

Marulan South Limestone Mine 2019 – 2023 Mining Operations Plan

Name of Mine:	Marulan South Limestone Mine
MOP Commencement Date:	01 September 2019
MOP Completion Date:	26 February 2023
Mining Authorisations (Lease / License Number):	Consolidated Mining Lease No. 16 (1992) Mining Lease No. 1716 (1992)
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1 INTRODUCTION

1.1 History of Operations

Limestone mining north of Bungonia Gorge began in 1875 with major developments emerging in the 1920's to supply limestone for cement manufacturing and steel making.

By 1953 two (2) main pits were well established and by the early 1970's the facets of the business included limestone for cement, steel making, agriculture, glass making, lime manufacturing, quicklime and hydrated lime.

In 1974 a formal merger of the two (2) mining companies at Marulan South took place. The northern mine pit was mined by Southern Portland Cement (SPC) which was owned by Australian & Steel (BHP) who used the mine to supply limestone to their steel works and cement plant at Berrima. The southern mine pit was mined by Metropolitan Portland Cement who supplied limestone to their cement plant at Maldon. During the 1960's Metropolitan Portland cement was absorbed into the Australian Portland Cement Manufacturers of Australia (APCMA) which was formed by the Blue Circle (UK) company following the purchase of Commonwealth Portland Cement, Standard Portland Cement and Metropolitan Portland Cement.

In 1974 Blue Circle (as owners of APCMA) and BHP (as owners of SPC) agreed to merge their operations to form Blue Circle Southern Cement Ltd (BCSC) with both parties retaining equal ownership. In 1987 Boral Limited purchased BCSC and continues to retain ownership of the company as a wholly owned subsidiary. As at 1st August 2010, BCSC changed the company name to Boral Cement Limited (BCL or Boral).

The Marulan South Limestone Mine is sited on a high-grade limestone resource. Subject to market demand the mine will typically produce 3 to 3.3 million tonnes of limestone and 120,000 to 200,000 tonnes of shale per annum, primarily for cement and lime manufacture, for limestone aggregates and fine crushed, limestone products including sand and for use in steel making.

The expected quantity of mine production during the Mining Operations Plan (MOP) period is consistent with the 2 to 5 million tonnes of mining for minerals in accordance with Environment Protection Licence Number 944.

1.1.1 The 2009 - 2015 MOP

The mine has previously operated under the 2009 – 2015 MOP supported by a Review of Environmental Factors (REF), dated 1st December 2010 as approved by the then Department of Industry and Investment on 30 March 2011.

The 2009 - 2015 MOP/REF initially planned for a 6.5-year period covered continued mining operations and associated processing activities within Consolidated Mining Lease (CML) No. 16 including:

- Complete removal of “Centre Ridge” overburden bund to provide immediate access to limestone below and commence formation of the single pit operation;
- Continued development (subject to mining depth restrictions) of eastern batters (North Pit) to improve stability and reform access for limestone mining, combined with;
- Rehandle of “Barbers Creek” overburden emplacement material to improve emplacement stability and opportunity for improved revegetation;
- Re-commencement of overburden emplacement within the previously approved “Barbers Creek” area with a modified, lower impact design and reduced environmental footprint;

- Continuation of shale mining and stockpiling from western batters (North Pit) including rehandle of existing old lime stockpiles and waste materials;
- Significant completion of the approved western “Main Gully” overburden emplacement and stockpile areas incorporating design options that provide improved landform rehabilitation and revegetation outcomes;
- Completion of mining within the approved “Q8 Closed” design, southern end of the South Pit to approximately 340m elevation;
- Including retention of the existing rim above the 410-metre contour that will significantly reduce visual impacts from the southern side of Bungonia Gorge;
- Preparation and commencement of the South Pit for overburden emplacement;

The 2009 - 2015 MOP/REF together with two MOP Amendments MOP Amendment 1A – Waste Lime Management (dated 31 October 2011) and MOP Amendment 1B – Tallong Water Supply Pipeline (dated 30 June 2011) was initially accepted in accordance with implementation of the Mining Act Amendment 2008, Section 170(1)(b) for a two-year period and approved until 31 March 2013.

1.1.2 Extension of the 2009 - 2015 MOP

The initial two-year approval period for the 2009 - 2015 MOP/REF as amended was extended to the 30 June 2015 and then was subsequently granted approval until 30 June 2016 in accordance with the then Department of Trade and Investment, Resources and Energy’s correspondence dated 8 August 2013.

This extension was to provide time for Boral to proceed with a State Significant Development application, for a proposed 30-year continued operation of the mine with the approved MOP as required, covering current operations.

State Significant Development application (SSD 7009) together with supporting environmental impact assessment has taken considerable time in preparation with Boral realising in November 2015 that obtaining development consent by 30 June 2016 was unlikely. Boral applied for a further extension of the current MOP.

On 2 March 2016, the then Department of Industry, Resources and Energy granted a further extension of the 2009 - 2015 MOP/REF to 31 March 2018.

A review of additional geological information from a staged exploratory drilling programme resulted in a reappraisal of the 30-year mine development plan and subsequent delay in SSD 7009. To ensure adequate time was made available to complete SSD 7009 and obtain a new 30-year development approval a new 2018 – 2023 MOP as detailed in Section 1.1.3 was submitted to the then NSW Department of Planning & Environment – Division of Resources and GeoScience (DP&E – DRG) in December 2017.

1.1.3 The 2018 -2023 MOP

The 2018 – 2023 MOP dated 14 December 2017 was prepared for the Marulan South Limestone Mine, in relation to two mining authorisations, Consolidated Mining Lease CML No.16 and Mining Lease No. 1716 both held by Boral Cement Limited.

The 2018 – 2023 MOP was prepared to incorporate all activities associated with the continued mining and processing of limestone and shale for approximately a 5-year period, from 1 April

2018 to the 26 February 2023, the latter date coinciding with the expiry date of Consolidated Mining Lease, CML No.16.

Mining activities described in this 2018 – 2023 MOP would remain consistent with current approvals as detailed in the 2009 - 2015 MOP and supporting REF. Mining activities would remain within the established disturbance footprint and project approval boundaries.

A new REF was therefore not considered necessary to support this 2018 – 2023 MOP.

The 2018 – 2023 MOP was approved by DP&E – DRG on 1 March 2018 until 26 February 2023 coinciding as previously stated with the expiry date of Consolidated Mining Lease, CML No.16.

It was considered likely at the time of submission that the full 5-year term of the 2018 – 2023 MOP may not be completed on the basis that the 30-year SSD 7009 application would be approved and that the grant of a new mining authority would be completed by late 2019. These approvals would trigger the requirement for a new MOP based on the proposed 30-year mine plan and new conditions of approval and authorisations.

Boral lodged SSD 7009 with the Department of Planning & Environment in late 2018 with the exhibition period ending in early April 2019. This State Significant Development application for continued mine operation is currently undergoing assessment with response to submissions currently being finalised prior to referral to the Independent Planning Commission.

Likely delay in the approval of SSD 7009 and issues to be addressed for a new Mining Lease Application will impact on the current 2018 – 2023 MOP's mining operations schedule in regard to short-term availability of areas for blending limestone and for "above ground" overburden emplacement.

In addition, the issue of erosion and sedimentation from the 1970's Bryce's Gully rehabilitation area as reported to the Environment Protection Authority (EPA) on 31 January 2018 requires an environmental management plan for inclusion in a submission for a MOP Amendment.

These issues have been discussed with officers from DP&E – DRG including presentations in Wollongong on 13 June 2019 and in Maitland on 25 June 2019.

Boral now submit a new 2019 – 2023 MOP with a supporting REF as described in Section 1.1.4 that effectively replaces the current 2018 - 2023 MOP dated 14 December 2017 and combines in one new MOP document the Bryce's Gully Water Management Plan and several operational MOP Amendments. This new 2019-2023 MOP is required for submission no later than 13 August 2019 as detailed in the Department of Planning & Environment – Resources Regulator's correspondence dated 24 June 2019. (**Attachment 1**).

1.1.4 Proposed 2019 - 2023 MOP

Due to the number of proposed MOP changes and revisions to the existing REF document a new 2019 – 2023 MOP and supporting REF has been prepared in preference to amending the current 2018 - 2023 MOP document.

The 2019 – 2023 MOP has been prepared to incorporate all activities associated with the continued mining and processing of limestone and shale for a 3.5-year term, from 1 September 2019 to the 26 February 2023, the latter date coinciding with the expiry date of Consolidated Mining Lease, CML No.16 as previously nominated in the 2018 - 2023 MOP.

The contents of this MOP and supporting REF provide relevant information on the mining, processing and rehabilitation operations necessary for compliance with existing conditions imposed on the mine by BCL's mining leases, development consents, other approvals and licences and the *ESG3: Mining Operations Plan Guidelines September, 2013*.

Proposed mining activities from 1 September 2019 and a revised material production schedule have been included in **Section 2** and replace the 2018 - 2023 MOP detail.

