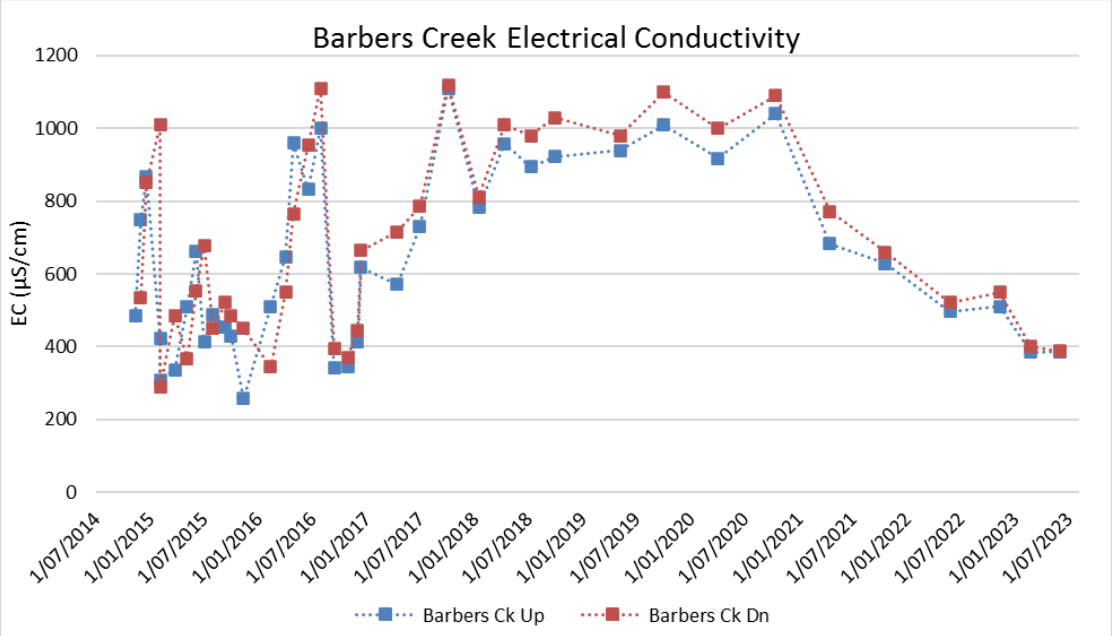


Figure 2- Barbers Creek upstream and downstream EC

The suspended solids in Barbers Creek are often below detection limits of <5 mg/L as shown in Figure 3 below. The highest levels of suspended solids were recorded in January 2023 at levels of 11 mg/L and 8 mg/L at Barbers Creek upstream and Barbers Creek downstream respectively.

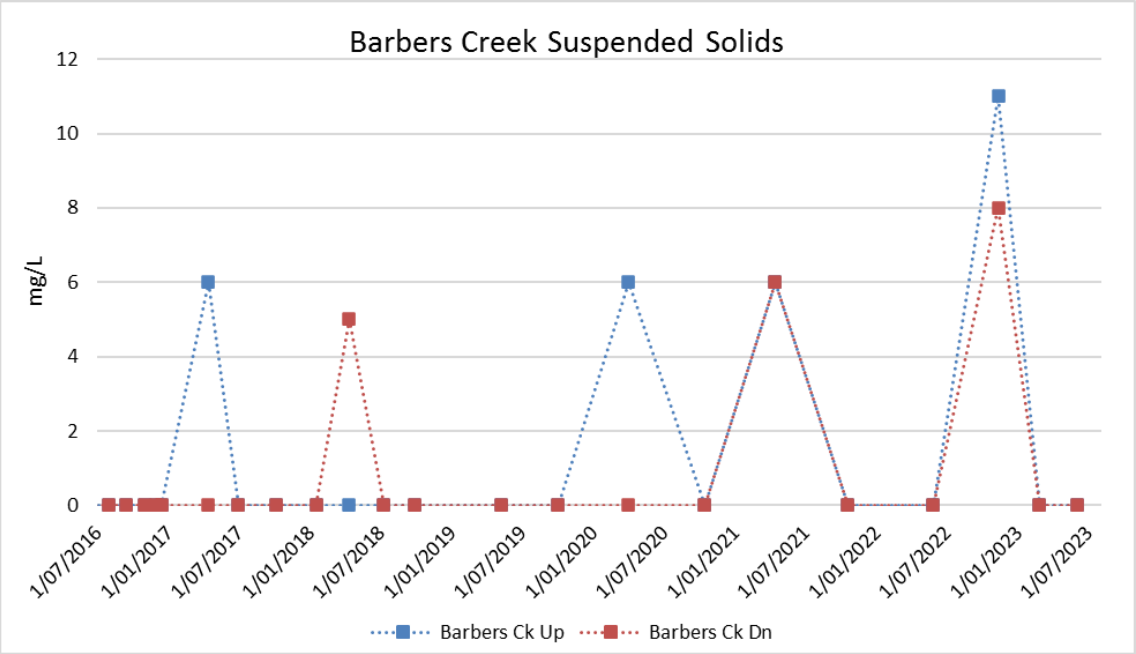


Figure 3- Barbers Creek upstream and downstream Suspended Solids

The dissolved oxygen levels in Barbers Creek range from 4.4 mg/L to 11.5 mg/L since 2014 (Figure 4). Samples taken from upstream and downstream sites have generally followed the same trend, with the same average of 9.3 mg/L at both sites.

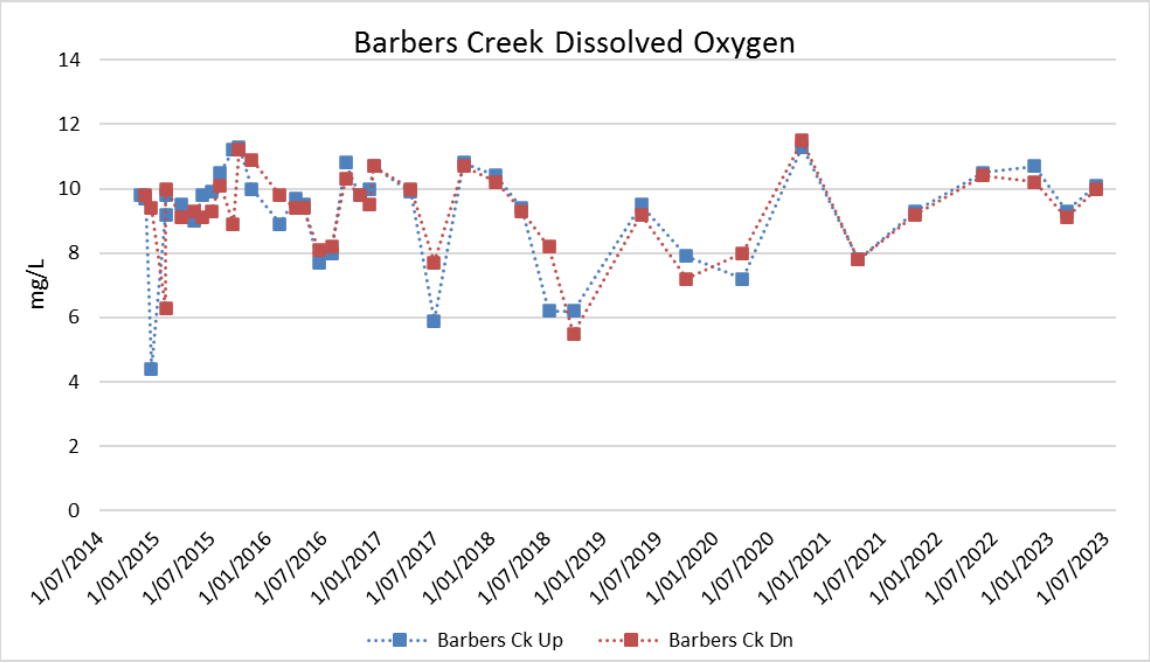


Figure 4- Barbers Creek upstream and downstream Dissolved Oxygen

The total nitrogen levels in Barbers Creek have generally remained below 2 mg/L apart from one spike of 3.8 mg/L/ at the upstream site in April 2017 (Figure 5). The average total nitrogen at Barbers Creek upstream and downstream are 0.60 mg/L and 0.54 mg/L respectively.

Nitrogen levels can be arbitrarily high at any point in time, particularly in small ephemeral creeks where a single dead animal can cause spikes in either Nitrogen or Phosphorus or both. If a spike appears, a comparison is made with other analytes such as dissolved oxygen to determine if there are any potential ongoing issues of concern. In this case, dissolved oxygen has remained generally between 6 and 11 mg/L which is indicative of a normal healthy river system.

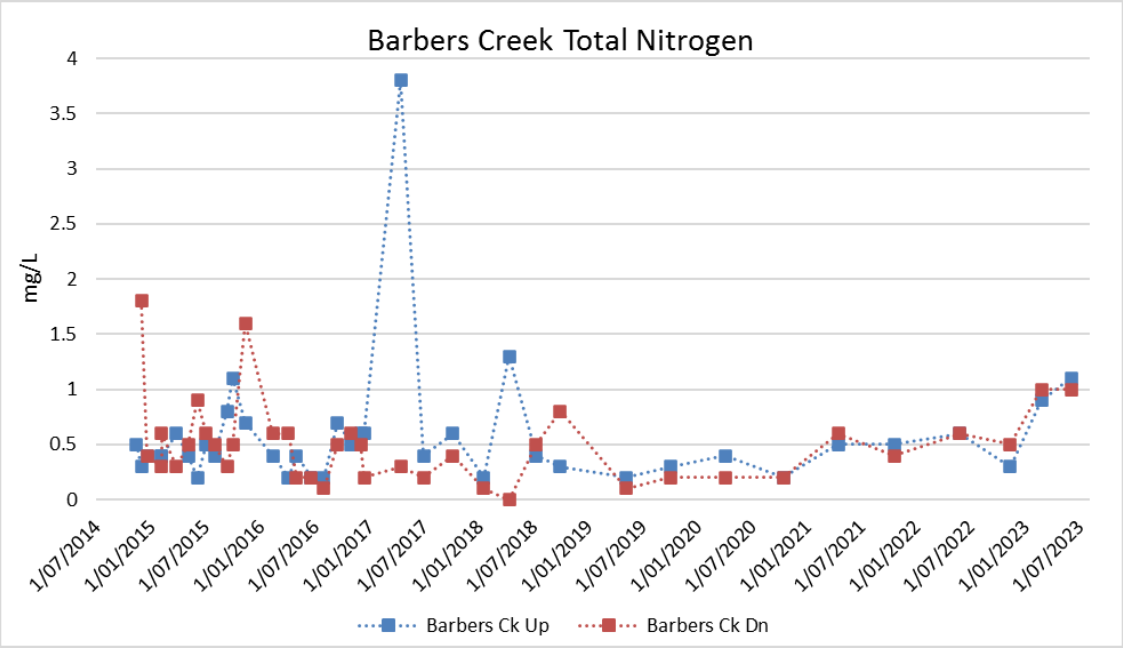


Figure 5- Barbers Creek upstream and downstream Total Nitrogen

The Barbers Creek total phosphorous concentrations generally remain below the detection limits of <0.01 mg/L, as shown in Figure 6 below. There have been several peaks in phosphorous over the past 9 years, with maximums recorded as 0.1mg/L at the upstream site in January 2023, and in the downstream site in December 2016.

Phosphorus is as an essential nutrient for all plant and animal life, commonly as phosphate in inorganic fertiliser. Natural levels of Phosphorus have a similar range of between 0.01 to 0.08 mg/L. ANZECC guidelines place Phosphorus levels for natural rivers and streams at less than 0.1 mg/L. The levels found in Barbers Creek are within natural levels and do not indicate that there has been any contamination with fertilisers used in the rehabilitation work on the eastern emplacement and batter areas.

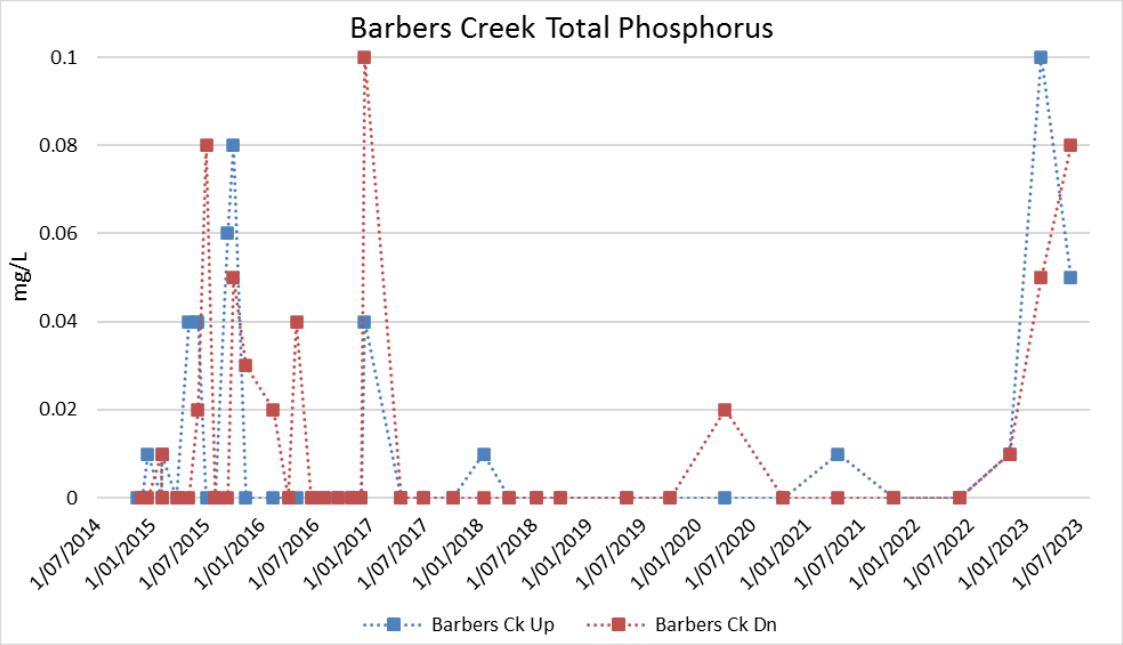
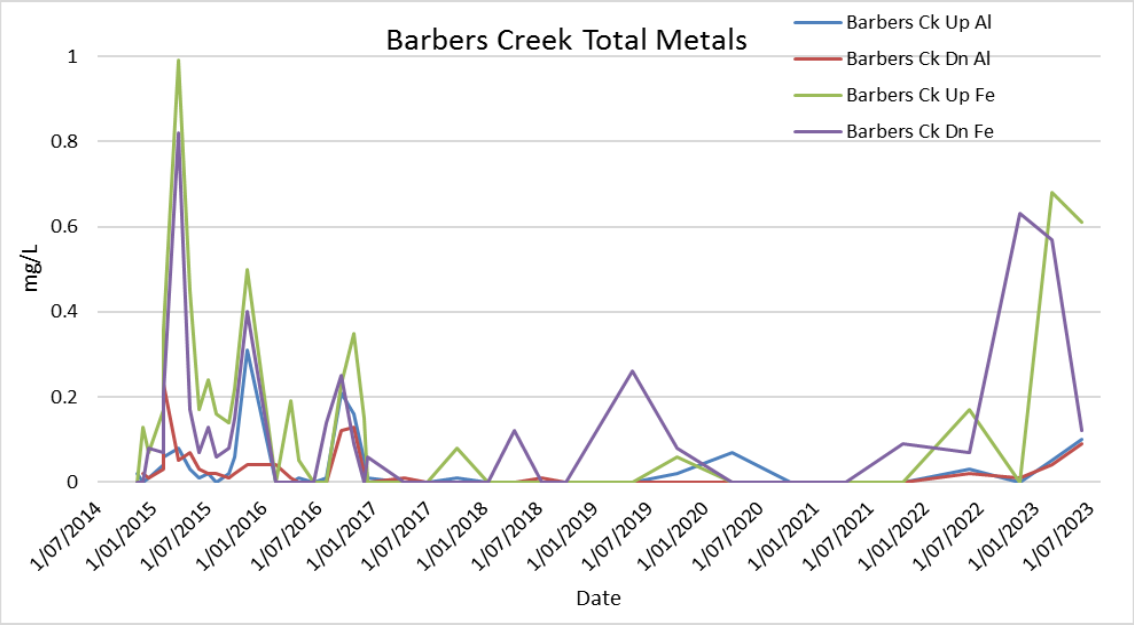


Figure 6- Barbers Creek upstream and downstream Total Phosphorus

When characterising general aquatic water systems, it is important to describe metal content. Metals vary in natural systems and usually reflect the type of underlying geology through which the waterway flows. Metal concentration can also be influenced by groundwater seeps and springs which can be metal rich due to the prolonged time in contact with source rock.