Areas of mining activity updated from the 2018 - 2023 MOP are shown labelled A, B and D for revegetation C1 and for overburden emplacement C2 and C3 on **Plan 1A** detailing the Pre-Mining Environment – Project Locality.

In comparison with the 2018 - 2023 MOP, a new **Appendix 8**, as referenced in **Section 3**, has been included and presents the investigations and proposed environmental management for erosion and sedimentation control from the 1970s Bryce's Gully rehabilitation area.

In addition, the 2018 – 2023 MOP, Appendix 1 now includes **Appendix 1A** – Review of Environmental Factors (2010) and **Appendix 1B** – Review of Environmental Factors (2019) in support of minor (less than 5 ha) of land disturbance and increase in height for the existing western overburden emplacement to allow continued mine operation pre – SSD 7009 approval.

Updated plans for mining and overburden emplacement as referred to in the text component of this 2019 – 2023 MOP are presented at the rear of the document.

As previously stated, and in conjunction with the SSD 7009 – Environmental Impact Study / Development Application, Boral is in the process of making application for new mining authorities. The approval of the proposed 30-year SSD application and grant of new mining authorities will require a new MOP submission consistent with all new consents, authorisations and licence conditions.

1.2 Current Consents, Authorisations and Licenses

In consideration of the size, location and current State Significant Development application in progress, the Marulan South Limestone Mine for the purposes of this 2019 – 2023 MOP is referred to as a **Level 1 Mine**. Development consents, leases and licences held by the mine site are outlined in the following sections.

1.2.1 Development Consents

The local government authority is the Goulburn Mulwaree Council. The mine previously operated under the Mulwaree Local Environmental Plan (LEP) 1995 that was gazetted on 1 December 1995. This LEP adopted the 1980 model planning provisions including the provision which allows the continued operation of mines which were in existence on the day that the LEP was gazetted.

The Mulwaree LEP 1995 has now been replaced by the Goulburn Mulwaree LEP 2009 effective 13 March 2009.

The requirement to vary and / or consolidate existing development approvals in accordance with changes in both local and state planning legislation for the continuation of existing operations and to cover future mine development has previously (2nd September 2010) and continues to be supported by specialist planning and legal advice.

Currently limestone mining and processing operations within Consolidated Mining Lease No.16 and Mining Lease 1716 (refer to Sections 1.2.2 and 1.2.3) are subject to two development consents that precede the 1995 LEP (refer to **Plan 1A**).

These consents are for;

- The Barbers Creek Disposal Area for which development consent was given on 21 December 1972 to Southern Portland Cement Limited, and

- Q8 Quarry and Main Gully Disposal Area to which development consent was given on 16 October 1974 to BCSC.

The remaining lease area is operated under “continuing use rights”, under section 109 of the EP&A Act, as defined by the boundary of disturbance as at 1st August 2007 (refer to **Plan 1A**).

In addition, further development applications have been approved for separately mining “white” clay and “brown” clay shale and for additions to plant and services.

Development consent details are as follows;

- Development Application Number (DA No.) 2802 granted 13 February 1995 for Proposed White Clay Extraction on lands described as Portion 83 and public road with Portion 83 in the Parish of Marulan;
- DA No. 118/967 granted 22 May 1997 for Proposed Clay Shale Extraction within the Marulan South Limestone Quarry on lands described as Portions 81, 82, 132, 114, ML8, and ML 16 in the Parish of Marulan;
- Application No.129/0405/OSMF for an on-site sewerage management facility, approved by Goulburn Mulwaree Council on 8 September 2005 to upgrade septic facilities at the Lime Plant;
- DA No. 646/0405/DA approved by Goulburn Mulwaree Council for two – 200 m3 silos installed adjacent to the existing lime product storage and load out facility;
- DA No. 546/0506/DA for a lime plant maintenance shed, approved by Goulburn Mulwaree Council on 20 June 2006; and
- DA No. 0156/1112 for a limestone sand plant capable of producing up to 800,000 tpa of manufactured sand, approved by Goulburn Mulwaree Council on 1 March 2012.

1.2.2 Consolidated Mining Lease No. 16 (Act 1992)

The Marulan South Limestone Mine had historically been covered by over 66 mining titles including Mineral Leases, Mining Leases, Mining Purposes Leases, Private Lands (Mining Purposes) Leases, Private Lands Leases and a Special Lease.

As at 23 April 2004 all previous titles were consolidated into Consolidated Mining Lease, (CML) No. 16 (Act 1992) over an area of about 616.5 hectares as indicated on **Plan 1A**. CML No. 16 was previously held by Blue Circle Southern Cement Ltd (and now BCL) both wholly owned subsidiaries of Boral Limited. The lease expiry date is 26 February 2023.

CML No. 16 was granted for the purpose of prospecting and mining for agricultural lime, clay/shale, iron minerals, limestone, marble, and structural clay.

The lease includes 27 conditions covering mining, rehabilitation and environmental management. A copy of CML No.16 Schedule of Conditions is included as **Appendix 2**.

In addition, the lease is subject to various surface exemptions and depth restrictions as previously detailed on Plan 4 of the 2009 – 2015 MOP/REF. Plan 4 (copy attached in **Appendix 3**) provides detail for the “Eastern Batters” based on CML No. 16 - Plan M26910.

1.2.3 Mining Lease No. 1716 (Act 1992)

Mining Lease No. 1716, was granted for a term of 21 years by the then Department of Industry, Resources and Energy on 4 September 2015 for mining clay/shale, iron minerals, limestone, marble, and structural clay.

Grant of Mining Lease No.1716 effectively removed the depth restriction of 30.48m below the surface of CML No. 16 contained within 12.04 hectares of the former PML 18. Refer to **Plan 1A** showing the location of Mining Lease No. 1716 in relation to the boundary of CML No.16.

To date mining activities “above” ML 1716 have been limited to earlier overburden removal and emplacement.

During this 2019 – 2023 MOP, activity proposed within ML 1716 includes haul road access and further overburden removal in this “Eastern batter” location, **Plan 1A** – (Area D) to allow for mining remnant limestone in batters and at depth.

The lease includes 8 conditions covering mining, rehabilitation and environmental management. A copy of Mining Lease Conditions 2013 for Mining Lease No.1716 is included as **Appendix 4**.

1.2.4 Environmental Protection License (EPL) No. 944

Boral Cement Limited is the licensee of EPL 944 for the “Marulan South Limestone Mine and Lime Plant” 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.

The EPL (reference archived copy dated 7 August 2014) is subject to an EPA licence review due 14 March 2020.

The latest Annual Return for the period 28 January 2018 to 27 January 2019 was submitted 26 March 2019 with no non-compliances recorded for the licence period.

A copy of EPL 944 is included as **Appendix 5**.

1.2.5 Other Licenses

Table 1.2.5 details all other licences held by the Marulan South Limestone Mine.

Table 1.2.5 Other Licenses

Description	Licence Number	Licensing Authority	Comments
Acknowledgement of Notification of Hazardous Chemicals on Premises	NDG/008099	WorkCover	Depots include petrol & diesel storage, flammable liquid, compressed gas, petroleum gas and explosives. As of 01/01/15 changes to notification rely on updating Schedule 11 Notification of Hazardous Chemicals when there is a change only. Site plans and emergency contacts to be kept in the manifest box (February 2016, removed ammonium nitrate depot)
Licence to Import	11-100005-004	WorkCover	Issued to Orica for supply of explosives Cert No 000004-000018012. Valid until 15 June 2021

Description	Licence Number	Licencing Authority	Comments
Licence for the Manufacture of Explosives	XMNF100033	WorkCover	New Licence issued to 29 October 2015. Valid until 29 October 2020
Apparatus Licence Land mobile "two-way" systems	1958988 1958989 9922223	Australian Communications and Media Authority	Expiry date: 21/07/20 Expiry date: 23/01/20 Expiry date: 22/02/20
Radiation Management Licence	5061123	NSW OEH-EPA	Licence to sell/possess radioactive substances or items containing radioactive substances. Licence re-issued to 21 August 2019
Motor Vehicles Repairers Licence (Motor Vehicles Repairs Act 1980)	MVRL 36381	NSW Fair Trading Motor Vehicle Repair Industry Authority	Motor Mechanic Fixed Workshop Next licence lodgement renewal date is 2 January 2021.
Refrigerant Trading Authorisation Certificate	AU 04450	Department of the Environment	Refrigerant trading authorisation Expiry Date 10 March 2021.
Water Access Licence (2 x Bores, North Pit) Previously 10BL602077 & 10BL602078 Lot 7300, DP1149129	WAL 24697 10WA116142	NSW Water	Extraction of 12ML per annum of groundwater for industrial purposes. Bores WP16 & WP17. Cert. of Title issued 9 May 2013. Works Approval valid to 10 August 2024.
Water Access Licence (New) (1 x Bore for construction) Lot 114 DP750029	WAL 41976 10AL122346 10CA122907	NSW Water	Statement of Approval for new bore. Valid to 2 December 2028
Surface Water Licences x 2 (1 x Overshot Dam & 2 Pumps) Previously 10SL012214 Lot 1, DP37041	WAL 25352 WAL 25207 10WA102352	NSW Water	Water supply (76ML) for mining and (1ML) for domestic purposes per annum from Barbers Creek. (See Note 1) Works Approval valid to 30 June 2024.

Description	Licence Number	Licensing Authority	Comments
Surface Water Licence (1 x 38mm Centrifugal Pump) Previously 10SL025561 Lot 204, DP870194	WAL 25373 10WA102377	NSW Water	Water supply (10ML) for mining purposes per annum from Barbers Creek. Works Approval valid to 25 April 2026.
Bore Licences	10BL605442 10BL605443 10BL605444 10BL605445 10BL605449 10BL605450	NSW Water	Six monitoring bore licences issued 10 Oct 2013 in perpetuity.
Groundwater	ROI17-1-061	NSW DPI-Water	838ML groundwater allocation granted 27 September 2017.

Note 1: From 1 July 2012, the total volume of water taken in any three (3) consecutive water years under this access licence must not exceed a volume which is equal to the lesser of either:

A. the sum of:

- i. water in the account from the available water determinations in those 3 consecutive water years, plus
- ii. water in the account carried over from the water year prior to those 3 consecutive water years, plus
- iii. any net amount of water assigned to or from this account under a water allocation assignment in those 3 consecutive water years, plus
- iv. any water re-credited by the Minister to the account in those 3 consecutive water years, or

B. the sum of:

- v. the share component of this licence at the beginning of the first year in those 3 consecutive water years, plus
- vi. the share component of this licence at the beginning of the second year in those 3 consecutive water years, plus
- vii. the share component of this licence at the beginning of the third year in those 3 consecutive water years, plus
- viii. any net amount of water assigned to or from this account under a water allocation assignment in those 3 consecutive water years, plus
- ix. any water re-credited by the Minister to the account in those 3 consecutive water years.

1.2.6 State Significant Development Application

As previously stated in Section 1.1 and following submission of the SSD 7009 – Environmental Impact Study / Development Application that is currently pending approval, Boral is in the process of making application for new mining authorities.

The approval of the proposed 30-year SSD application and grant of new mining authorities will require a new MOP submission consistent with all new consents, authorisations and licence conditions.

This 2019 – 2023 MOP is to permit continued mine operation in particular access to areas for limestone blending and additional “above ground” overburden emplacement during a longer than anticipated approval process.

1.3 Land Ownership and Land Use

CML No. 16 and ML 1716 under which the mine operates, covers an area of 616.5 ha, which includes land owned by Boral (approximately 475 ha), Crown Land (adjoining to the south and east) and five privately owned titles as shown on **Figure 1** and as included on the Land Ownership table, **Table 1.3**. There is also Boral owned land surrounding the mine that does not fall within the two mining authorities.

Land use surrounding the mine is a mixture of extractive industry, grazing, rural residential, commercial/industrial and conservation.

The mine is separated from the Bungonia National Park and State Conservation Area to the south by Bungonia Creek and is separated from the Shoalhaven River and Morton National Park to the east by Barbers Creek.

Peppertree Quarry, owned by Boral Resources (NSW) Pty Limited, borders the mine to the north. The site of the former village of Marulan South is located between the mine and Peppertree Quarry on land owned by BCL. The village was established principally to service the mine but has been uninhabited since the late 1990's. The majority of the village's infrastructure has been removed and only a village hall and former bowling club remains. The bowling club has been converted into administration offices for the mine and the hall is used by the mine services team.

A small number of rural landholdings surround the Boral properties to the north and west, including an agricultural lime manufacturing facility, fireworks storage facility, turkey farm and rural residential (a number of these properties are actively grazed). The main access for these properties is via Marulan South Road. Rural residential properties are also located to the northeast of the mine along Long Point Road.

1.4 Stakeholder Consultation

Stakeholder consultation during the preparation of this 2019 – 2023 MOP, has continued to be conducted through the Annual Environmental Management Review (AEMR) process that is integral to the MOP. The principal government agency being the Wollongong office of the now Department of Planning, Industry and Environment, Division of Resources and Geoscience - Resource Regulator (DPIE – RR).

In addition, and in association with stakeholder consultation as part of SSD 7009, BCL have continued to maintain an open and consultative approach with all identified stakeholders including other government agencies, landowners, the community and other interested parties. Stakeholder engagement is conducted in accordance with the "Peppertree Quarry & Marulan South Limestone Stakeholder Engagement Action Plan 2019-2020".

Key government agencies within the now Department of Planning, Industry and Environment (DPIE) that the mine consults with on a regular basis include, the Office of Environment and Heritage, Water and the National Parks and Wildlife Service (NP&WS) situated locally within the Bungonia State Recreation Area in addition the NSW Environment Protection Agency (EPA), and the Goulburn Mulwaree Council.

On an annual basis since 2005 presentations of the proposed mining operations as described in this MOP have been made in association with departmental visits and AEMR site inspections. The most recent site visit by DPIE was conducted on the 4th April 2019. This visit was attended by officers from both the Assessment Coordination Unit and by Environmental Inspectors from the Resource Regulator's Wollongong office as part of DPIE-DRG's assessment of SSD 7009 and to discuss applications for new mining authorities to meet both short and longer term mine operational requirements. Follow up meetings in Wollongong on the 13th June 2019 confirmed acceptance by the DPIE – RR for submission of this amended 2019 -2023 MOP no later than 13th August 2019. (Refer **Attachment 1**).

In addition, the EPA – South East Region following their site visit on the 30th April 2019 have been updated in regard progress with the Bryce’s Gully water management plan and inclusion of the plan as part of this 2019 – 2023 MOP submission.

BCL continues to maintain good working relationships with surrounding landowners and the community and actively seeks interaction with these parties particularly in regard to the environment. Examples of this interaction include the coordination of feral animal control programs with landholders and the adjoining Bungonia State National Park/Recreation Area administered by NP&WS.

Table 1.3 Land Ownership in and around CML No 16

Label	Lot	DP	category	Label	Lot	DP	category
1	1	1124189	FREEHOLD	33	3	106569	FREEHOLD
2	12	881240	FREEHOLD	34	3	527501	FREEHOLD
3	3	203290	FREEHOLD	35	4	106569	FREEHOLD
4	23	867667	FREEHOLD	36	21	657523	FREEHOLD
5	2	1004503	FREEHOLD	37	3	617992	FREEHOLD
6	2	1124189	FREEHOLD	38	114	750029	FREEHOLD
7	282	750029	CROWN	39	82	750029	FREEHOLD
8	4	203290	FREEHOLD	40	132	750029	FREEHOLD
9	22	867667	FREEHOLD	41	7300	1149129	CROWN
10	5	203290	FREEHOLD	42	2	1186554	FREEHOLD
11	24	867667	FREEHOLD	43	1	617992	FREEHOLD
12	1	261615	FREEHOLD	44	165	750029	FREEHOLD
13	1	860561	FREEHOLD	45	193	750029	FREEHOLD
14	2	860561	FREEHOLD	46	115	750029	FREEHOLD
15	1	106569	FREEHOLD	47	131	750029	FREEHOLD
16	2	527500	FREEHOLD	48	154	750029	FREEHOLD
17	1	527500	FREEHOLD	49	186	750029	FREEHOLD
18	2	106569	FREEHOLD	50	179	750029	FREEHOLD
19	100	1064794	FREEHOLD	51	197	750029	FREEHOLD
20	16	111641	FREEHOLD	52	156	750029	FREEHOLD
21	14	111641	FREEHOLD	53	83	750029	FREEHOLD
22	15	111641	FREEHOLD	54	155	750029	FREEHOLD
23	7	111641	FREEHOLD	55	87	750029	FREEHOLD
24	6	111641	FREEHOLD	56	1701	610507	FREEHOLD
25	12	570616	FREEHOLD	57	1702	610507	FREEHOLD
26	111	830458	FREEHOLD	58	98	750029	CROWN
27	112	830458	FREEHOLD	59	187	750029	FREEHOLD
28	114	830458	FREEHOLD	60	191	750029	FREEHOLD
29	113	830458	FREEHOLD	61	7302	1149129	CROWN
30	9	111645	FREEHOLD	62	7301	1149129	CROWN
31	1	132244	FREEHOLD	63	7303	1149129	CROWN
32	2	132244	FREEHOLD	64	130	750029	FREEHOLD

2 PROPOSED MINING ACTIVITIES

2.1 Project Description

During the 3.5-year term (1 September 2019 to 26 February 2023) of this 2019 – 2023 MOP, BCL proposes to continue mining limestone at a rate of up to 3.38 million tonnes per annum (mtpa) and continue the increase in the rate of overburden removal targeting a 1:1 (overburden to limestone ratio) to improve limestone accessibility.

As and if required, additional contract overburden removal in campaigns of approximately 2 to 3 million tonnes will be considered subject to approval timing for SSD 7009 and new mining authority applications, market and economic considerations and the need to maintain adequate quantity of available limestone for blending. Clay shale will continue to be extracted at a rate of between 120,000 and up to 240,000tpa.