The analysis of metals in the following graphs use total values not dissolved or filtrable. These values are used to give an indication of total metal load for comparative purposes and are usually higher than the dissolved levels which are referenced in guidelines such as ANZECC 2000.



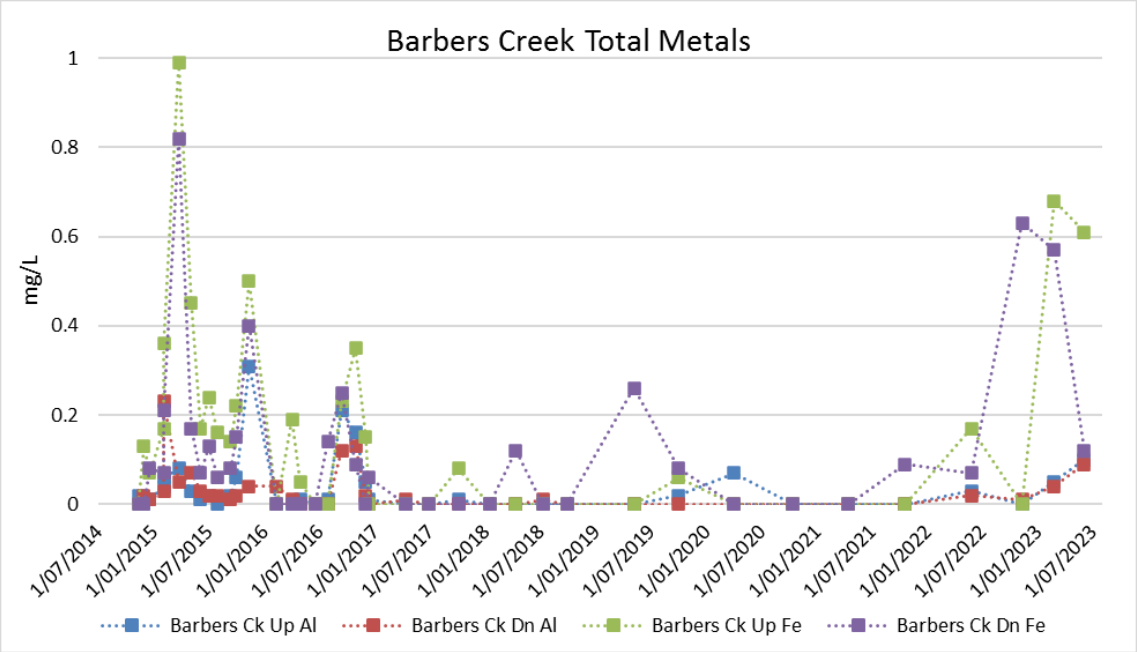


Figure 7- Barbers Creek upstream and downstream Total Metals (Aluminium and Iron)

Figure 7 above shows Aluminium and Iron concentrations both upstream and downstream of Barbers Creek. The graph shows that although concentrations fluctuate, they fluctuate in relative unison. This is generally and indication that the concentrations are reflective of rainfall and flow volumes within the creek. There is no indication that the section of Barbers Creek as it flows past the Marulan Mine is having an influence on the concentrations of Iron and Aluminium. It is also noted that the level of Aluminium in the water is generally low being below detection limits but on occasions has been relatively high.

An elevated reading occurred on 10th September 2015 with 0.31 mg/L Aluminium upstream and 0.23 mg/L downstream within Barbers Creek. With the long term average concentration of Total Aluminium being less than 0.05 mg/L, the elevated reading on a particular monitoring event could have several reasons. As Aluminium is often an ingredient in fertilisers, it could be reasonably assumed that the elevated levels could have been caused by rehabilitation activities. A review of other water quality parameters during that quarter also revealed elevated total Nitrogen levels which also supports the conclusion that this sample was exposed to fertilisers.

The use of fertilisers on rehabilitation areas is normal and it is expected to be detected in downstream water quality analysis. Short term spikes are not hazardous to normal environmental or riverine processes and have no lasting or ongoing impacts. However, excessive use of fertilisers can cause nutrient related impacts within receiving waters. This situation becomes impacting if the elevated levels are sustained over longer time periods which often is the case with streams draining active agricultural areas where regular fertiliser treatments result in continual leaching of nutrients.

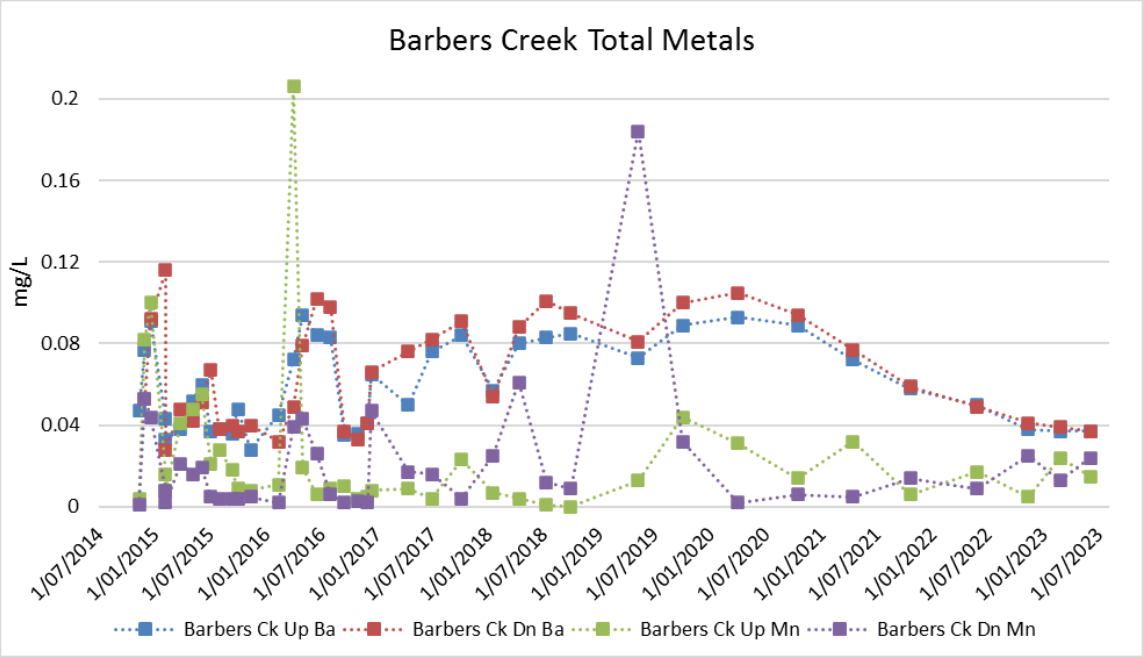


Figure 8- Barbers Creek upstream and downstream Total Metals (Barium and Manganese)

Barium and Manganese concentrations are shown in Figure 8. Both minerals are naturally occurring although can also be generated by anthropogenic processes. Manganese is also a common fertiliser additive. There is no specified level of Barium in the ANZECC guidelines however Manganese has a 95% ecosystem protection goal of 1.9 mg/L. A Manganese spike occurred in December 2015 shortly after the spike in Aluminium which also indicates that the cause could have been fertiliser addition which was making its way down stream. In May 2019 a similar spike in Manganese occurred in the downstream site indicating the time taken for the fertilisers to move through the sediments. This timeframe would be expected with an ephemeral creek system which does not see regular water movement but only following rainfall.

Barbers Creek is feed from a series of short ephemeral tributaries which drain the eastern slopes of the Marulan Mine. It can therefore take several flushing events to move sediments into the main water course of Barbers Creek.

2.3.2 Bungonia Creek Water Quality Results

Bungonia Creek lies to the south of the Marulan Limestone Mine. Both Barbers and Bungonia Creeks have similar geomorphology comprising bedrock, large boulders and pools with little macrophyte growth. There is a groundwater base flow component which assists in overall flow volume but can also have an effect on water quality in low flow conditions. Barbers Creek is more prone to having periods of no visible surface flow than Bungonia Creek.

Bungonia Creek receives water from Main Gully which is essentially the clean water diversion from the mine. It includes water from completed rehabilitation areas and undisturbed land however a large component of the original catchment has been cut off by the mine pit and overburden emplacements. This dirty water is directed into the South Pit.

Figures 9 to 16 show the results of historic water quality in Bungonia Creek and centre on the upstream and downstream monitoring sites. The upstream site is well away from any potential influence of the mine while the downstream site is located just prior to the confluence with the Shoalhaven River.

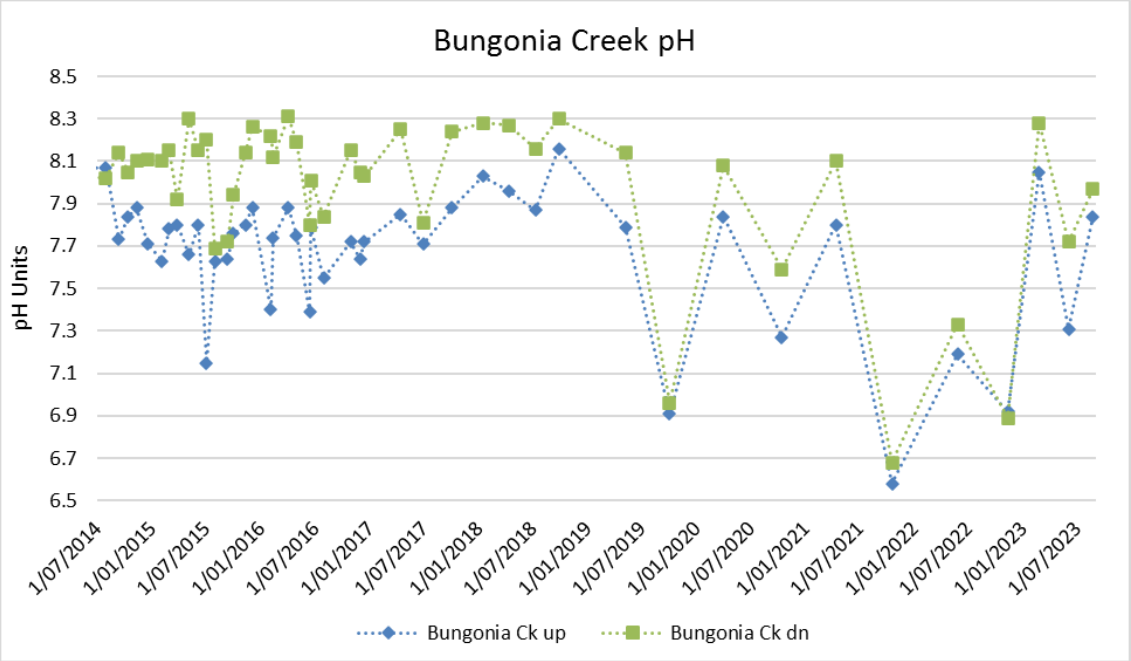


Figure 9- Bungonia Creek upstream and downstream pH

Figure 9 shows the pH between the upstream and downstream sites. There is excellent correlation between the two sites indicating that variations in pH are caused by natural factors which impact both the upstream and downstream sites in a similar manner.

There is however an overall increase in alkalinity downstream of the mine with the Bungonia Down site having a long term average pH of 8.0 while the long term average for the upstream site being a pH of 7.6. Both values are reflective of the geology that the creek flows through.

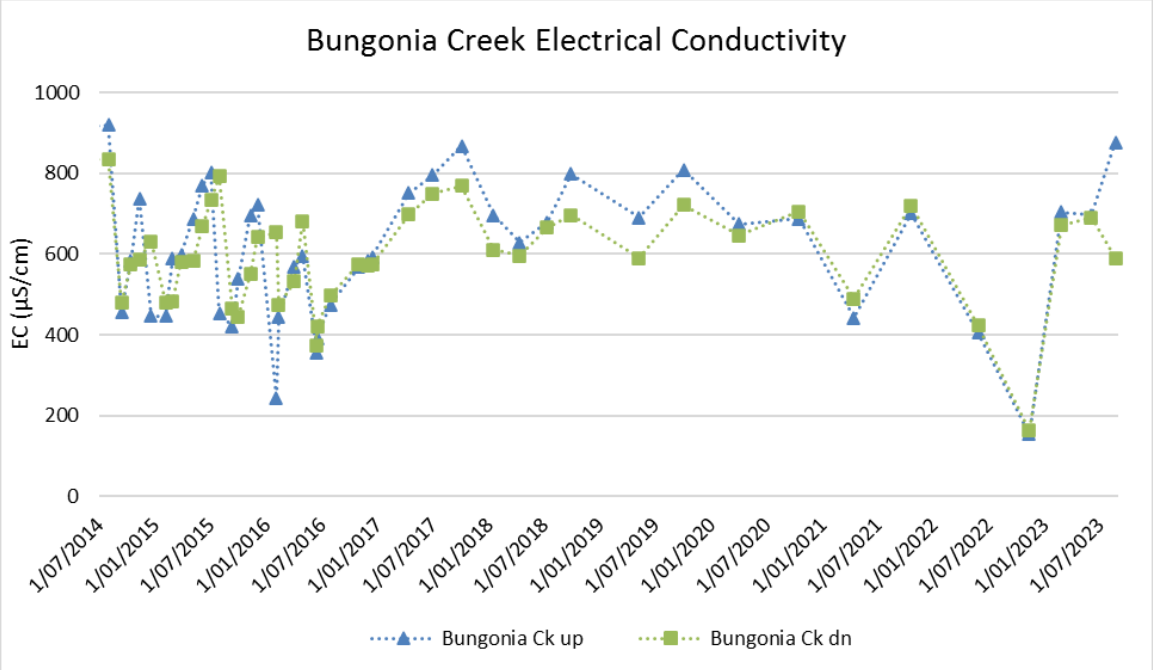


Figure 10- Bungonia Creek upstream and downstream EC

The salt content in water is measured as Electrical Conductivity. Fresh water generally has a very low conductivity of between 20 to 50 µS/cm. In natural waterways, the level of salt is a factor of the surrounding geology that the water is passing over and the length of time that the water is in contact with that strata. Groundwater generally has higher salt levels because it has spent longer in contact with the host rock while rainwater has very low conductivity because it has yet to be influenced by the surface it flows over on the ground.

Figure 10 shows the upstream and downstream conductivity results since 2014. This graph shows that there is some fluctuation in the level of salt but a very good correlation between the upstream and downstream sample sites. The long term average conductivity for the upstream site is 611 µS/cm, while the long term average for the downstream site is slightly lower at 594 µS/cm.