The proposed material production schedule for the 2019 – 2023 MOP is presented in **Table 3** and is based on mining approximately 12 million tonnes of limestone blended from areas including both the western batters (middle and eastern limestone) and eastern batters (ML1716) of the “North Pit” and a “North Pit” extension as detailed in **Plans 3A, 3B and 3C/3D**. Limestone mining in the southern end of the “South Pit” has now been completed to 350m and initial emplacement of overburden together with stockpiling of blending grade limestone commenced.

The mining of limestone as scheduled requires the removal of at least 11.8 million tonnes of overburden during the MOP period. This material will be emplaced within a revised western overburden / middle gully emplacement design with approximately 4 to 5 million tonne capacity up to 650m elevation. Remaining overburden and blending grade limestone will be emplaced as backfill into the southern end of the mine.

It is again considered likely that the full 3.5-year term of this 2019 – 2023 MOP may not be completed on the basis that the 30-year SSD 7009 application is approved and the grant of a new mining authority is completed prior to the expiry of CML No.16 on 26 February 2023.

Limestone and (overburden as required) will continue to be mined using drilling and blasting methods. Clay shale will continue to be mined by excavator or front-end loader. Limestone, clay shale and overburden will be transported to the primary crusher, stockpile areas and overburden emplacement areas using the existing load and haul fleet of front-end loaders and trucks as detailed in Section 2.2.

Products produced at the mine will continue to be despatched by road and rail, with the majority despatched by rail.

2.2 Asset Register

The Domains or land management units identified within the Marulan South Limestone Mine for the previous 2018-2023 MOP are presented in **Plan 2** and are as summarised in **Table 4** below. The areas for each Domain were based on the maximum disturbance within the 2018-2023 MOP term and were for the purpose and use in determining the Rehabilitation Cost Estimate (RCE) of \$20.8 million as detailed on the Open Cut Summary Rehabilitation Cost Estimate sheet included as **Appendix 6**.

For the 2019 – 2023 MOP additional disturbance area of about 5 hectares in and around the middle gully emplacement area as indicated on **Plan 2** is estimated to increase the current RCE by about \$120,000 or 0.6% of the current \$20.8 million total RCE.

These Domains will be revised and updated following SSD 7009 approval to include an expanded disturbance footprint for mine, overburden emplacement and infrastructure development.

Table 4 Primary (operational) Domains

Code	Primary (operational) Domain Description	Area (ha)
1	Infrastructure Area comprising <ul style="list-style-type: none"> • northern limestone and shale crushing, conveying, screening, blending, bin storage, stockpiling and reclaim processing plant and facilities, • limestone sand manufacturing plant, • rotary lime kiln and hydration plant, • rail loadout and rail shunting facilities • maintenance and repair workshops, • HV powerline and distribution • fuel storage facilities • explosives storage facilities • processing water storage distribution and storage • bitumen road access and parking • administration and production offices 	58.7
1-1	Infrastructure Area comprising Two sections of haul-road and two sections of site access tracks	9.7
2	Waste Lime Placement Encapsulated within western OB emplacement	1.2
3	Water Management Areas Western, central dam storages. Southern sediment ponds.	3.3
4	Overburden Placement Areas Western and former middle gully OB emplacements Revised (extended) middle gully emplacement	49.4
5	Stockpiled Material (included in infrastructure and mine areas)	
6	Open Cut Mine Void Combined north and south pits operated using mobile plant and equipment as listed below.	134.4
6-1	Land Disturbance (early mining) Old limestone “borrow pits”, lime burning facilities and former HV powerline easement	7.6
7	Rehabilitation Areas (progressive) Southern slopes of the western OB emplacement and a small cleared area. Eastern batter areas comprising former Bryce’s Gully, Barbers Creek and South Pit emplacement areas.	54.4
	TOTAL ALL DISTURBANCE	318.7

The mobile plant and equipment typically used within the Marulan South Limestone Mine include the following:

- Cat 777D haul trucks x 2;
- Cat 777C haul trucks x 3;
- Cat 777B haul truck x 1;
- Cat 777 90,000L Water Cart;

- Cat 250D Articulated dump truck;
- Cat 993K Front end loader x 2;
- Cat 992G Front end loader;
- Cat 988 Front end loader;
- Komatsu WA 800-3 Front end loader;
- Komatsu WA 100-3 Front end loader;
- Cat 245 Excavator / Rock breaker;
- Cat 432D Backhoe;
- Liebherr R984 Excavator (out of service) replaced with Cat 6015B;
- Komatsu 14 Grader;
- Atlas Copco LM800 Drill Rig;
- Service Truck;
- Tadano 25t Crane;
- Explosives mixing and handling truck;
- Perway service light truck;
- Mustang Bobcat x2;
- Fork lifts; and
- 4WD light vehicles.

2.3 Activities over the 2019-2023 MOP Term

This 2019-2023 MOP is a revised schedule for continued operation of the Marulan South Limestone Mine and updates the previous 2018-2023 MOP in regard to mining locations (that remain within current development approved areas) and in the proposed quantity of overburden for removal.

As detailed in Section 2.1, during this 3.5-year MOP term (1 September 2019 to 26 February 2023), BCL proposes to continue mining limestone at a rate of up to 3.38mtpa but now proposes to remove overburden at rates to match limestone mining. In addition, contract overburden removal in campaigns of approximately 2 to 3 million tonnes will be considered.

For comparison the proposed material production schedules for the 2019 – 2023 MOP and the previous 2018 - 2023 MOP are included and presented below in **Table 3 (2019-2023)** and **Table 3 (2018-2023)** respectively. The annual MOP periods or “Years” are aligned with BCL’s financial years and therefore for simplicity comparison is made from the 2018 - 2023 MOP **Year 2** being 1 July 2019 to 30 June 2020. The approximate 8mth period, 1 July 2023 to 26 February 2023 remains to coincide with expiry of CML No.16 on 26 February 2023.

Table 3 (2019-2023) Material Production Schedule During the 2019-2023 MOP Term

Material Production Schedule During the 2019-2023 MOP Term								
Material	Unit		01Jul19	01Sept19	01Jul20	01Jul21	01Jul22	TOTALS
			30Aug20	30Jun20	30Jun21	30Jun22	26Feb23	
			Year 1		Year 2	Year 3	Year 4	
Stripped Topsoil	m ³		0	1,500	0	0	0	1,500
Overburden	tonnes		516,700	2,583,300	3,200,000	3,300,000	2,200,000	11,800,000
Limestone	tonnes		533,300	2,683,000	3,300,000	3,300,000	2,200,000	12,016,300
Shale	tonnes		48,000	192,000	240,000	240,000	160,000	880,000
Limestone Sand	tonnes		90,000	360,000	450,000	450,000	300,000	2,160,000
Quicklime	tonnes		18,000	72,000	90,000	90,000	60,000	432,000
Hydrated Lime	tonnes		56,000	70,000	70,000	70,000	47,000	332,000

Table 3 (2018-2023) Material Production Schedule During the 2018-2023 MOP Term

Material Production Schedule During the 2018-2023 MOP Term								
Material	Unit		01Jul18	01Jul19	01Jul20	01Jul21	01Jul22	TOTALS
			30Jun19	30Jun20	30Jun21	30Jun22	26Feb23	
			Year 1	Year 2	Year 3	Year 4	Year 5	
Stripped Topsoil	m ³		0	0	0	0	0	0
Overburden	tonnes		379,100	1,516,500	1,987,500	822,500	1,200,000	5,905,600
Limestone	tonnes		660,600	2,642,600	3,177,100	3,223,300	2,267,400	11,867,800
Shale	tonnes		24,000	96,000	120,000	120,000	80,000	560,000
Limestone Sand	tonnes		90,000	360,000	450,000	450,000	300,000	2,160,000
Quicklime	tonnes		18,000	72,000	90,000	90,000	60,000	432,000
Hydrated Lime	tonnes		56,000	70,000	70,000	70,000	47,000	332,000

The mining of 12 million tonnes of limestone as scheduled now requires the removal of approximately 11.8 million tonnes of overburden during the 2019 – 2023 MOP period.

Limestone is to be mined and blended from different areas within the existing mine disturbance footprint including both the western batters (middle and eastern limestone) and eastern batters (ML1716) of the “North Pit” and from a “North Pit” extension as detailed in **Plans 3A, 3B and 3C/3D**. Limestone mining in the southern end of the “South Pit” has as previously indicated now been completed to 350m elevation.

If and as required, additional overburden removal on a campaign basis may increase the total quantity of overburden removed during the MOP period to approximately 15 million tonnes.

As previously indicated in Section 2.1 it is considered unlikely that the full 3.5-year term of this 2019 – 2023 MOP will be completed on the basis that the 30-year SSD 7009 application is approved and the grant of a new mining authority is completed prior to the expiry of CML No.16 on 26 February 2023.

The 2019 – 2023 MOP and accompanying Review of Environmental Factors (2019) (Refer to **Appendix 1B**) in support of minor (less than 5 ha) of land disturbance and increase in height for the existing western overburden emplacement allows the majority of the 6.3 million tonnes of overburden removed up until the end of **Year 2** (30 June 2021) to be emplaced “above ground” therefore minimising the quantity reporting as backfill into the southern end of the “South Pit”.

This pre – SSD 7009 development of the western and middle gully emplacement areas permits improved scheduling of mine operations as the future transition to the SSD 7009 approval takes place.

In the event of further delay in SSD 7009 approval and/or the grant of new mining authorities the 2019-2023 MOP provides some contingency including a northern extension of the “North Pit” to access limestone but requiring removal or relocation in part of existing stockpiling and reclaim infrastructure and the requirement in MOP **Year 3** and MOP **Year 4** (a 20-month period) to emplace all additional overburden as backfill into the “South Pit”.

Re-design of the existing western and middle gully overburden emplacements to provide emplacement space for both waste lime and overburden will require new disturbance (less than 5 ha) beyond existing MOP boundaries but within current development approved areas as defined on **Plan 1A**. The clearing of vegetation and recovery of topsoil materials is detailed in Section 2.3.2.

Product despatched from site includes crushed and sized limestone including limestone sand, quicklime and hydrated lime with estimated quantities as shown tabled in **Table 3**.

Waste lime comprising quicklime, hydrated lime or limestone or any combination of the three will continue to be trucked to the western overburden emplacement for encapsulation.

The existing 2-hectare area of the western overburden emplacement designated as shown on **Plan 2** is near capacity. A new adjacent area is proposed as part of a re-designed middle gully emplacement as detailed in Section 2.3.3 and Section 2.3.4.

The following sections, Sections 2.3.1 to 2.3.12 provide further detail in regard proposed mining activities including limestone mining and overburden removal during the complete MOP term as shown scheduled on **Plans 3A, 3B and 3C/3D**.

2.3.1 Exploration

A staged exploration drilling programme has been undertaken in conjunction with the 30-year mine State Significant Development and has continued during 2018/2019.

Drilling investigations have also been undertaken to establish new ground water supply bores in accordance with Water Access Licence (WAL 41976). New ground water supply and ground water monitoring point is required to replace existing “North Pit” bores that are likely to run dry or be exhumed when mining the “North Pit” extension.

Further exploration likely to be undertaken during the term of this MOP would involve additional “in-fill” resource definition and quantification drilling in particular for the middle limestone member and areas in and around the northern end of the mine. This would be used to identify further resource and support alternative options to optimise mine development.

Exploration reporting is conducted in accordance with Condition 9 of CML 16 and as noted in conditions attached to ML1716.

2.3.2 Land preparation

As indicated in Section 2.3 new disturbance beyond existing MOP boundaries but within current development approved areas as defined on **Plan 1A** is proposed during **Year 1** of this 2019 – 2023 MOP. Where practical vegetation clearing and recovery of topsoil materials is planned prior to any overburden emplacement in and around the existing middle gully emplacement.

Land clearing protocols and the identification and management of “topsoil/subsoil” and “alternate growing media” is detailed in the “*Marulan South Limestone Mine Rehabilitation Strategy*”, July 2010 (**Appendix 7**).

In addition, recommendations contained in the “*REF – Biodiversity Impact Assessment*” by Niche, August 2019 will be implemented to avoid, minimise or mitigate potential impacts to flora, fauna and their habitats including;

- Clearing will be restricted to the vegetation occurring within the Study Area. Surrounding bushland areas will not be impacted as part of the activities.
- Access to the Study Area would be via existing haul roads and access tracks. All surrounding areas of vegetation would not be utilised for access.
- Demarcate the study area to ensure adjacent vegetation is not harmed from vegetation clearing.
- On-going weed management should continue in the study area to avoid invasive species becoming established.
- Silt fencing should be used at all locations where erosion and sediment runoff may occur.
- Any vegetation removal other than that detailed in this report should be subject to further assessment.
- Implement a two-stage clearing protocol for the removal of hollow-bearing trees as per below:
- The following recommendations are to be considered to reduce the impact the proposal may have on fauna:
 - Clear all vegetation but the hollow-bearing tree during the pre-clearance survey (stage1).
- Following a 24hour grace period, clear the hollow bearing tree (stage 2).
 - Mechanically shake or agitate the habitat tree prior to felling to encourage any remaining animals to either leave the tree or at least show themselves and possibly be removed, where possible.
 - Following stage 2 clearing, hollow-bearing limbs from the tree which have been felled should be taken to predetermined locations. It is recommended that the

- hollow bearing limbs be placed in the vegetation directly opposite the impact area within native bushland.
 - Keep on-site at all times the contact details of the project ecologist or site environmental representative, veterinary care and local animal welfare groups (e.g. WIRES, the Native Animal Trust Fund).
- Should any fauna be found in the felled tree:
 - The ecologist or suitably trained site environmental representative will relocate all uninjured animals that are rescued to within adjoining bushland. Captured animals will be released immediately or held for the shortest time possible (preferably less than 24 hours).
 - Nocturnal animals captured in the clearing process will be released at dusk. If an animal is reluctant to move away, then it shouldn't be released and the ecologist or suitably trained site environmental representative shall take responsibility for contacting a fauna welfare group or veterinarian and will deliver the animals to that group.
 - Any animals kept for any purpose should be secured in a cloth bag, stored with an appropriate material (woollen cloth) for warmth and placed in an appropriate non-sealed container until its release or for transport to an approved carer. Species such as reptiles known for their ability to escape poorly secured cloth bags, and possums and particularly Koalas, should be placed within double lined canvas bags.

2.3.3 Construction

Planning of the site has indicated that only minor construction activities will be required during the 2019-2023 MOP period.

Projects currently in progress or to be instigated include;

- Establishment of suitable water re-cycling and storage areas in association with surface water management plans;
- New groundwater supply and monitoring bore commissioning together with associated site water reticulation;
- Prepare new waste lime emplacement area in association with re-designed middle gully emplacement area as detailed further in Section 2.3.4;
- Development of in pit crushing system and/or minor modifications to existing mine processing plant and equipment for blending purposes. This includes proposed screening trials within middle limestone and contact zone sediments on the western batters;
- Removal / relocation in part of existing stockpile / reclaim infrastructure if required for complete "North Pit" extension;
- Minor civil projects (car parking, office refurbishment, drainage projects and roadways); and
- Ongoing replacement/upgrade of dust control systems.

2.3.4 Limestone Mining and Overburden Removal

The sequencing of limestone mining and overburden removal during the 2019 - 2023 MOP as detailed in the Material Production Schedule - **Table 3 (2019-2023)**, is presented on **Plans 3A, 3B and 3C/3D** and is summarised for each plan as follows. The individual MOP periods are best estimates subject to achieving the expected material production rates during that period and therefore may vary accordingly.

Plan 3A – Year 1 covering the 10mth period 1 September 2019 to 30 June 2020

This first “Year 1” is for a 10-month period when an estimated 2.6 Mt of limestone is mined and blended from all areas including the initial “North Pit” extension (Area A), commencement of eastern batter development within ML1716 (Area D), continued mining of middle limestone from the western batters and some mining of the 0.5 Mt of limestone available in the “South Pit” down to 350m.

An important consideration in mine development is the blending of the main eastern limestone, with middle limestone and shale mined from both the eastern and western batters targeting a 6 to 8% silica content.

Of the estimated 2.6 Mt of overburden to be removed, the majority will be from initial development of the eastern batters within ML1716 (Area D) with emplacement in both the “South Pit” and the middle gully / western overburden emplacement (WOBE) as shown on **Plan 3A**.

Following practical clearing and recovery of vegetation and seed resources together with “topsoil materials” or growing medium in and around the middle gully emplacement area an estimated 70,000 tonnes of overburden is required in the initial preparation of containment bunds for the relocated waste lime emplacement area within Area C2 as shown on **Plan 2** and **Plan 3A**. Emplacement of an additional 300,000 tonnes of overburden would further encapsulate this 0.7ha waste lime emplacement area at approximately 612 to 615m elevation below a 5 to 8m bund at 620m.

Management of waste lime emplacement areas is continued under established site, safe work plans.

Cleared vegetation and seed resources together with “topsoil materials” recovered from Area C2 will be utilised for direct revegetation on landform establishment areas available on the WOBE or stockpiled for later use in similar growth medium development on lower final batters on the western side of the redesigned middle gully emplacement. These final batters align with SSD 7009 overburden emplacement designs.

Plan 3B – Year 2 covering the 12mth period 1 July 2020 to 30 June 2021

During MOP Year 2 an estimated 3.3 Mt of limestone is mined with blending again from all active mine areas but predominately from continued development within Area D of the eastern batters (ML1716) together with western batter development, westward to the extraction limit, (Area B) in middle limestone and downward along the western contact area of the eastern limestone toward 500m bench elevation.