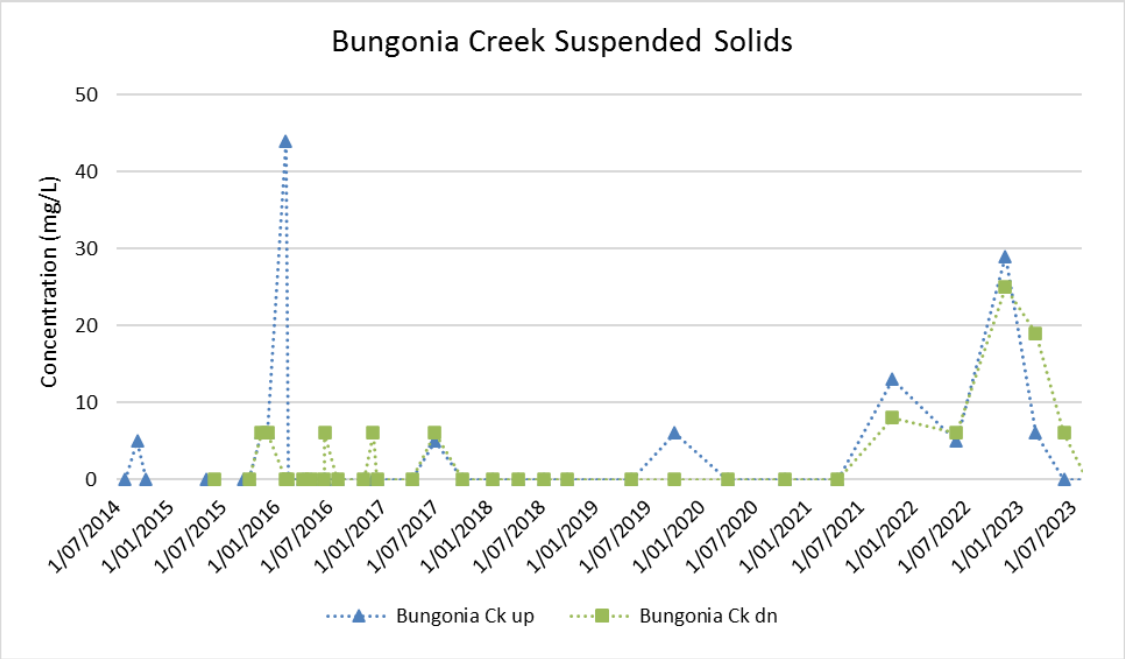


Figure 11- Bungonia Creek upstream and downstream Suspended Solids

The long term average suspended solids and dissolved oxygen levels is shown in Figures 11 and 12 respectively. The overall levels indicate that Bungonia Creek has very clear and well oxygenated water that is actively flowing. However, the data also shows that during storm events, sediment is moved downstream. These flushing events influence stream morphology over time.

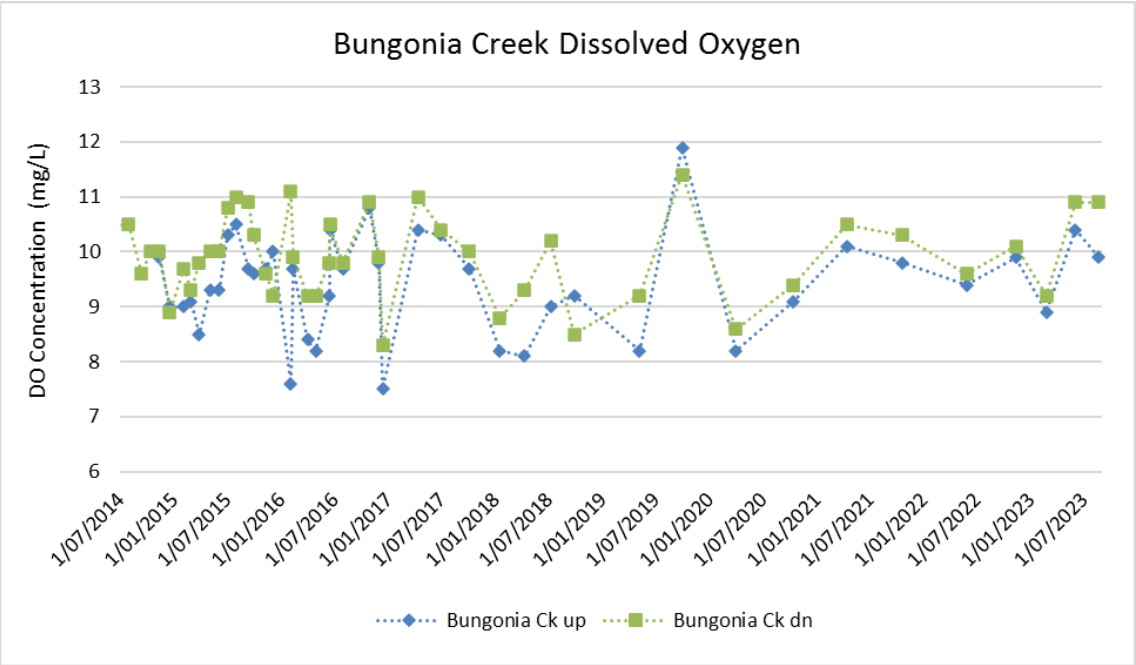


Figure 12- Bungonia Creek upstream and downstream Dissolved Oxygen

The Dissolved Oxygen levels are considered optimal for stream health and for the support of aquatic ecosystems. Nutrient levels are shown in Figures 13 and 14. Nitrogen and Phosphorus are considered non-toxic environmental stressors. They are essential elements for ecosystem health but in larger quantities they can result in excessive algal growth and cyanobacterial blooms (ANZECC 2000). Total Nitrogen values in an Upland River category under ANZECC 2000/2018 guidelines is 0.25 mg/L while the long term irrigation trigger value is 5 mg/L.

Although the overall levels are high, the upstream level is also elevated compared to the default ANZECC goal. The increase downstream appears to be the result of the discharge from the Blowhole site which is located between the upstream and downstream sites. The results from the Blowhole are discussed in Section 2.3.2.

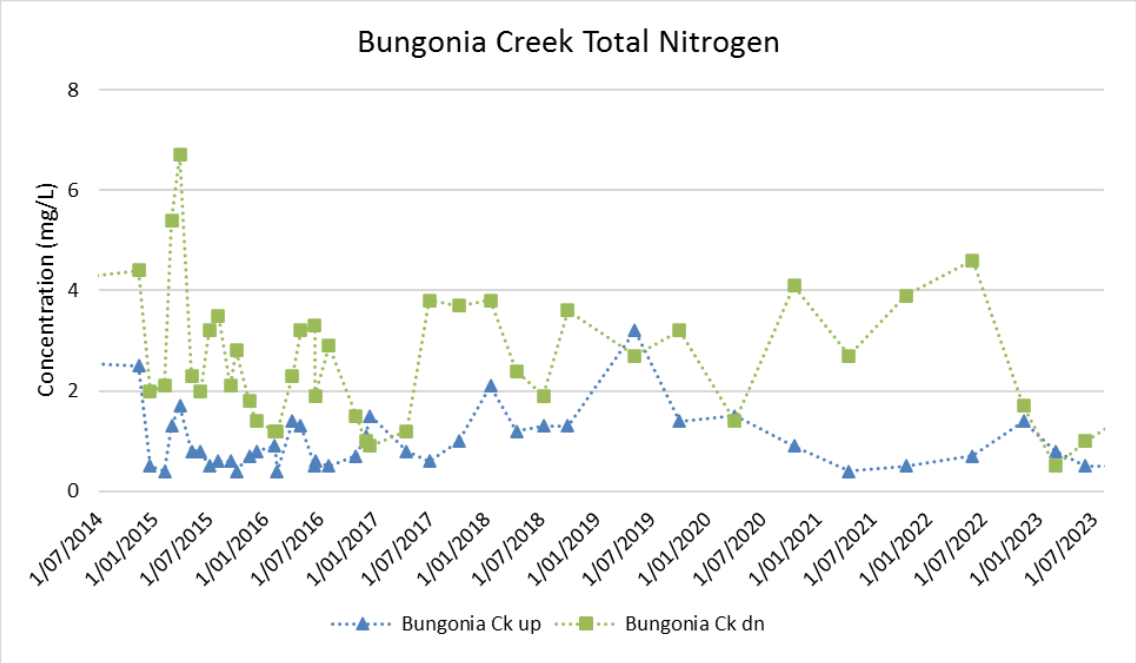


Figure 13- Bungonia Creek upstream and downstream Total Nitrogen

Bungonia Creek is approximately 30 km long and drains a large area of agricultural land upstream of the mine. The elevated Nitrogen could be caused by agricultural fertilisers however the increase from the upstream and downstream sites indicates that majority of the contribution is coming from the Blowhole (refer Figure 21).

As the levels are relatively consistent, it is unlikely to be caused by flow. Changes in flow appears to have an influence on some metals and suspended solids, however the concentration of Nitrogen has been relatively consistent despite changes in flow conditions between above average rainfall periods and drought. These issues are discussed in the following section.

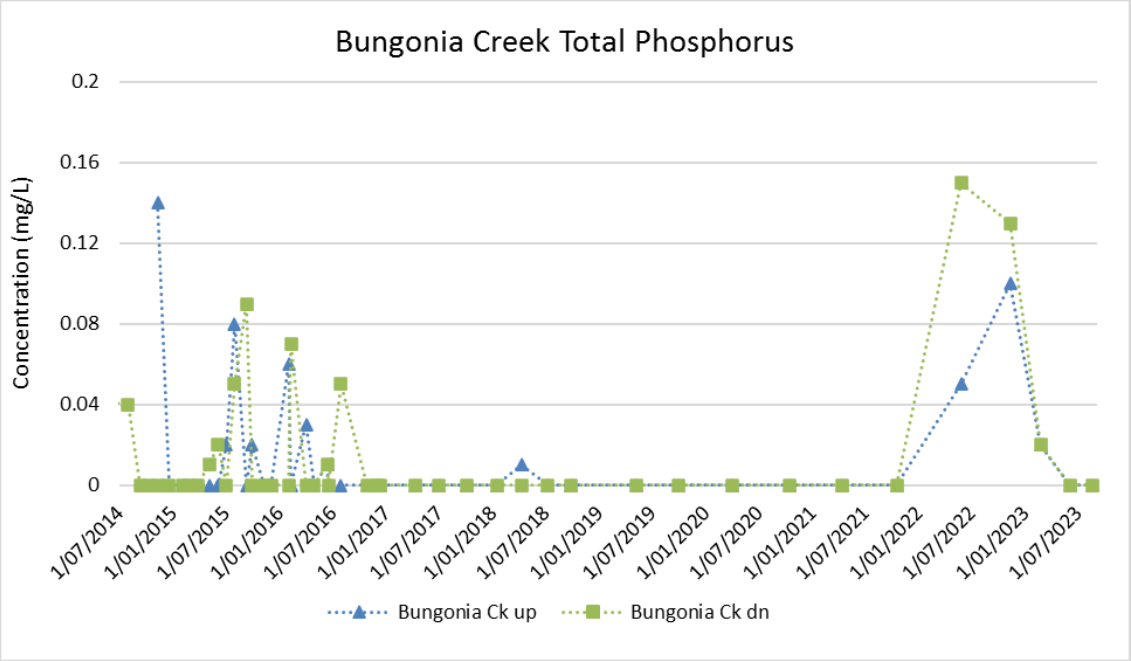


Figure 14- Bungonia Creek upstream and downstream Total Phosphorus

Phosphorus is also an indicator of nutrient levels. ANZECC 2000 guidelines have a goal for Upland Rivers of 0.02 mg/L of Total Phosphorus. There are many occasions where the level of Phosphorus is above the environmental trigger. The monitoring program commenced in a period of higher flow conditions post Millennial Drought (2001-2009). This period was followed by dry conditions in 2017 to 2019 with subsequent above average rainfall in 2021-22.

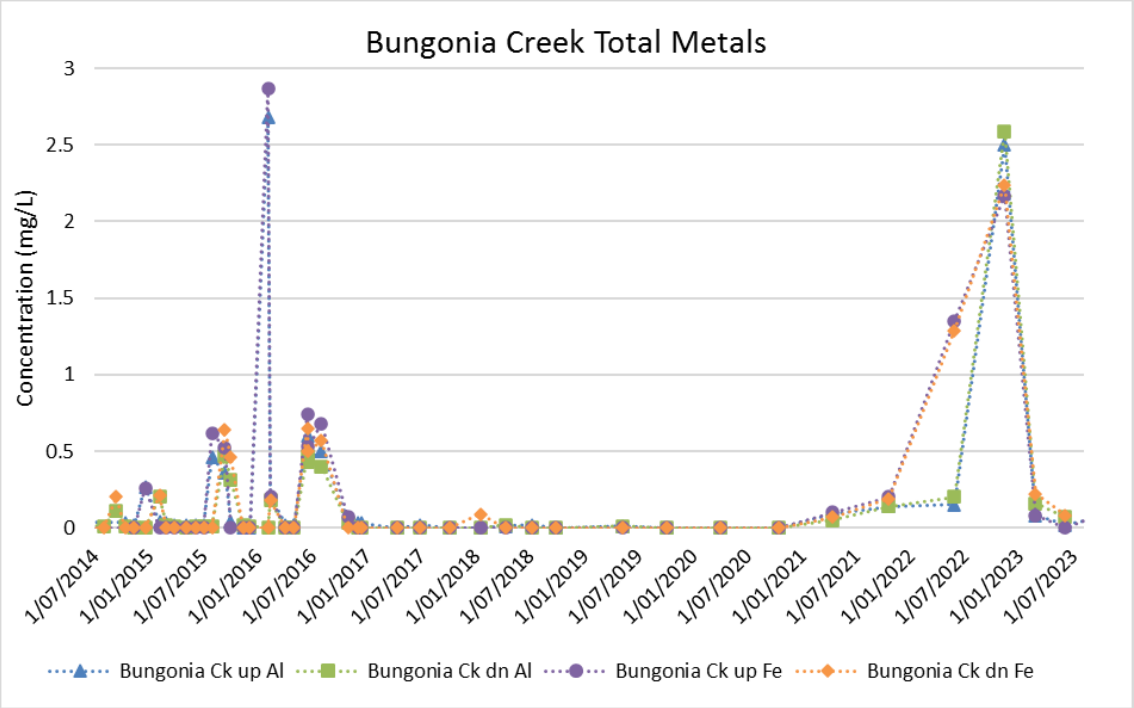


Figure 15- Bungonia Creek upstream and downstream Total Metals (Aluminium and Iron)

The pattern with Aluminium and Iron concentration is similar to that of Suspended Solids which appear to be influenced by flow conditions. Higher flow will tend to relocated minerals from higher in the catchment down towards the confluence with the Shoalhaven River. There was one elevated Iron level of 2.8 mg/L in February 2016 however are no environmental goals specified for Iron concentration and it could have been an outlier result.

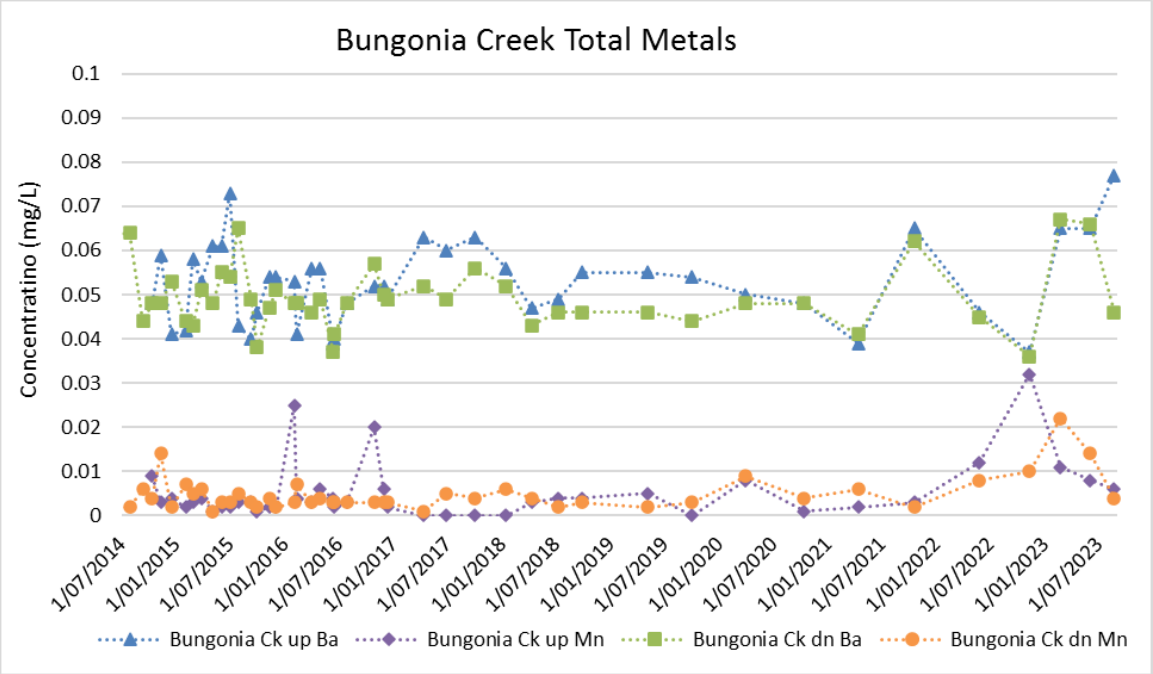


Figure 16- Bungonia Creek upstream and downstream Total Metals (Barium and Manganese)

Other metals tend to follow a close correlation between the upstream and downstream sites and the overall levels are considered indicative of a healthy river system.