Overburden removal targeting 3.2 Mt is predominantly directed to the middle gully and western overburden emplacement areas. Depending on quantities of blending clay shale recovered from overburden removed and lower grade limestone recovered (as currently stockpiled in the “South Pit”) it is likely that the redesigned middle gully / WOBE will be completed to the 650m design elevation by the end of Year 2.

Plan 3C/3D – Years 3 and 4 covering the 20mth period 1 July 2021 to 26 Feb 2023

Subject to the approval timing of SSD 7009 and the grant of new mining authorities, MOP Years 3 and 4 provide a 20mth contingency period to continue limestone mining at 3.3mtpa and overburden removal at similar rates. All overburden would be emplaced as backfill within the “South Pit” and removal / relocation of stockpile / reclaim infrastructure would need to be considered to allow full “North Pit” extension as shown on **Plan 3C/3D**.

Ground Vibration

Peak particle velocity within the lease area not to exceed 10mm/sec.

Peak particle velocity at any dwelling or occupied premises 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 within the lease area not to exceed 120dB (linear)

Blast overpressure noise level at any dwelling or occupied premises not to exceed 115dB (linear) in more than 5% of the total number of blasts over a period of 12 months.

Blasting is routinely carried out between 10:00 and 16:00 hours on weekdays and generally early afternoon (excluding Saturdays, Sundays and Public Holidays).

Prior to blasting, warning sirens are activated in accordance with safe blasting procedures.

Additional procedures are followed prior to any blasting that may affect the public utilizing the Bungonia State Recreation Area walking trails and the environs of Bungonia Gorge.

In accordance with Condition M7 of EPA Licence No. 944, BCSC must video record each blast fired during rim removal or in the area shown on the Plan titled "Blast Affecting Bungonia Gorge", dated 30 October 1996. The results of such blasting must be submitted to the OEH – EPA at the end of the licence reporting period.

Drilling and blasting will continue to be undertaken in limestone on a typical 4 to 5 metre x 4 metre pattern with 165 mm diameter holes inclined at between 60 and 75 degrees to meet bench slope design requirements. Minimal blasting of overburden is expected.

Typical drill and blast parameters include:

- In-situ density of limestone (t/m³) 2.7
- Blasts per week 3 to 4
- Blast hole diameter (mm) 165
- Blast hole inclination (degrees) 60 to 75
- Blast hole depth (m) 15 + 3 metres sub-grade
- Blast hole spacing (m) 5
- Blast hole burden (m) 4
- Stemming (m) 5
- Initiation Non-Electric

Typical blasts involve between 27 to 35 drill holes charged with bulk emulsion explosive. Holes are singularly detonated using non-electric delays and booster charges.

Approximately 6 to 8 tonnes of explosive are typically used to blast between 17,000 and 25,000 tonnes of limestone requiring some 1,200 tonnes of explosive usage per annum.

The storage, handling and use of explosives at the Marulan South Limestone Mine is conducted in accordance with the relevant licensing and statutory requirements including Mine Health and Safety Act and Regulations and Explosives Act and Regulations.

On site explosive storages licensed with WorkCover include detonator storage for up to 10,000 detonators and an explosive storage magazine for up to 10,000kg of explosive. Explosives storage facilities are located as shown on **Plan 1C**.

Limestone Processing

Processing of limestone mined involves crushing and screening through primary, secondary and tertiary stages depending on product and customer requirements. Processing plant and equipment including stockpile areas are located as indicated on **Plan 1C** and **Plan 2**. 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 on line using Geoscan technology.

The majority of crushed limestone product is despatched by rail to customers including BlueScope Steel, BCL's Berrima and Maldon cement works, and Omya.

Kilnstone grade limestone sourced from the South pit is also processed as kiln feed for BCL's rotary lime kiln and associated plant including hydrator, auxiliary plant, storage and dispatch facilities which are situated within CML No 16. Alternate supply of kilnstone grade limestone and lime manufacturing options will continue to be reviewed during the MOP period.

Where appropriate a combination of dust sprays, including use of Polo Citrus dust foam, covered conveyors and dust collectors are used to minimise dust throughout the processing plant operations.

Lime kiln and hydrator stack emissions are monitored continuously using instrumentation with data fed back to the kiln control room using the Citect scada system.

It is not envisaged that any significant changes to the existing limestone processing plant will be required during the MOP period except for normal upgrade/replacement, environmental improvements minor modifications, repair and maintenance.

2.3.5 Waste Management

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

The workshop channels all runoff 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 Main Gully waste emplacement.

The Marulan South Limestone Mine continues to operate five sewerage treatment facilities:

- 1 x Main envirocycle unit that receives effluent from main offices, laboratory, bathrooms, store and conference room;
- 2 x Lime plant envirocycle units servicing the kiln control room, hydration, dispatch and workshop areas; and
- 2 x Septic tanks. One located at the "machine shop"/primary crusher the other adjacent to the "Fettlers' shed".

A third septic system services the former "Club" facility, north of the main office and is located outside the CML No. 16 boundary.

The "machine shop"/primary crusher septic tank, is inspected and pumped out weekly by an accredited waste disposal contractor. The "Fettler's shed" and "Club" units are adequately serviced by adsorption trenches.

2.3.6 Limestone and Limestone Product Stockpiles

BCL's limestone stockpile has a nominal capacity of 400,000 tonnes.

Limestone bin capacity for rail dispatch is approximately 20,000 tonnes.

The lime products capability is 1,600 tonnes of quicklime and 700 tonnes of hydrated lime. The addition of two silos and associated transfer equipment operational since August 2008 has increased the quicklime and hydrated lime stock holdings by 300 tonnes.

2.3.7 Water Management

Water management for the earlier 2009 – 2015 MOP has previously been assessed by environmental, land and project management consultants GSS Environmental (surface water) and by water and environment consultants Aquaterra Pty Ltd (ground water). These assessments were considered consistent with proposed activities to be undertaken during the 2018 – 2023 MOP term and similarly for the 2019 – 2023 MOP term.

The following sections reference appropriate detail from each of the two assessments conducted and include relevant updates as reported in recent AEMRs.

Additional investigation of both groundwater and surface water has been undertaken as part of the environmental impact assessment for SSD 7009. Relevant sections of these studies are referenced in the REF (2019) included in **Appendix 1B**.

More recent investigation of the 1970's Bryce's Gully overburden emplacement following the issue of erosion and sedimentation as reported to the EPA on 31st January 2018 is referred to in Section 3.1 – Environmental Risk Assessment and detailed in **Appendix 8**.

Surface Water Management

Surface water impacts and proposed management measures to be implemented during the MOP period are classified and detailed in Section 7 of "*Surface Water Assessment, Marulan South Limestone Mine*", GSSE 2009.

Activities requiring surface water management include the Eastern (Barbers Creek) waste emplacement area, the Western (Main Gully and Middle Gully) waste emplacement areas together with commencement, during the earlier MOP, of mining activities required for North and South Pit integration that is now essentially completed.

Sections 7.1 to 7.4 of the above report provide detail (dimensions, storage capacity and characteristics of water to be contained) for water management structures summarised on the Mining Activities Plan - Plan 4 in Appendix 8 – Plans. In addition, further information including surface water catchments, water flow and the location of containment structures is detailed in Figure 4 of "*Surface Water Assessment, Marulan South Limestone Mine*", GSSE 2009.

Summarised in Section 7.7 are details of two new sediment control (dirty water) dams and one clean water dam proposed during the MOP period. Table 11 of "*Surface Water Assessment, Marulan South Limestone Mine*", GSSE 2009 provides further description of a 6.5ML and nominal 4ML sediment control dam proposed for the Eastern (Barbers Creek) and Western (Main Gully) emplacements respectively.

The location of existing and proposed water management structures is shown on the 2009 - 2015 MOP Plan 4-1 and in **Table 2.3.7**.

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.

Normal practice is for surface run-off from undisturbed areas or “clean water” to be diverted and separated from “dirty water” or run-off over areas disturbed by mining and mine related activities. However due to site topographical restrictions diversion and separation of surplus “clean” and “dirty” water flows is not always practical for the Marulan South Limestone Mine. Some clean water is collected in a series of farm, mine and plant dams located on the west side of the North and South pits. This water is retained and primarily used for dust suppression on haul roads.

The majority of surplus surface run-off is therefore directed into both the North and South Pits.

The potential sources of pollution from the mine, in particular oil & grease and total suspended solids, (TSS) and the relevant control strategies in place have previously been identified in the Water Management Plan and the Ground Water Monitoring Programme prepared by Matrix+ Consulting in 2005.

The Water Management Plan is subject to revision. A revised ground water monitoring programme commenced during the 2014/2015 AEMR period using six newly commissioned monitoring bores together with an extended surface water monitoring programme covering locations as indicated on **Plan 1C**.

Monitoring and reporting

Water monitoring and reporting requirements in accordance with EPL 944 include the North pit bore. BCL maintains a voluntary monitoring point being the automatic water sampler located in the lower section of Main Gully, this water monitoring point is triggered automatically when the water in the area rises during a rain event.

Table 1.3.7 Proposed Additional New Sediment Control Dams

Location	Purpose	Estimated Total Catchment area	Dam, Capacity (5 day, 95 th Percentile event) (ML)	Annual AVG Catchment Water Supply (Excluding Losses) (ML/yr)
Sediment Control Dams (Dirty Water Dams)				
Northern Operations area (Catchment Q1)	<ul style="list-style-type: none"> Construction of a clean water dam 	23 ha	4ML	To be determined
Eastern Emplacement (Barber's Creek Emplacement) Catchment: Q3	<ul style="list-style-type: none"> Runoff control from new extended Eastern Emplacement. Improved water quality of offsite discharge to Barbers Creek via the downstream filter dam (life of which also increased). Provision of water for dust suppression and rehab if required 	6.6 ha	6.5 ML	6 ML/yr
Western Emplacement (Main Gully Emplacement) Catchments: D1, Q9	<ul style="list-style-type: none"> Runoff control from large Western Emplacement Area Pre-treat and settle suspended solids prior to discharge along Southern Haul Road to South Pit void. 	47.5 ha (40.8+6.7)	4ML +	33 ML/yr

	<ul style="list-style-type: none"> ▪ Provision of water for dust suppression water and rehabilitation ▪ Minimise reliance on existing groundwater bore in this area. 			
Western Emplacement (Catchment Q5)	<ul style="list-style-type: none"> ▪ Potential upstream clean water dam 	27.5ha	8ML	To be determined

Groundwater Management

Ground water impacts and proposed management measures to be implemented during the MOP period are presented in the “*Marulan South Limestone Mine – Groundwater Assessment*” completed by Aquaterra Pty Ltd dated 12 October 2009.

In particular Section 3.2 provides impacts on groundwater levels with continued mining activities in the North Pit and Eastern Batters and within the South Pit.

2.3.8 Hazardous Materials

Dangerous goods depots include 1 x Petrol, 2 x LPG, 1 x oils, 1 x compressed gas and 1 x distillate are utilized at the mine in accordance with new licencing for Acknowledgement of Notification of Dangerous Goods on Premises - Licence Number 35/008099.

Hazardous and Dangerous material facilities are inspected at least annually by an externally accredited inspector to check for any problems or upgrades required under the regulations.

As required, all enclosures to fuel facilities are bunded to meet AS 1940 Storage and Handling of Flammable and Combustible Liquids, 2017.

The Asbestos Register titled “Asbestos Survey Report” Report No. 6011/02/ASR, dated 13 July 2005 is available on-site in accordance with NOHSC (WorkSafe) Code of Practice and OH&S Regulation 2001.

A Phase 1 Contaminated Land Assessment was undertaken during 2010 to update and further identify potential land contamination issues on site. The results from this assessment, and the recommendations within, will be used by BCL to appropriately manage any potentially contaminated lands to be impacted upon during the MOP period.

The removal and reconfiguration of the Tallong water supply pipeline was undertaken during the 2009 – 2015 MOP period, this activity was conducted in accordance with the recommendations of the Phase 1 Contaminated Land Assessment.

Removal of an approximately 1,100 metre section of the Tallong AC water pipeline that supplies Boral Cement Limited’s, Marulan South Limestone Mine with water was undertaken by Boral Resources (NSW) Pty Limited in June 2011 during the establishment and relocation of services for their adjoining Peppertree hard rock quarry development. Boral Resources (NSW) Pty Limited engaged Longstone Pty Ltd (ABN 20083458664), a licenced local asbestos removal contractor, to remove the section of pipeline.

The removal of the AC water pipeline was undertaken in accordance with the Safe Work Method Statement, dated 25 May 2011, in approximately 6 days during the period of 3 June 2011 to 10 June 2011.

All asbestos materials removed were delivered to the Goulburn Mulwaree Shire Council Waste Facility at 100 Sinclair Street, Goulburn. In addition, soil sampling and a visual inspection of a section of the AC water pipe route was undertaken by Robson Environmental.

2.3.9 Other Infrastructure

Site access from the Hume Highway is via the 9 km Marulan South Road. Materials and supplies continue to be transported to site and limestone, shale and lime products continue to be despatched by truck from site.

A single line rail track owned and maintained by BCL is located within CML No. 16 and provides access to the main Great Southern Railway at Medway Junction located approximately 8km to the north. In addition, a 1 km length of triple line track is used for shunting and train loading. The majority of limestone products produced are despatched by rail.

Electricity supply is via the “Marulan” 33/11kV zone sub-station located to the west of CML No. 16 and distributed throughout the mine as shown on **Plan 1C**.

Natural Gas as required to fuel the lime kiln is supplied via a high-pressure gas pipeline. Coal firing is also used with coal delivered by road to the coal handling facility.

Water for processing and dust suppression is supplied via a pipeline from the nominal 85 mega litre Tallong Dam facility leased from the State Rail Authority and located 10 km to the north and currently from two on-site bores located in the north end of the North pit.

Appropriate detail on the sewage treatment facilities is provided in Section 2.3.6.

Site communications are via telephone line and satellite optical fibre network.

2.3.10 Bushfire Management

Bushfire response and management is an ongoing site program both from a safety and environmental aspect.

The Bushfire Management Plan (2015) for the mine provides a number of risk control measures for protection of property and lives from bushfires. The mine holds various firefighting equipment including:

- Fast fill hoses and connections;
- Two water tankers;
- Clean water dams with maintained access points;
- Earthmoving equipment;
- Water pumps;
- Portable radios;
- Fire Alarms; and
- First aid rooms and supplies.

This equipment will be made available on request to the Southern Tablelands Zone RFS for use within the area.

The Marulan Rural Bushfire Brigade continues to monitor bushfire risk and conducts an annual inspection to determine levels of natural fuel sources in and around the Marulan South Limestone Mine lease area. Bushfire risk is minimized by carrying out ‘burn offs’ as required in accordance with the necessary permits and regulations.

In addition, fire risks associated with natural fodder or grassed paddocks in and surrounding the lease area continue to be controlled by sheep grazing or by leasing rights for grazing.

Training in firefighting is ongoing.

2.3.11 Public Safety

Public safety risks arise in Bungonia Gorge at times of blasting within and where members of the public can access the site un-authorised.

Additional procedures are followed prior to blasting in areas declared as “Blast Affecting Bungonia Gorge” (refer to Section 2.3.4)

A site security plan was updated in 2006 which incorporates fencing, security gates and electronic monitoring to improve site security and reduce the risk of un-authorised public access. This plan has been subject to annual reviews with the latest version awaiting final approval by DPI – Safety Inspectors.

Features of the security plan and system include the following;

- One 6 metre sliding gate located at the Main office, and associated chain mesh fencing to ensure appropriate scrutiny of all site visitors;
- One pedestrian gate, located near the old bowling club car park (now the visitor’s car parking area allow access to the office to ensure visitor sign in;
- Two swing gates located on the Lime Kiln Road prior to the main weighbridge and associated chain mesh fencing to allow entry only through the gate itself;
- Additional chain mesh fencing to the mine site perimeter, around the main entry areas, to ensure the possible points of entry and exit are limited to the control points, being the gates; and
- Signage for both the new and existing mine perimeter fencing.

The security system has further been improved with the relocation of the Sites Administration and Training functions “off lease” to the old bowling club rooms. All visitors now report to a Main Office and register prior to entry to the Mining Lease CML 16 site.

Review and upgrade of the Site’s Induction system for visitors, contractors and employees is an ongoing component of the BCL Site Safety Management Plan.

3 ENVIRONMENTAL ISSUES MANAGEMENT

3.1 Environmental Risk Assessment

To identify mine activities, processes and facilities which require control strategies to ensure environmental protection and compliance with conditions of lease, license and development consent, the former BCSC initially conducted a “Broad Brush Environmental Risk Assessment” in January 2008 that was facilitated by GSS Environmental.

In preparation of the 2018-2023 MOP, the original “Broad Brush Environmental Risk Assessment” (February 2008) that was updated for the 2009-2015 MOP was reviewed to identify the key environmental risks to be assessed for mining and associated activities. The 2017 environmental risk assessment undertaken for the 2018-2023 MOP period is still considered relevant for this 2019-2023 MOP.

The methodology used complied with AS/NZS ISO 31000:2009, Risk management - Principles and guidelines. The revised 2017 environmental risk assessment indicated that with appropriate management controls in place environmental risks could be minimised and maintained within low to medium category.

In regard overburden emplacements and in particular the older “1970s” Eastern Batter emplacements comprising Bryce’s Gully, Barbers Creek and South Pit locations it has been recognised that maintaining a good revegetation cover over these steep (angle of repose) slopes is key to minimising surface erosion, reducing sedimentation and maintaining surface stability.

This 2019 – 2023 MOP includes in **Appendix 8** the required Bryce’s Gully Water Management Plan (WMP) as a requirement of both the EPA following Boral’s reporting of the erosion and sedimentation issue from Bryce’s Gully on 31 January 2018 and agreement with the DPIE – Resources Regulator as detailed in their letter dated 24th June 2019 and included as **Attachment 1**.