2.3.3 Blowhole Water Quality Results

The Blowhole site is located between the Bungonia Creek Upstream and Bungonia Creak Downstream sites. It is a natural spring at a lower elevation of South Pit which meaning its water is sourced from the limestone deposit below the extraction area. It is a point where groundwater discharges to surface waters and is a common feature in karst limestone environments. Being groundwater derived, the water quality is significantly different from the surface water of Bungonia Creek.

It is also possible that underground cavities exist within the limestone strata. These may contain organic compounds, stygofauna or accumulated minerals which can lead to vastly different water quality than would normally be derived from springs.

The pH levels at the Blowhole have spanned over a range of 1.4 pH units over the past 9 years, with a minimum and maximum of 6.8 pH units and 8.2 pH units respectively. The overall trend has shown a gradual decline in pH over this period of time (Figure 17). The average has been recorded as 7.9 pH units. The variability in pH indicates that there may well be other factors affecting the pH in addition to the surrounding limestone which would normally keep the pH relatively alkaline. A pH of below 7.5 indicates that these other factors have overcome the alkalinity of the surrounding limestone.

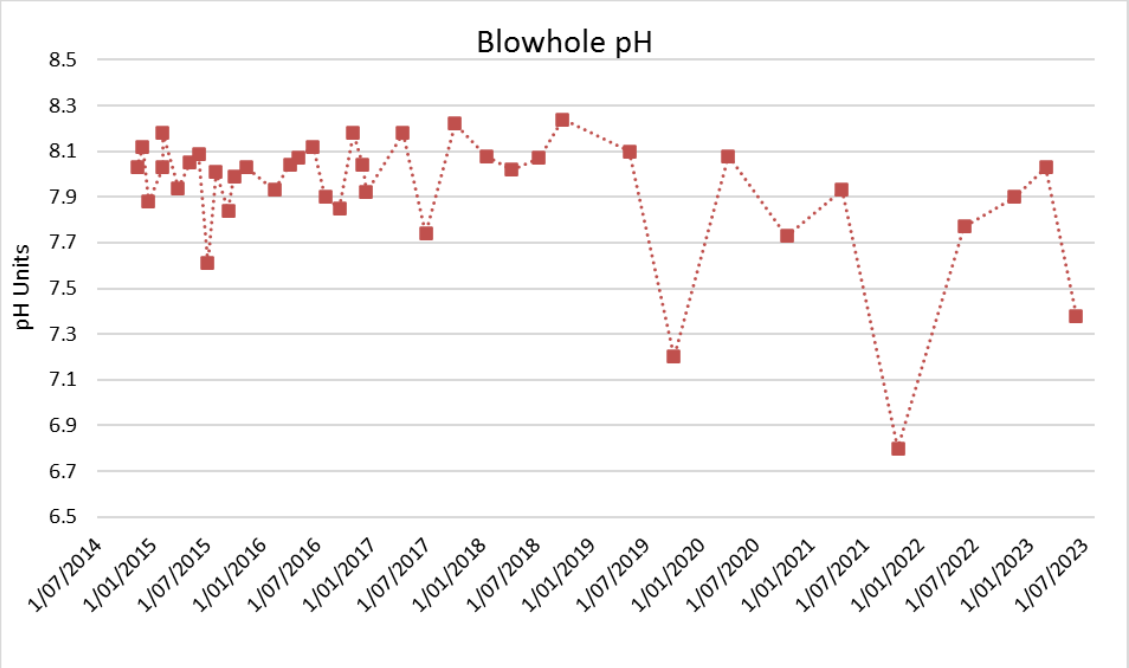


Figure 17- Blowhole pH

Figure 18 below shows that the electrical conductivity concentration of the Blowhole has fluctuated from 524 µS/cm to 724 µS/cm with an average of 632 µS/cm since 2014. The concentration has remained relatively stable over this period of time, with no obvious trends.

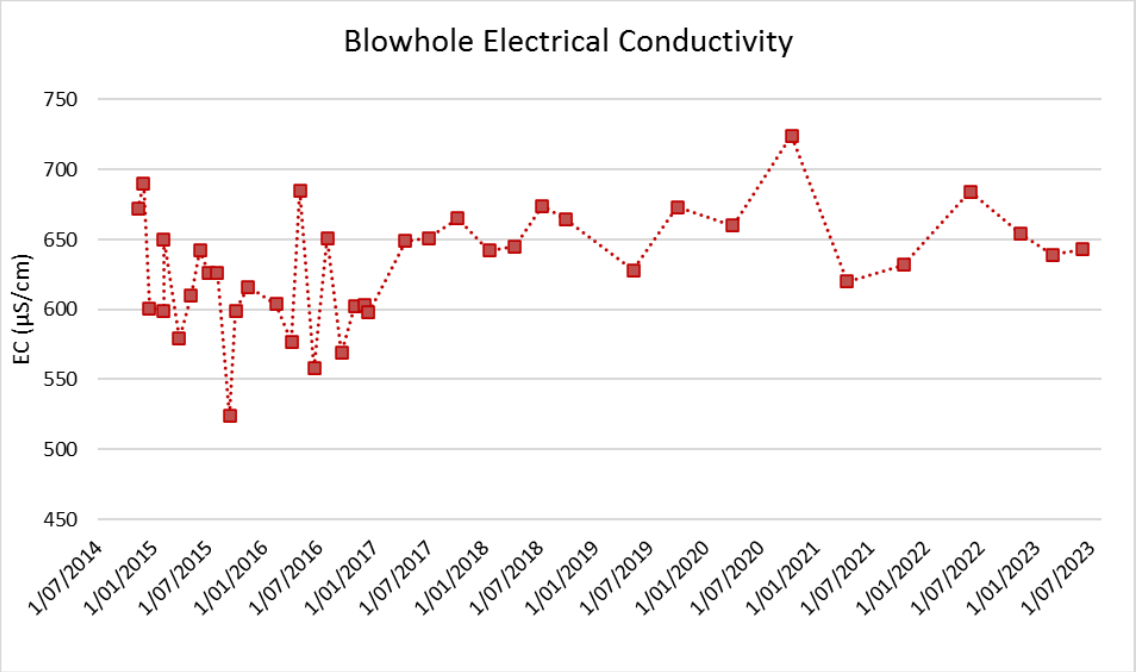


Figure 18- Blowhole Electrical Conductivity

The suspended solids generally remained below the detection limits (<5mg/L), with only a few outliers up until 2019 (Figure 19). Since that time, the levels have ranged between 6 mg/L to 60 mg/L, with an increasing trend since January 2022. During periods of high solids loading, the discharge has been noted as brown to orange in colour. This indicates the presence of elevated minerals.

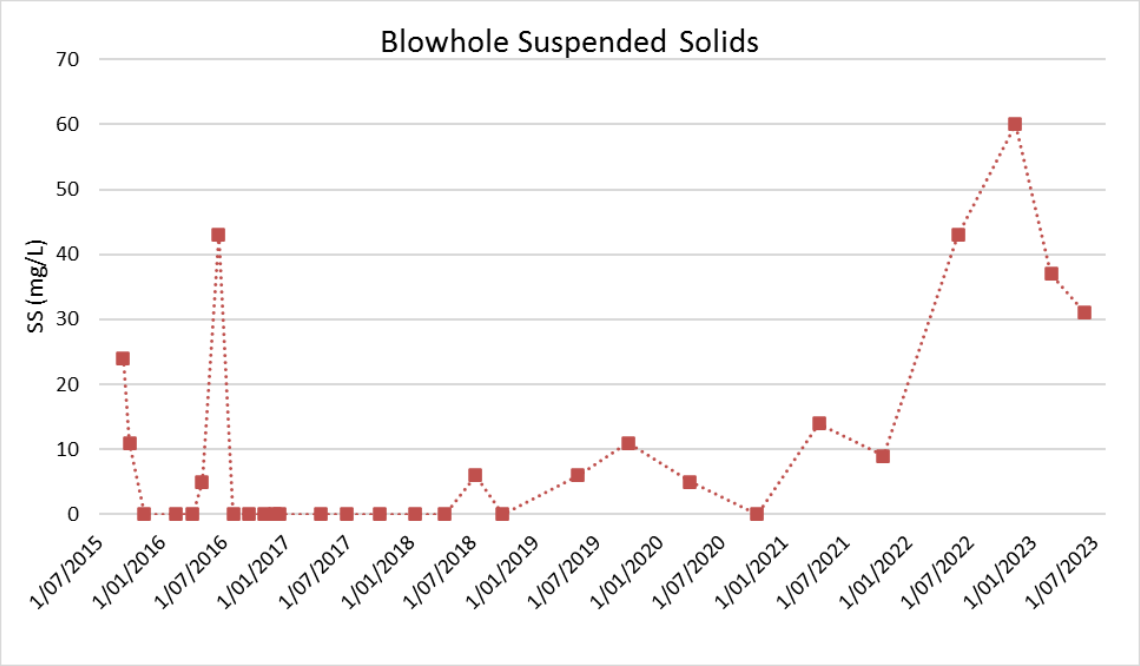


Figure 19- Blowhole Suspended Solids

The dissolved oxygen concentrations within the Blowhole have remained relatively consistent, with an average of 9.73 mg/L and a range of 7.5 mg/L to 11.2 mg/L, as shown on Figure 20. Results show that the groundwater discharged from the Blowhole has sufficient dissolved oxygen levels to support aquatic life.

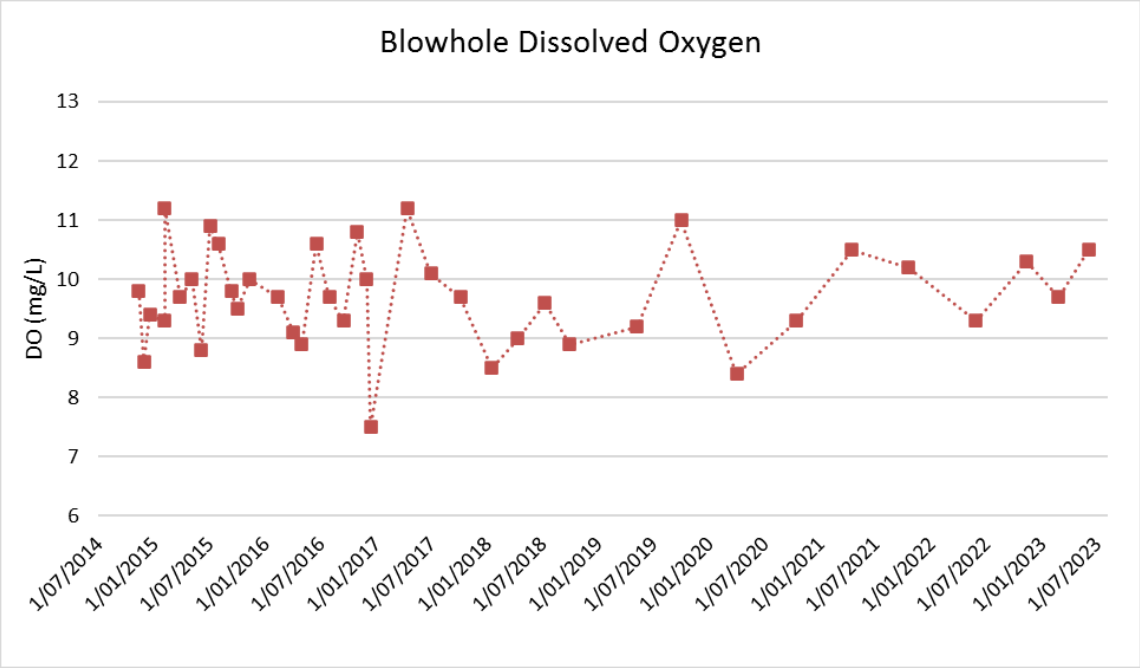


Figure 20- Blowhole Dissolved Oxygen

Nitrogen and Phosphorus occur naturally but the levels at the Blowhole are uncharacteristically high (Figure 21). For natural systems to yield Nitrogen at the measured levels would indicate the presence of high levels of organic matter. As the volume of the Blowhole discharge is relatively small, there is only a minor increase in Nitrogen levels downstream (refer Figure 13). However, the cause of the elevated Nitrogen is unknown. The long term average Total Nitrogen concentrations are 8.65 mg/L, with a range of 5.1 mg/L to 15.1 mg/L. Since 2018, with Nitrogen levels have remained between 6 mg/L and 8 mg/L with a spike in 2020-2021, with levels rising to as high as 14 mg/L, similar to levels recorded in earlier years (2014 and 2017).

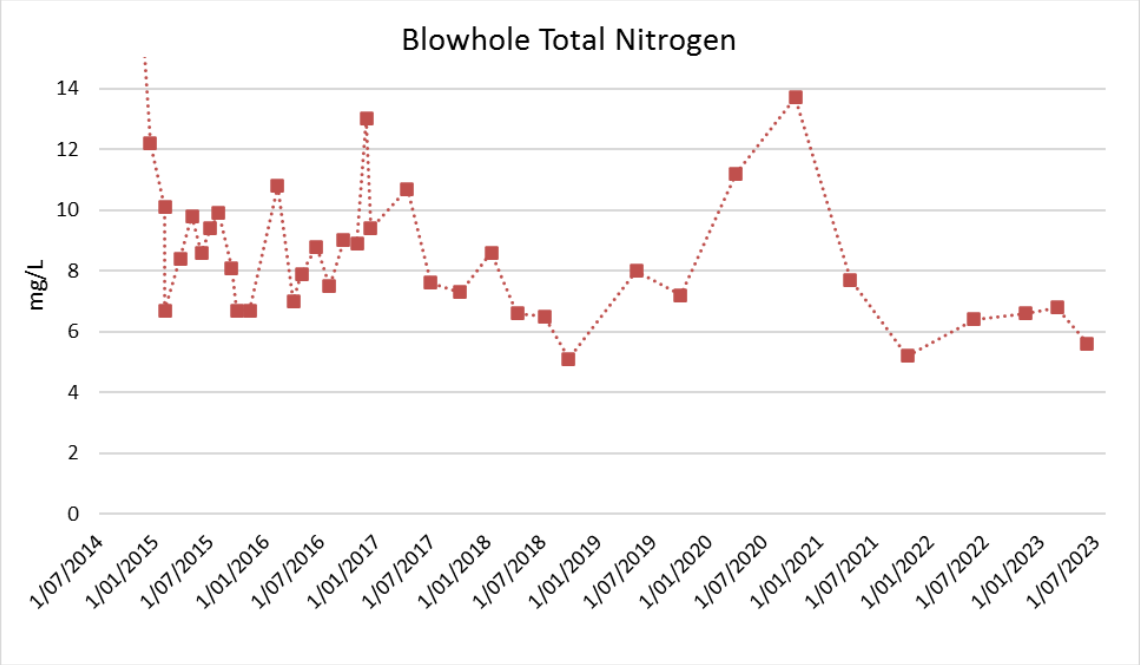


Figure 21- Blowhole Total Nitrogen

For a period of 4 years from 2017 to 2021, the phosphorus concentration remained below the detection limit of 0.001 mg/L. Levels of phosphorus spiked in June 2022, with a level of 0.09 mg/L during heavy rainfall and high flow events (Figure 22). The concentration of phosphorus dropped back below detection limits later in 2023.

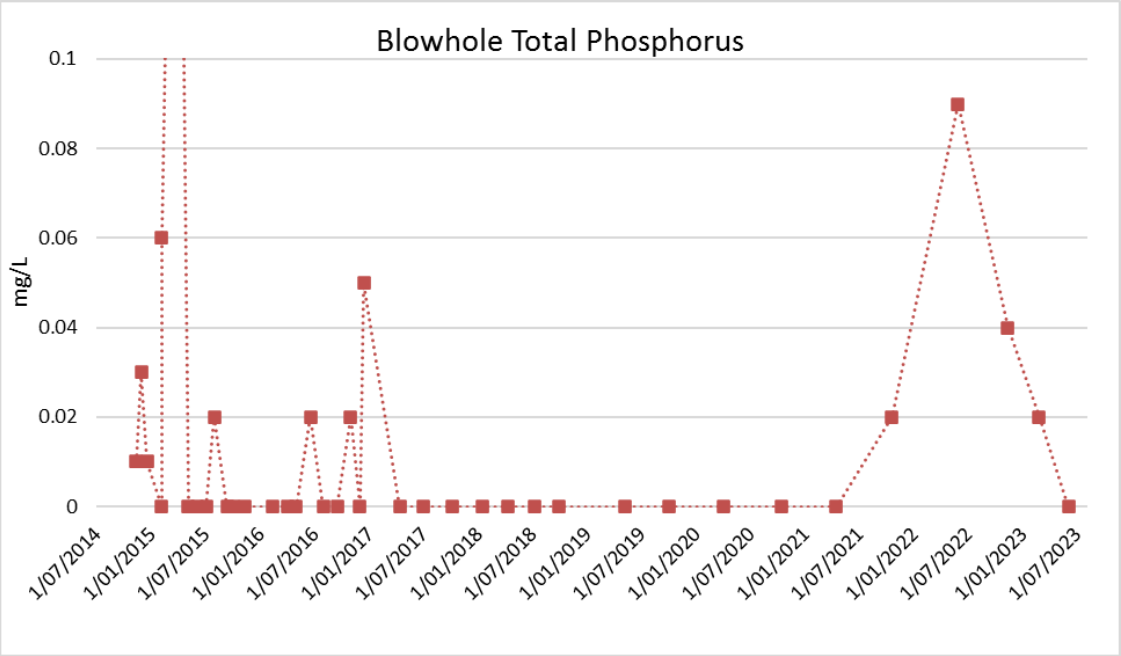


Figure 22- Blowhole Total Phosphorus

The total Aluminium and Iron concentrations mirror the trends observed for phosphorus above. The metals in Figure 23 show lowered concentrations, often below detection limits during the drought, with elevated levels peaking in November 2022, before dropping back to lowered concentrations in 2023. The highest recorded Aluminium and Iron levels were 0.80 mg/L and 0.88 mg/L, with long terms averages of 0.07 mg/L and 0.10 mg/L respectively.

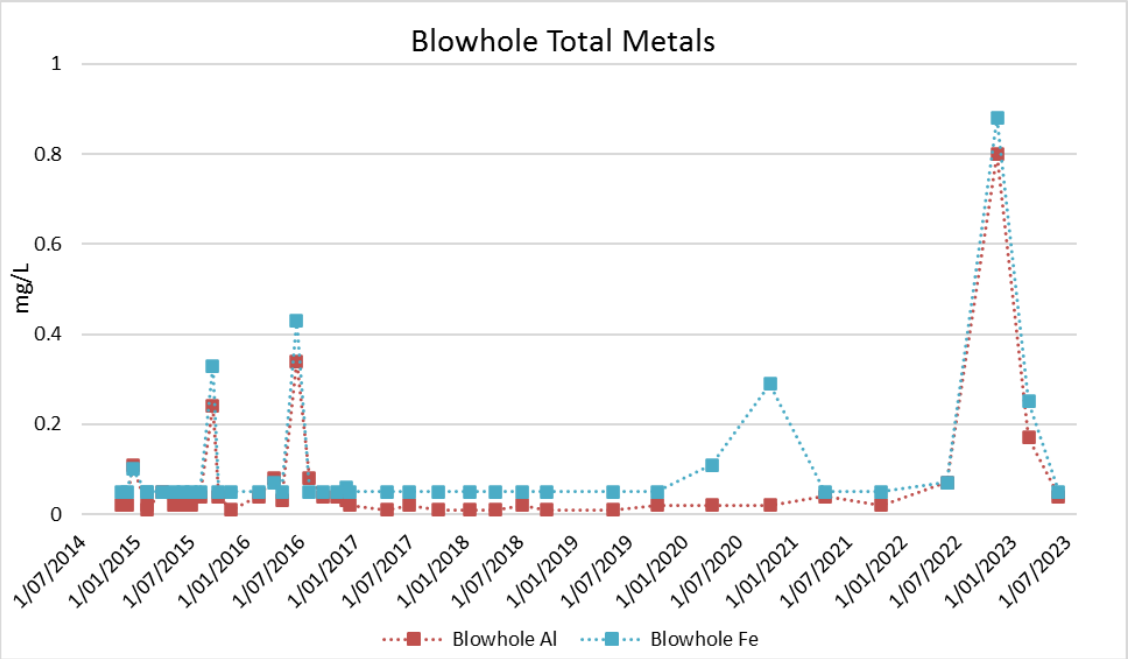


Figure 23- Blowhole Total Metals (Aluminium and Iron)

Barium has shown an increasing trend since mid-2020, with a maximum concentration of 0.061 mg/L and an average of 0.037 mg/L since 2014 (Figure 24). Manganese is also shown on Figure 24, with levels often below detection limits of 0.001 mg/L and an average of 0.0036 mg/L.

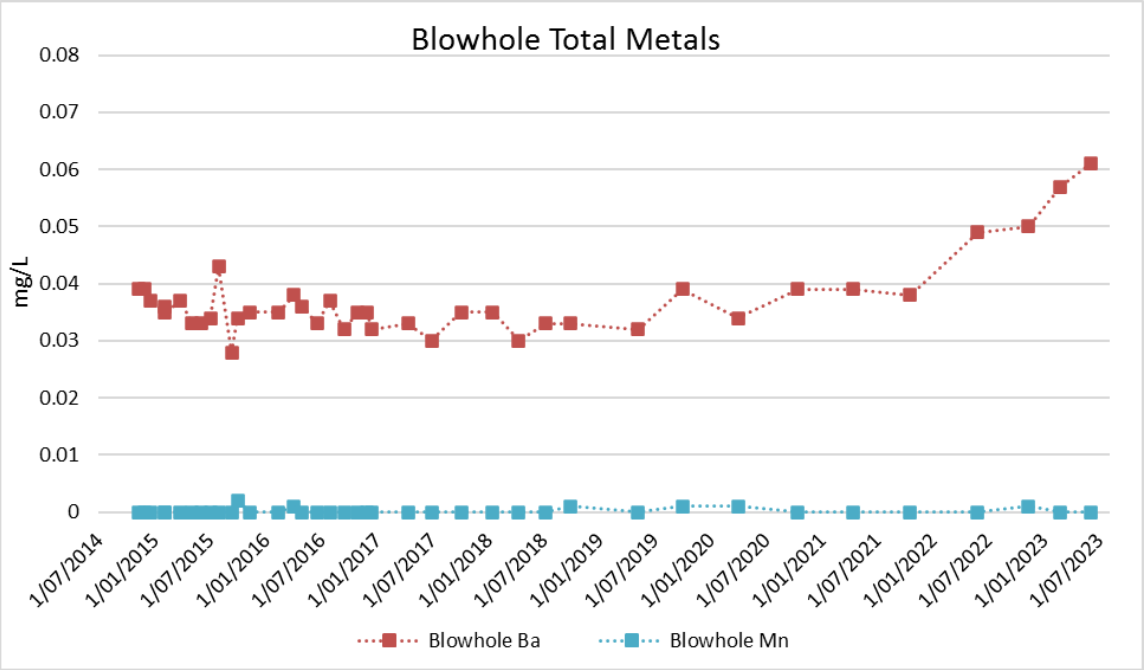


Figure 24- Blowhole Total Metals (Barium and Manganese)

2.3.4 Main Gully

Main Gully Sediment Basin 2 is equipped with an automatic water sampler which is triggered automatically when the water levels rise during storm events. Overflow events occurred during July 2022 and October 2022 following heavy rainfall. Results for July 2022 and three separate events in October 2022 are presented in Table 1 and Table 2 respectively.

From the 1st July to 4th July 2022 inclusive, 206mm of rainfall was recorded at the site weather station which exceeded the 95% 5 day rain event for Marulan.

In the five days to 9th October 2022, 158mm of rainfall was recorded which exceeded the 95% 5 day rain event for Marulan of 52.8mm. A further 132.5mm was recorded from the 21st-25th October, and a final 31mm on the 31/10. The total rainfall recorded for the month was 363mm. Both of the July and October events were caused by a persistent off shore low pressure system resulting in widespread flooding.

Table 1- Main Gully Overflow Water Quality Monitoring Results July 2022

Date	pH Units	EC (µS/cm)	Suspended Solids (mg/L)	Turbidity (NTU)	Oil and Grease
3/7/2022	7.86	426	148	350	<5
4/7/2022	8.03	453	10	61.1	<5
5/7/2022	8.06	469	12	60.4	<5
6/7/2022	8.13	528	8	37.9	<5
7/7/2022	8.19	616	8	28.2	<5
8/7/2022	8.18	664	6	20.1	<5

Table 2- Main Gully Overflow Water Quality Monitoring Results October 2022

Date	pH Units	EC (µS/cm)	Suspended Solids (mg/L)	Turbidity (NTU)	Oil and Grease
8/10/2022	6.86	487	23	35.6	<5
9/10/2022	7.48	421	589	895	<5
10/10/2022	7.86	457	132	245	<5
22/10/2022	7.97	604	1460	3110	<5
23/10/2022	8.02	460	730	1660	<5
31/10/2022	7.87	564	1260	2710	<5

**Three individual events are separated by bold lines*

The results show that during storm events when discharge occurs, suspended solids can be elevated however pH and conductivity are comparable with Bungonia Creek. Figure 11 shows that suspended solids loading with Bungonia Creek rose slightly during the same period. Although the Main Gully discharge would have an influence on solids loading within Bungonia Creek, Figure 11 shows that the upstream sample site in Bungonia Creek had a slightly higher suspended solids loading than the downstream site during this high rainfall period. Figure 27 also shows that the Shoalhaven River was also elevated upstream of the confluence with Bungonia Creek indicating that there was widespread movement of sediment within the receiving waters during this period of high rainfall.

2.3.5 Shoalhaven River Water Quality Results

The pH values in the Shoalhaven River are shown in Figure 25 below. pH is relatively consistent at all three sites within the river, with averages of 7.24 pH units at SR1, 7.20 at SR2 and 7.22 pH units at SR3. Values ranged from 6.19 to 7.89 pH units over the past 9 years. There is also very good correlation between all three sample sites within the Shoalhaven River indicating that the Marulan Mine is not influencing natural variability.

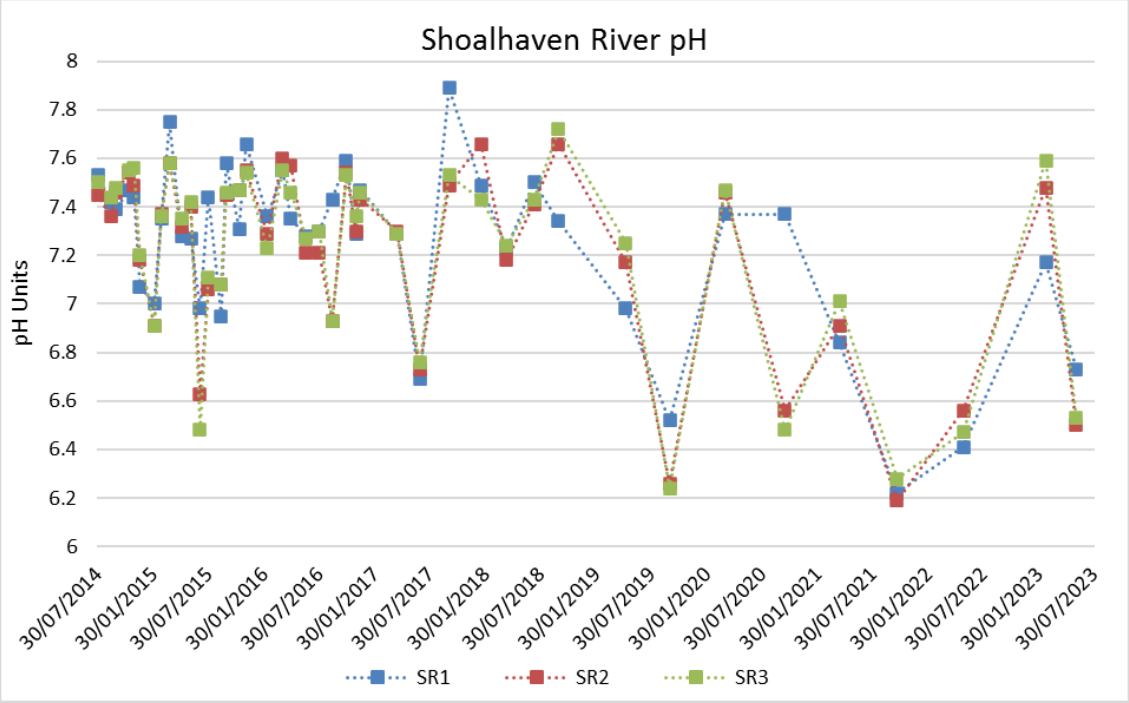


Figure 25- Shoalhaven River pH

The electrical conductivity values are closely mirrored at upstream and downstream sites in the Shoalhaven River. From 2020 onwards, the conductivity has been slightly higher at the downstream site (SR3), as seen in Figure 26. The average conductivity across SR1, SR2 and SR3 are 112 µS/cm, 116 µS/cm and 123 µS/cm respectively.

With only one exception, there is very good correlation between all three sample sites within the Shoalhaven River indicating that the Marulan Mine is not influencing natural variability.

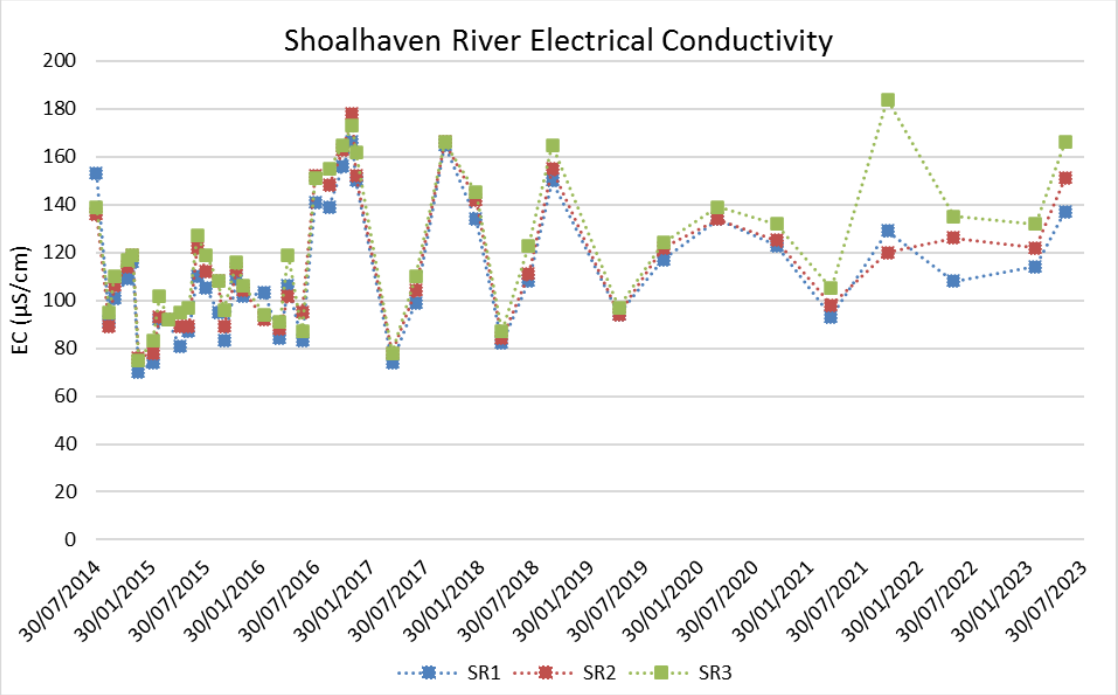


Figure 26- Shoalhaven River Electrical Conductivity

The suspended solids in the Shoalhaven River range from below detection limits (5 mg/L) to a maximum of 28 mg/L at SR2, which was experienced during the heavy rain events in 2021 (Figure 27). The levels generally fluctuate between <5 mg/L and 10 mg/L, with only a few peaks above these values over the past 9 years.

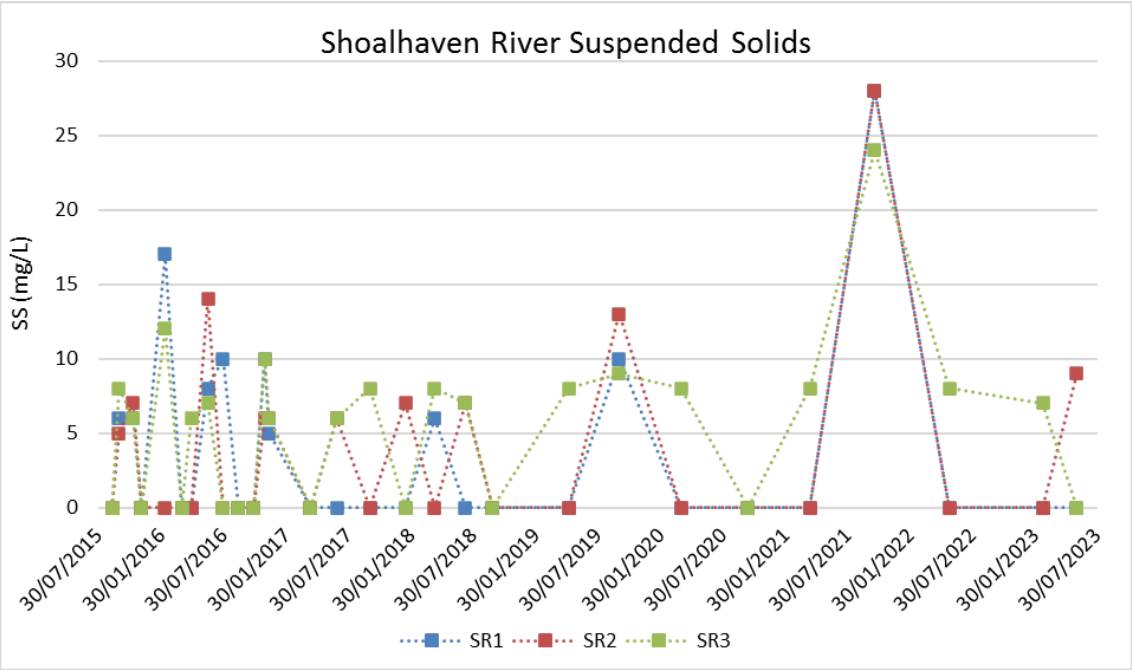


Figure 27- Shoalhaven River Suspended Solids

Suspended solids is a measure of fine particle movement within a waterway. It can indicate erosion caused by high rainfall events or poor quality water being discharged from a mine site. As there is very good correlation between all three sample sites within the Shoalhaven River, the Marulan Mine is not contributing to the solids loading of the Shoalhaven River.

Dissolved oxygen ranged from 7.3 mg/L to 12.0 mg/L over the three sites within the Shoalhaven River, and were within the range for a healthy ecosystem (Figure 28). There is also very good correlation between all three sample sites within the Shoalhaven River indicating that the Marulan Mine is not influencing natural variability.

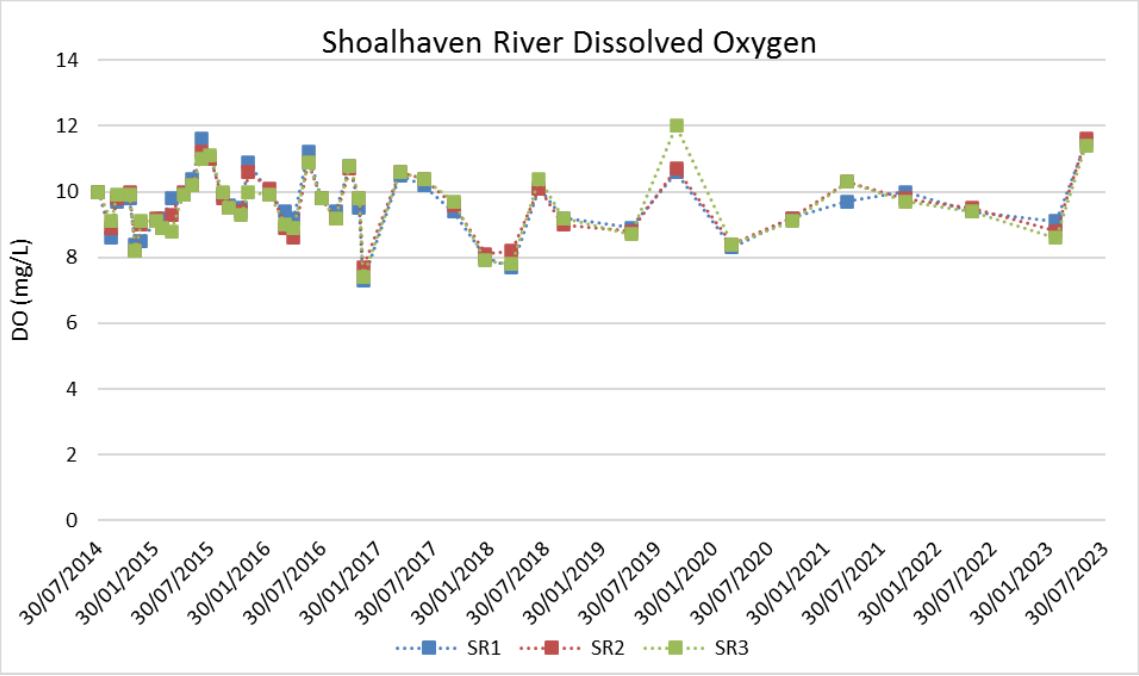


Figure 28- Shoalhaven River Dissolved Oxygen

Total Nitrogen generally remained below 3 mg/L as shown in Figure 29 below. The two outlying values were 8.2 mg/L at SR1 in February 2015 and 6.7 mg/L in June 2017 at SR3. On average the Total Nitrogen concentration across all sites is 0.6 mg/L.

The two outlying results occurred in site SR1 which is an upstream site while the second occurred in the far downstream site SR3. The corresponding values for the middle site SR2 were in normal ranges. This indicates local sources of the elevated nitrogen rather than from any discharge from Bungonia or Barbers Creeks.

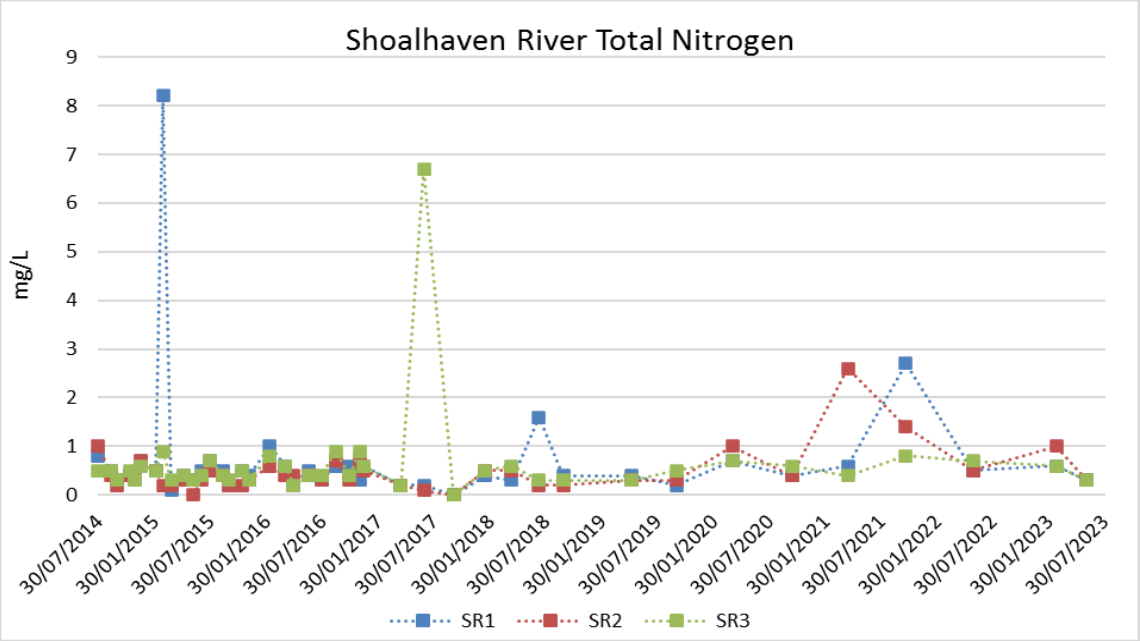


Figure 29- Shoalhaven River Total Nitrogen

The total Phosphorus levels range from below detection limits (0.01 mg/L) to a maximum of 0.31 mg/L at SR1 in March 2015. Generally phosphorus levels remain below 0.04 mg/L based on results over the past 9 years (Figure 30). SR1 is the upstream site and not related to any influence from the mine.

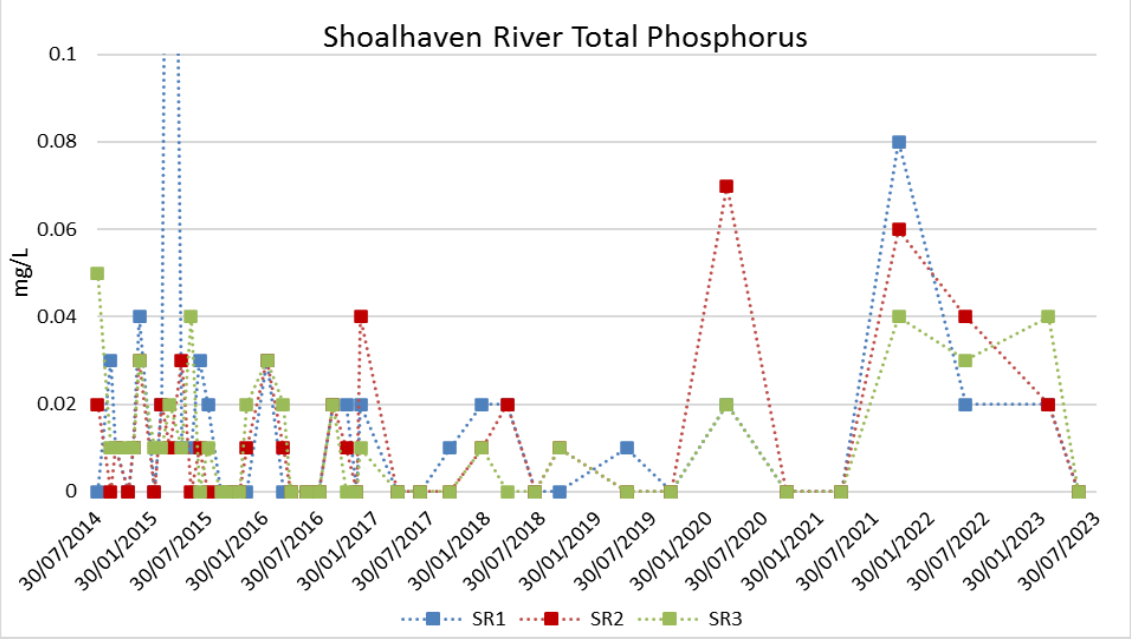


Figure 30- Shoalhaven River Total Phosphorus

Total metals aluminium and iron are shown below on Figure 31. The combined average aluminium concentration across all sites was 0.15 mg/L, with a minimum and maximum of 0.01 mg/L and 0.93 mg/L. Aluminium concentrations were slightly lower upstream at SR1 than at the two sites further downstream (SR2 and SR3). An elevated aluminium concentration was recorded in October 2021, which follows the same trend as other total metals, suspended solids, nitrogen and phosphorus. This was during a period of high rainfall and is considered the likely source of the elevated nutrients and mineral content.

As for the iron concentrations, the average concentrations at sample sites SR1, SR2 and SR3 are 0.53mg/L, 0.52mg/L and 0.50 mg/L respectively (Figure 31). There is a peak in levels during October 2021, where levels recorded are as high as 1.67 mg/L.

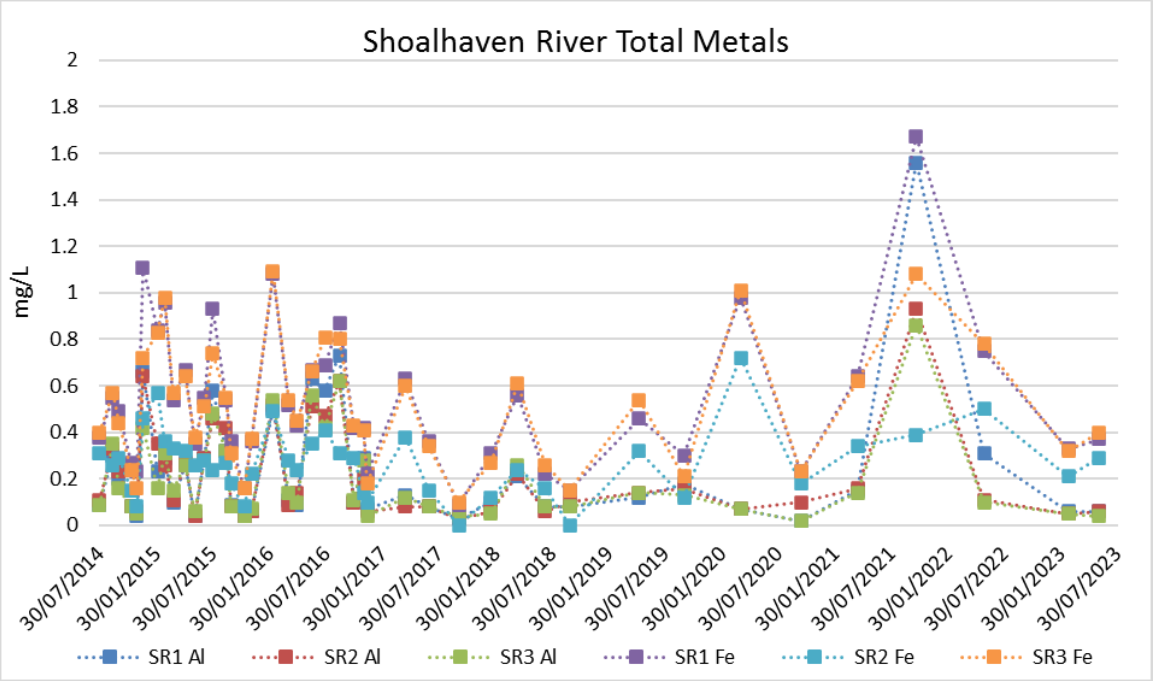


Figure 31- Shoalhaven River Total Metals (Aluminium and Iron)

Average Barium concentrations within the Shoalhaven River are 0.015mg/L, as shown on Figure 32. Total manganese concentrations ranged from 0.003 mg/L to 0.052 mg/L with an average of 0.015 mg/L since 2014. These levels are considered low and typical of an upland river system.

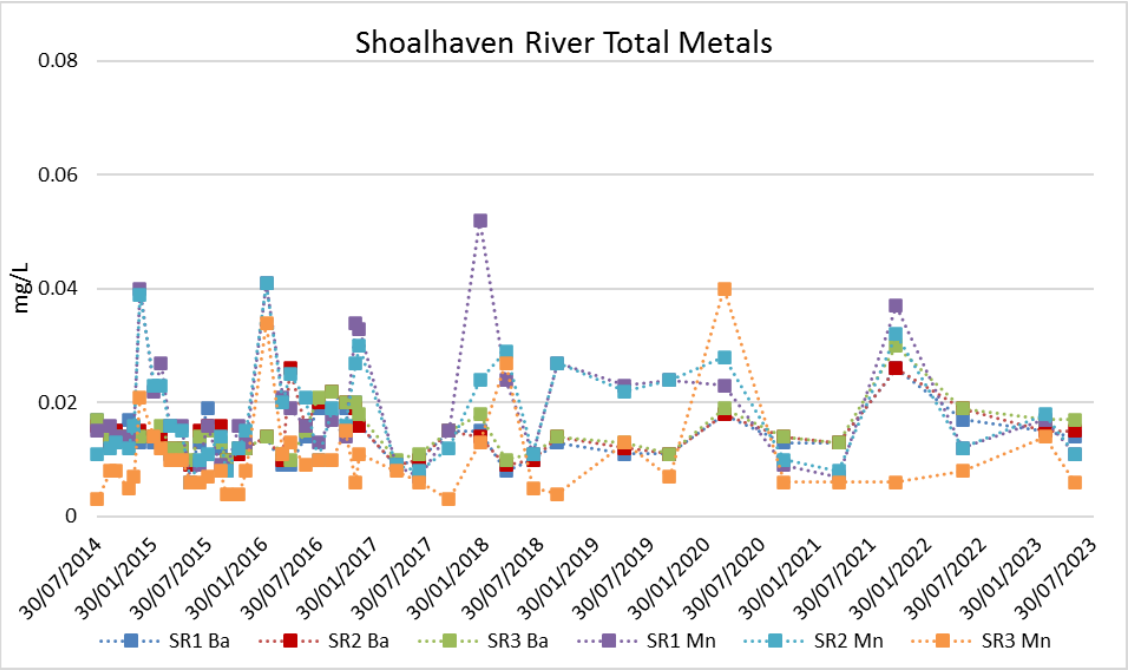


Figure 32- Shoalhaven River Total Metals (Barium and Manganese)

3. Geomorphology Monitoring Analysis

The outcomes of the geomorphology monitoring are discussed in the following sections. These include a photographic record of the stream morphology undertaken during the quarterly surface monitoring program.

3.1 Monitoring Program

Section 6.5 of the Water Management Plan, requires quarterly monitoring of Bungonia Creek, Barbers Creek and Shoalhaven River. The monitoring is to be a visual inspection to assess any potential changes in the stream or vegetation health. The selected sites are the upstream and downstream water quality monitoring locations for each waterway. The inspections will involve photographing the channel and creek banks, description of the condition and note any changes observed since the last inspection.

Although required to be commenced in the first quarter of 2023, the water quality monitoring program has included a photographic record of the sample point at the time of sampling prior to this. Selected photographs are provided in Appendix A. These photos show each of the sample points from the beginning of the water quality program to the most recent inspection date in June 2023.

The inspections of each site now take into account details of riparian vegetation condition and channel form and condition in accordance with the River Styles framework. This includes the following attributes:

- Lateral stability – identification of channel expansion, bank erosion migration and avulsion processes.
- Riparian vegetation – qualitative rating of the composition (native vs exotic), continuity and vegetation assemblages in the riparian zone.
- Grain size and sorting – visual estimate of the percent of the bed that comprises different grain size fractions.
- Bed stability and hydraulic diversity of sediment regime – interpretation of vertical bed activity via incision, visual estimate of surface water flow, identify sediment process zones (ie source transfer, accumulation).

The results of the monitoring program to date are discussed in Section 3.2 below.

3.2 Summary of Results

The following results are preliminary in nature given that the program has only just commenced with the approval of the Water Management Plan in January 2023.

3.2.1 Barbers Creek

Barbers Creek Upstream photos are provided in Plates 1 of Appendix A and Barbers Downstream photos are provided in Plate 2 of Appendix A. Barbers Creek is characterised by a rocky boulder channel with rock pools. The gradient of the channel ranges from 5% to 6%. Barbers Creek is a fifth order stream at the junction with the Shoalhaven River.

About 1.5km upstream from the confluence with Marulan Creek, Barbers Creek enters a steep sided gorge (CVS-Gorge) which extends for a distance of about 8 km down to the Shoalhaven River.

As shown on Plate 1, the upstream site has a rocky bed and banks with the banks showing signs of erosive water velocities. The bank has between 0% and 50% vegetation cover with some sections showing active erosive surfaces. This is a dynamic section of creek line where flow velocity ranges from near zero to extreme with sufficient force to relocate large boulders. There is little evidence of fine alluvial sediments in either the bed or banks.

There has been obvious change to this site between 2017 and 2023 with further instability of the banks and generally less vegetation cover. Vegetation cover is returning at present as time passes from the previous storm event.

Plate 2 shows the Barbers Creek Downstream site. There are less boulders in this section of creek and the bed and banks have a high concentration of finer sediment. The banks show evidence of recent erosion and colonizing species are currently returning. There are some weed grasses occurring in the finer sediments.

The creek flow path divides in low flow due to the high level of bed sediments and the greater percentage of lower flow velocities. Although erosion potential is high, this stretch of the creek is generally depositional. There has been some overall changes to the creek line over the past few years but these are less dramatic than the upstream sample site.

3.2.2 Bungonia Creek

As shown on Plate 3 and 4 of Appendix A, Bungonia Creek is strewn with boulders and pools. It runs through a steep sided narrow gorge for approximately 8.5 km upstream of the Shoalhaven River. The slope of the creek channel in the monitored section is approximately 4%.Bungonia Creek is also a fifth order stream at the junction of the Shoalhaven River.

The River Style of Bungonia Creek adjacent to the Project is Confined Valley Setting – Gorge (CVS-Gorge). The Bungonia Creek catchment is about three times larger than that of Barbers Creek and therefore has sufficient flow during large floods to mobilise larger boulders.

Plate 3 shows the Bungonia Creek Upstream site. This site is characteristically filled with very large boulders. Some of these boulders have fallen down the tallus slopes rather than being relocated down the river bed. The banks are coarse grained but still representative of an erosive surface. The banks show evidence of recent erosion due to extreme water velocities. The boulders provide some energy dissipation which has allowed some finer sediment to be deposited on the upstream side.

The banks are generally well vegetated with over 50% coverage and less than 10% exotic grasses. The nature of the banks show that there is a general variation between deposition and

erosive over time. These is a mixture of medium size rocks surrounded by coarse sediments showing alternating depositional and erosive episodes over time.

Plate 4 shows the Bungonia Creek Downstream site. This section of the creek is wider but still largely consisting of medium to large boulders for both the bed and banks. There are also sections which occur on bedrock. There is little evidence of deposition of finer materials.

The riparian vegetation is young but healthy, with evidence of regrowth since a prior erosional phase. There is less exotic species and up to 80% native vegetation cover. There appears to have been very little change over the past three years.

3.2.3 Shoalhaven River

The Shoalhaven River is shown on Plates 6, 7 and 8. In its reach mid-way between Bungonia Creek and Barbers Creek, it consists of a wide channel with sandy banks indicating significantly lower velocities than those experienced in Bungonia Creek and Barbers Creek.

The Shoalhaven Upstream site is shown on Plate 6. Although most of the channel is wide, the banks show typical sandy deposition on one site and bedrock controlled outer channel. On depositional banks, native vegetation is over 90% with little evidence of recent erosion. Outer banks show some evidence of past erosion but these have generally grassed over and stable.

Further downstream at the SR2 site (Plate 7), the river enters a straight section where both banks have finer grained sand and silt deposits. Native vegetation cover extends over the bank to the river bed in many places and is considered stable. There has been little evidence of any change over the past three years.

Further downstream, the SR3 site occurs on a gentle bend in the river. The inside channel (western side) shows slightly more deposition than the outer eastern channel surface which is more rocky and with coarser grained sediments. Both banks are stable with above 90% native vegetation cover and little evidence of previous erosion events during high flow.

4. Conclusions and Recommendations

4.1 Conclusions

This study has presented the results of water quality and riverine health monitoring for the period ending 30 June 2023. The water quality results show that upstream and downstream water quality varies throughout the year but generally follow a correlated trend, that is, elevated elements downstream are caused by elevated levels upstream. The only variation to this occurs in Bungonia Creek where nutrients, particularly Nitrogen are higher downstream compared to the upstream site. This variation is caused by the discharge from the Blowhole site rather than the mine.

The higher nutrients from the Blowhole site are not causing a measurable change in the quality of the Shoalhaven River.

River health studies have only just commenced in accordance with the Water Management Plan. The preliminary results indicate that the receiving waters of Bungonia Creek are naturally actively eroding upstream of the mine site but become more depositional towards the confluence of the Shoalhaven River. There have been several significant changes to the bed and banks of Bungonia Creek towards the confluence with the Shoalhaven River over recent years, reflecting the impact of extreme storm events.

Barbers Creek is erosion controlled for its full length adjacent to the mine. This stretch is steep sided and prone to extreme velocities during storm events. There has been evidence of sediment movement but the health of vegetation and the overall nature of the creek line has not changed over the past three years.

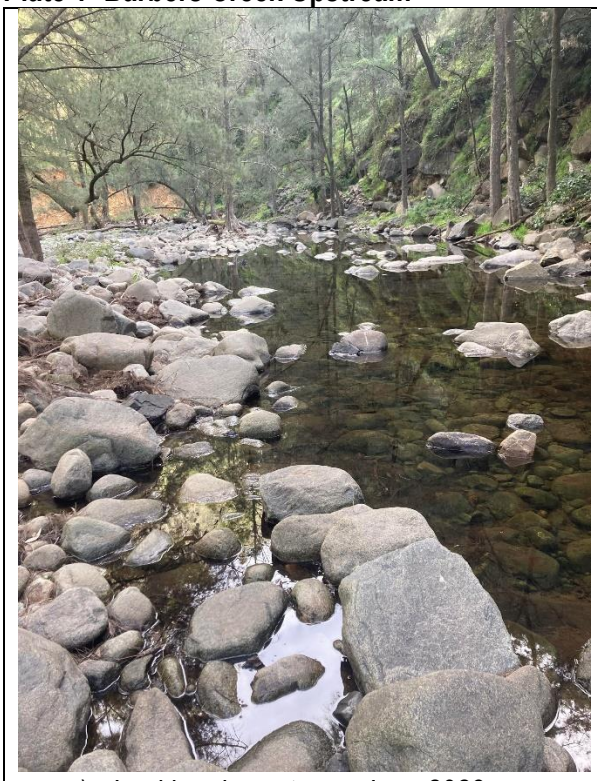
Photographic evidence of the three sites along the Shoalhaven River show little if any evidence of increased sedimentation. Riparian vegetation has remained healthy and no new bank erosion or instability has been detected.

4.2 Recommendations

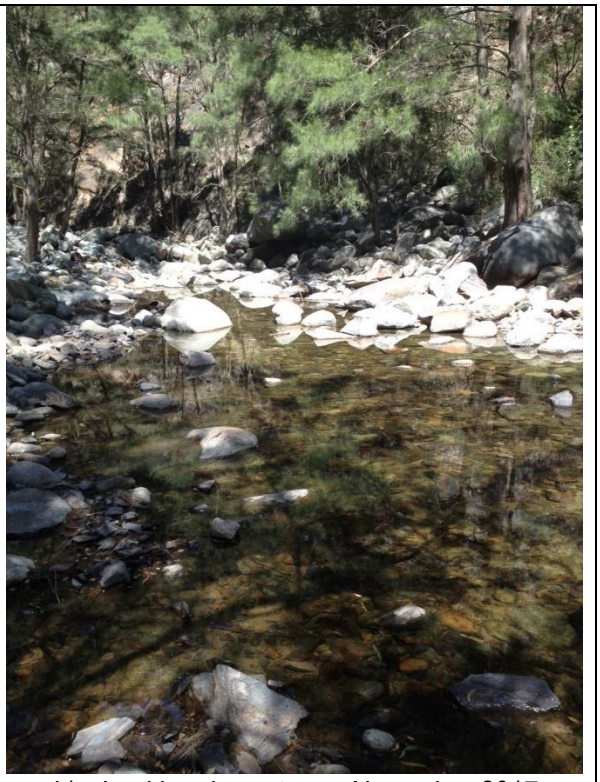
This study does not recommend any changes to the current monitoring program. Over time as more data becomes available, further refinement of the monitoring program may be considered.

Appendix A –Photographic Record

Plate 1- Barbers Creek Upstream

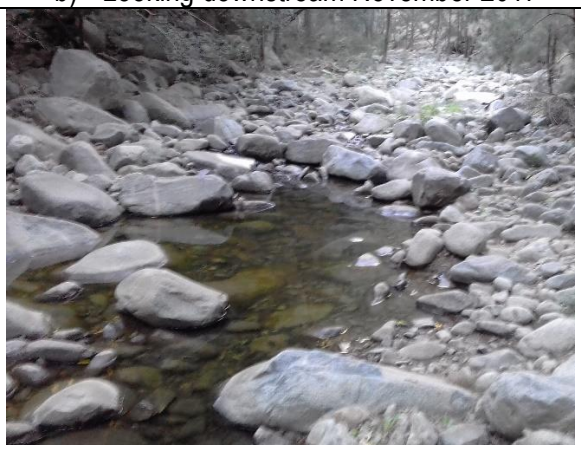


a) Looking downstream June 2023



b) Looking downstream November 2017

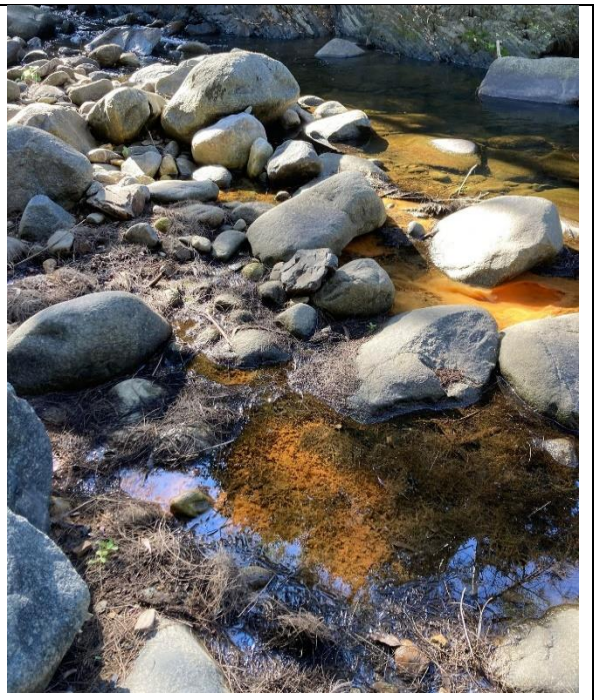
c) Looking to northern bank June 2023



d) Looking upstream May 2019

Plate 2- Barbers Creek Downstream

a) Looking downstream June 2023



b) Looking upstream June 2023

c) Looking downstream October 2020

d) Looking upstream October 2020

Plate 3- Bungonia Creek Upstream June 2023

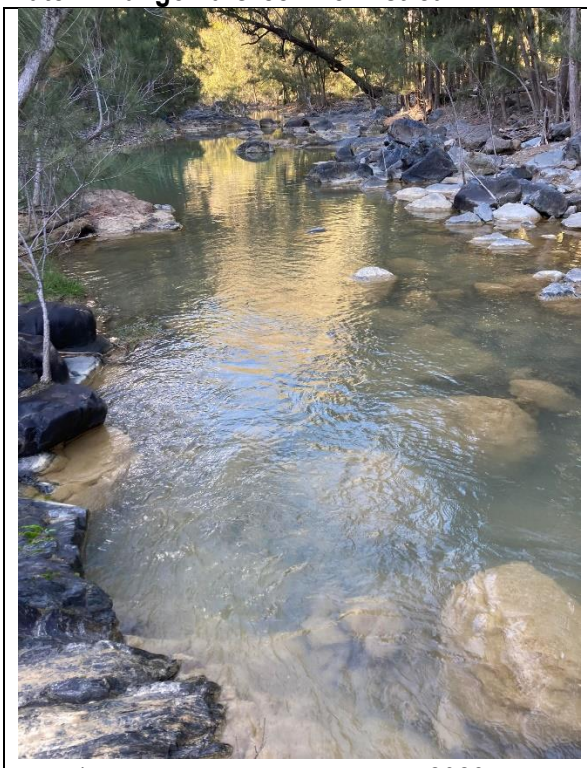
a) North bank looking at creek June 2023

b) Looking downstream June 2023

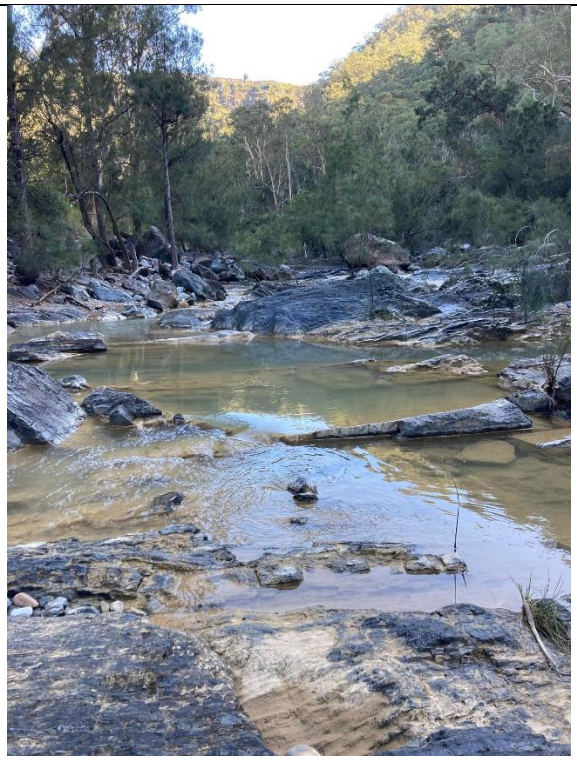
c) Sample site October 2020

d) Looking away from site October 2020

Plate 4- Bungonia Creek Downstream



a) Looking downstream June 2023

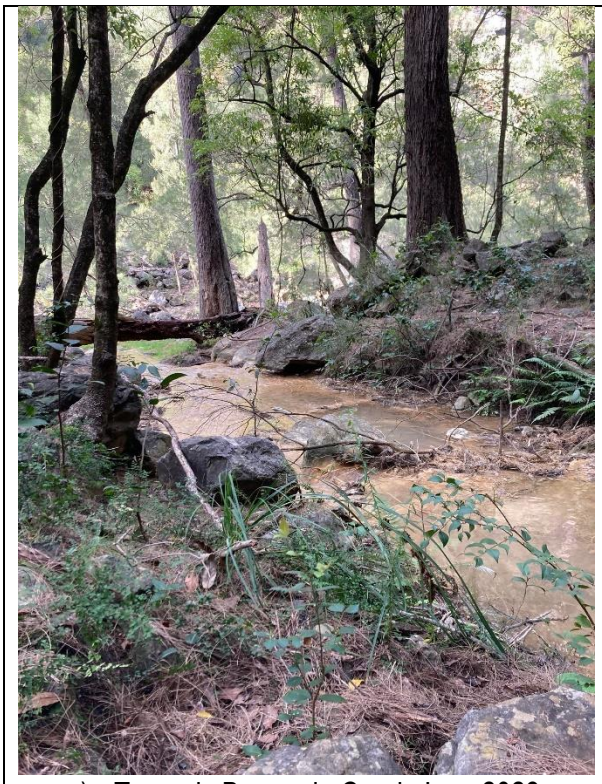


b) Looking upstream June 2023

c) Looking across the sample site October 2020

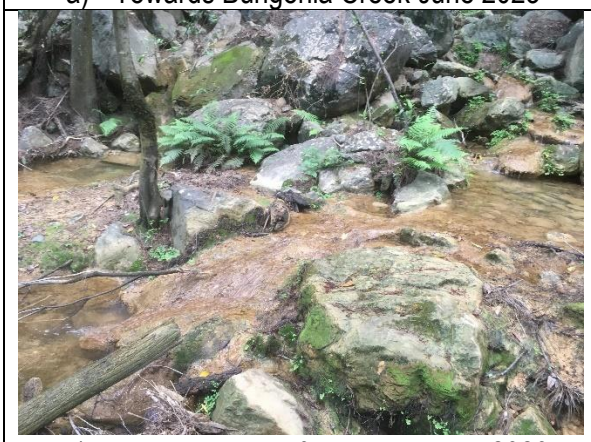
d) Looking upstream October 2020

Plate 5- Blowhole

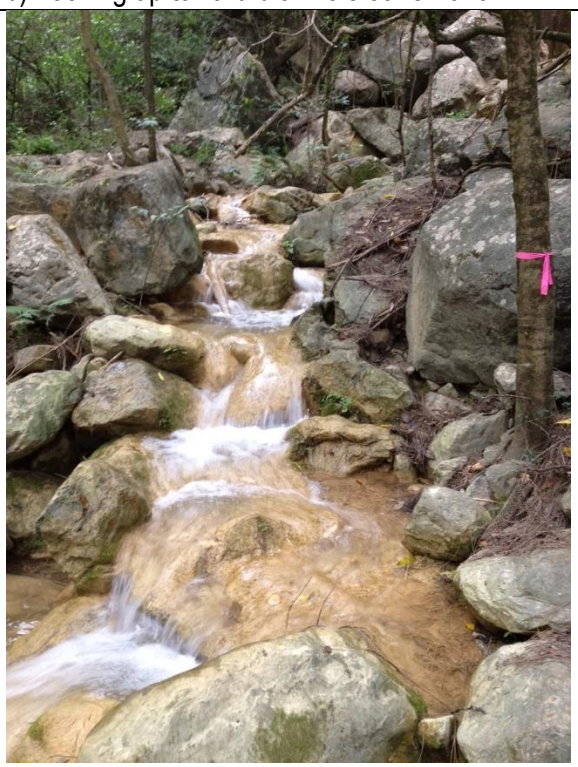


a) Towards Bungonia Creek June 2023

b) Looking up toward blowhole June 2023

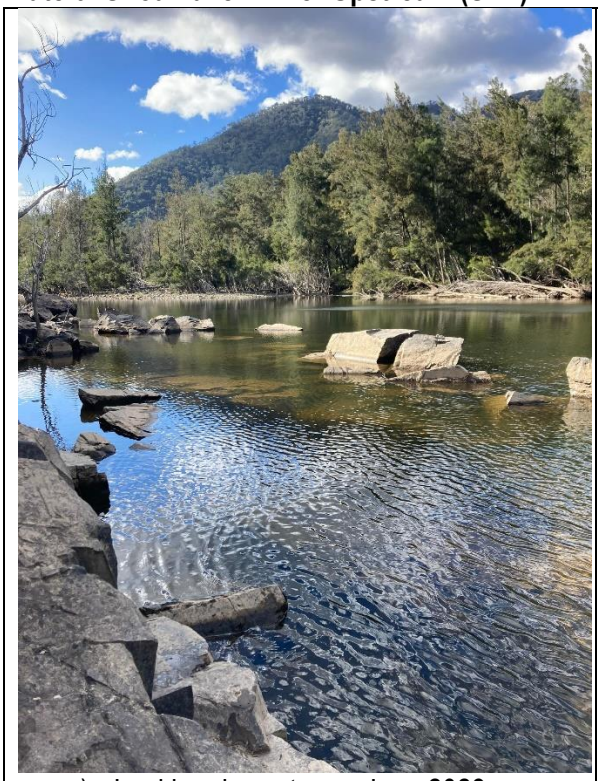


c) Looking across flow path March 2020

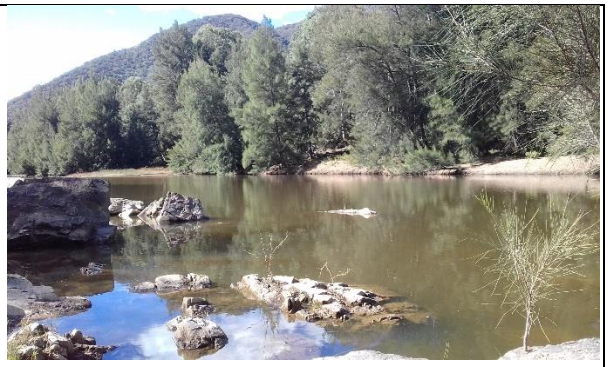


d) Toward blowhole November 2017

Plate 6- Shoalhaven River Upstream (SR1)



a) Looking downstream June 2023

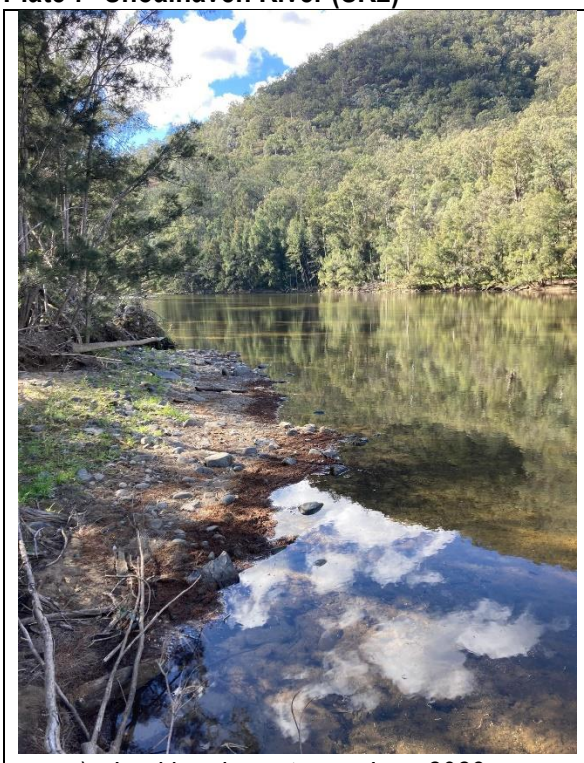


b) Looking downstream June 2019

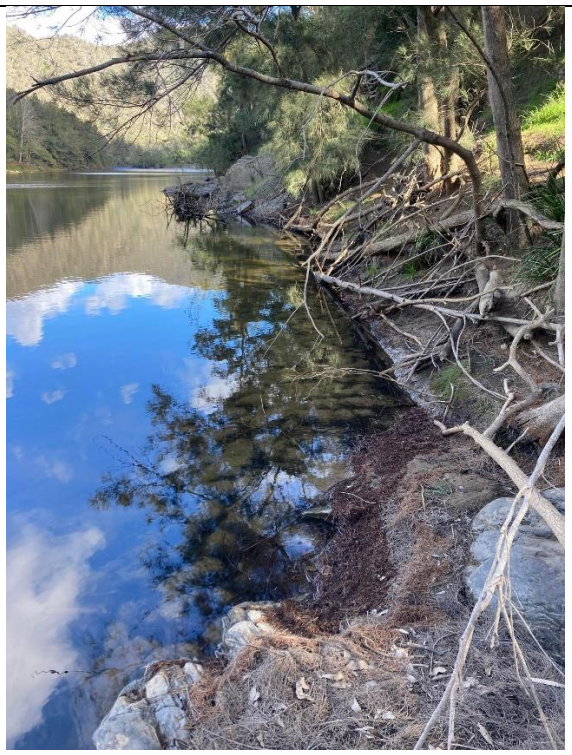
c) Looking upstream June 2023

d) Looking upstream Oct 2020

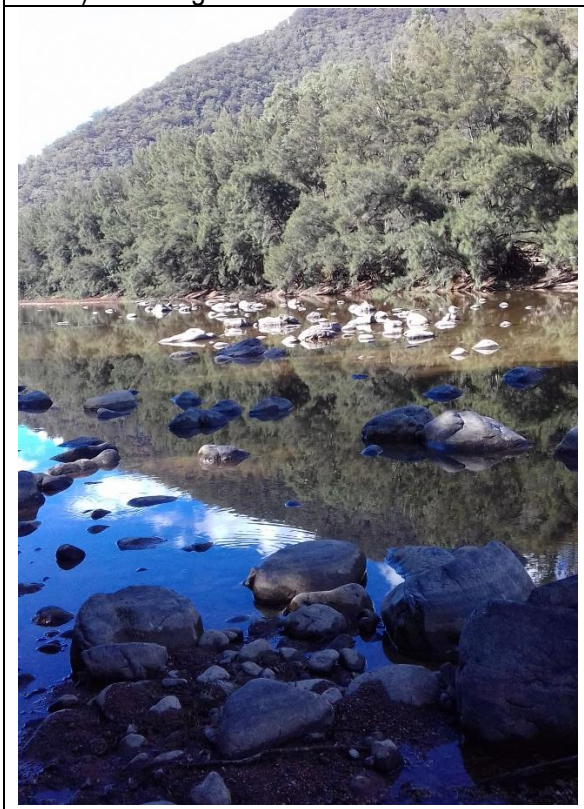
Plate 7- Shoalhaven River (SR2)



a) Looking downstream June 2023



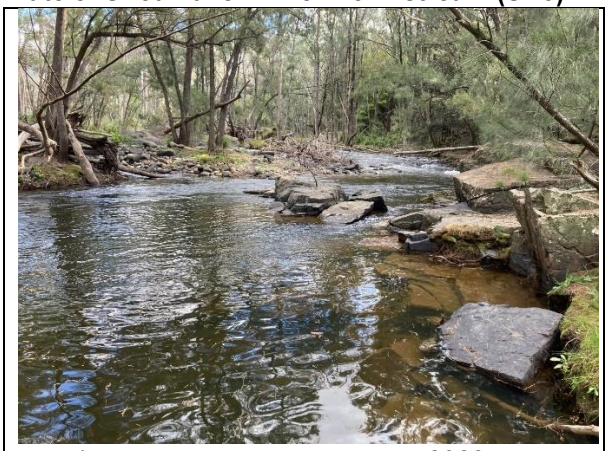
b) Looking upstream June 2023



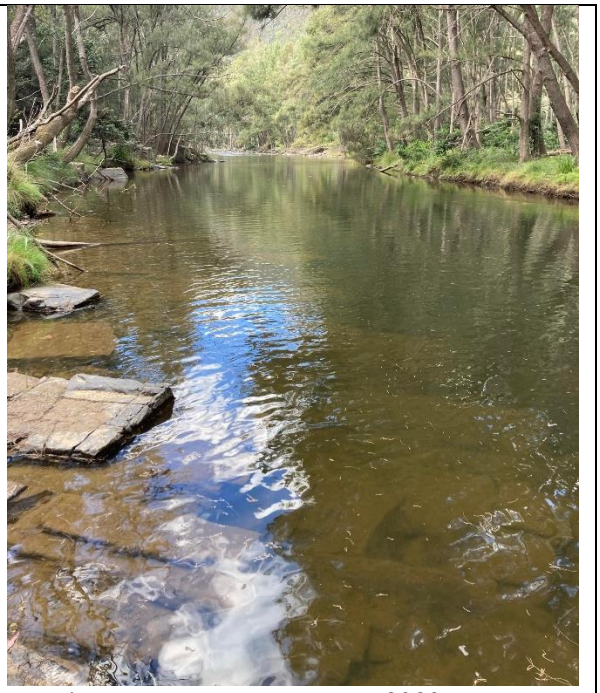
c) Looking downstream May 2019

d) Looking upstream March 2020

Plate 8- Shoalhaven River Downstream (SR3)



a) Looking downstream June 2023



b) Looking upstream June 2023

c) Looking downstream March 2020

d) Looking upstream October 2020