Environmental controls and environmental management plans used in mitigation of other potential environmental risks identified at the Marulan South Limestone Mine are discussed in the following sections

3.2 Environmental Risk Management

In accordance with Boral’s Environmental Policy, BCL will progressively implement and maintain environmental management systems for the mine based on the international standard ISO 14001 or its equivalent. An Environmental Management (Improvement) Plan has been progressively developed for the site and will facilitate the development of an Environmental Management System that will be integral with existing site safety and quality management systems.

The mine has maintained NATA accreditation since May 2000 in response to a previous Pollution Reduction Program, PRP 18 in accordance with the Site’s Environment Protection Licence Number 944 to ensure the integrity of environmental monitoring

Environmental issues and opportunities will continue to be managed during the MOP period according to the Site Environmental Improvement Plan that is reviewed annually.

Components of the Site Environmental Improvement Plan include;

- The Boral Environmental Policy;
- Site Environmental Management Committee;
- Internal company monthly reporting of environmental protection actions and breaches;

- Ongoing assessment of environmental risk; and
- Environmental awareness induction and training for employees, contractors and visitors.

Included in **Table 3.2** and numbered **1 to 19** are the various environmental management controls / mitigation measures proposed in this MOP to minimise environmental impacts. These are referenced to the appropriate section of the current REF, specialist consultant reports and/or environmental management plan.

Table 3.2 Environmental Management Controls

Environmental Management Control		REF and/or <i>relevant documents</i>	
No.	Title	Section	Description
1	Air Quality	4.1.2	Air Quality and Greenhouse Gas Mitigation Measures
2	Erosion and Sedimentation	8.0	Soil and Water Management Plan <i>Surface Water Assessment, GSSE (2009)</i>
3	Surface Water	4.3.3	Surface Water Mitigation Measures Eastern Emplacement Western (Main Gully) Emplacement Western (Middle Gully) Proposed Single Pit Void
4	Ground Water	4.2.3	Groundwater Mitigation Measures
5	Contaminated Land	4.8	Contaminated Land
6	Flora	4.6.3	Flora and Fauna Mitigation Measures
7	Fauna	4.6.3	Flora and Fauna Mitigation Measures
8	Weed and Feral Pests	5.9 & 6.4	Weed Management and Feral Animal Management <i>Rehabilitation Strategy, GSSE (2010)</i>
9	Blasting	4.5.3	Noise and Vibration Mitigation Measures
10	Noise	4.5.3	Noise and Vibration Mitigation Measures
11	Visual Impact and amenity	4.12.3	Visual Assessment Mitigation Measures - Long Point Lookout - Marulan South Road - Bungonia Lookdown Area
12	Aboriginal Heritage	4.13.3	Aboriginal Heritage Mitigation Measures
13	Natural Heritage	4.14.3	Other Cultural Heritage Mitigation Measures
14	Spontaneous Combustion	3.11	Spontaneous Combustion 2018-2023 MOP Section 3.2.1
15	Bushfire Management	3.12	Bushfire Management incorporated with Site Emergency Response Plan (revised 11/17)
16	Mine Subsidence	3.13	Mine Subsidence 2018-2023 MOP Section 3.2.1
17	Hydrocarbons	4.7.1	Boral Waste Management Standard HSEQ-8-04 and CEM-ENV-014
18	Public Safety	3.14	Public Safety incorporated with Site Emergency Response Plan (revised 11/17)
19	Topsoil management	4.4.3	Soils and Land Capability Mitigation Measures

3.2.1 Specific Risks Relating to Rehabilitation

This section provides information on specific risks relating to rehabilitation and how they are managed at the mine.

Geology and Geochemistry

The Marulan limestone deposit lies within the Lachlan Geosynclinal Province. During the Palaeozoic thick sedimentary formations were laid down in the region. The formations included sediments, volcanic lavas and ash and limestone reefs.

A reef complex formed the Bungonia Limestone Group which were later folded and faulted by crustal collisions and the levelled by substantial erosion. About 65 Million years ago the area was again uplifted giving way to a rejuvenated river system leading to the landscape of today.

The Palaeozoic formations around Marulan South (known as the Bungonia Limestone Group) consist of a number of generally parallel and north-south striking beds dipping at 65-85 degrees to the west. The beds include the Mt. Frome limestone, sedimentary rocks, volcanic rocks and the Eastern limestone.

The Eastern limestone has the highest grade and was therefore selected for the location of the mine. The near vertical north-south trend in the North pit gradually changes to a westerly dip in the southern end of the South pit. The limestone is bound to the east by the older Tallong shale beds and in the west by the younger shales, volcanic tuff and the Mt. Frome limestone. A north-south and various east-west dolerite dykes penetrate the limestone from beneath. The limestone bed is truncated in the north by the Glenrock Granodiorite intrusion.

Spontaneous Combustion

The storage of coal, previously used as a fuel for the calcination of limestone in the lime kilns was the only activity identified on site with the potential for spontaneous combustion.

The risk of spontaneous combustion is minimized by CO monitoring, alarming and a triggered, stored CO₂ 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.

The primary use of natural gas as kiln fuel has significantly reduced the potential risk of spontaneous combustion from coal storage at the mine.

Acid Mine Drainage

The potential for acid generation from regolith material (topsoil and subsoil) within the Study Area is considered low. Acid Sulphate Soils (ASS), which are the main cause of acid generation within the soil mantle, are commonly found less than 5 m above sea level, particularly in low-lying coastal areas such as mangroves, salt marshes, floodplains, swamps, wetlands, estuaries, and brackish or tidal lakes. The inland limestone geology of the site at high elevation indicates ASS potential is very low.

In 2015, RGS Environmental PTY Ltd were appointed to undertake a Geochemical Assessment of waste rock materials from the mine. Representative samples of waste rock material were received by RGS and subjected to a series of static geochemical tests to determine the potential for this material to generate acidity, salts and soluble metals/metalloids.

The geochemical assessment work on waste rock was completed in accordance with existing technical guidelines for the geochemical assessment of mine waste in Australia (DITR, 2007, AMIRA, 2002) and worldwide (INAP, 2009).

The samples were crushed to pass 10mm and then sub-samples pulverised in preparation for static geochemical testing. Each sample was tested for:

- pH and Electrical conductivity (EC);
- Total sulphur [Leco Method]; and
- Acid neutralising capacity (ANC) [AMIRA, 2002].

The results of these tests were used to calculate the Net Acid Producing Potential (NAPP).

One of the waste rock samples was also subjected to further testing to determine the sulphide sulphur content of the sample using:

- Chromium Reducible Sulphur [AS 4969.7-2008]

A total of 12 of the original 20 waste rock samples received by RGS were used to generate six composite samples of waste rock materials on the basis of lithology. The six composite samples were tested for:

- Total cations [HCl and HNO₃ acid digest followed by ICP-AES/MS];
- Total metals/metalloids [HCl and HNO₃ acid digest followed by FIMS and/or ICPAES/MS];
- Soluble metals/metalloids [ICP-AES/MS and FIMS (1:5 w:v water extracts)]; and
- Major cations and anions [ICP-AES/MS and PC Titrator (1:5 w:v water extracts)].

The results of the geochemical assessment program on the tailing material from the Project indicate that:

- Waste rock materials are classified as NAF and are essentially barren of sulphur. The waste rock materials therefore have a high factor of safety with respect to potential acid generation.
- Surface runoff and seepage from waste rock materials is likely to be slightly alkaline and contain low concentrations of dissolved salts.
- The waste rock materials contain relatively low concentration of metals/metalloids in solids. Whilst the concentration of arsenic, cobalt and manganese may be elevated compared to average crustal abundance in some of the contact material between limestone and shales, these elements are sparingly soluble in contact water.
- Most trace metal/metalloids in waste rock are sparingly soluble in slightly alkaline contact water and are unlikely to impact upon the quality of surface and groundwater resources at the site.

The following management measure was presented for adoption at the mine:

- Monitors surface run-off and seepage from the waste rock storage facility for pH, EC, total suspended solids (TSS) and the range of dissolved trace metals/metalloids and major ions on a quarterly basis.

Mine Subsidence

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 have been undertaken since December 2002 and have been continued on a regular basis by rock, soil and water engineering consultants Pells Sullivan Meynink Pty Ltd (PSM).

PSM advised that a geotechnical focus, based on a campaign approach, is no longer preferable due to the pit size and that ongoing review and management of the slopes is

required. PSM recommended that the mine consider ongoing mapping of faces to confirm adequacy of designs and pit slope monitoring as appropriate.

During the 2016/2017 AEMR period PSM performed an annual geotechnical report for the mine, with a focus on the Barber's Creek waste emplacement. PSM concluded that the area does not pose a critical risk of failure but advised that BCL should attempt to revegetate the batters of this emplacement as much as possible.

In the south pit mining operation, PSM noted that a rock bund is in place at the bottom of each bench, while traffic is present under the wall. PSM advised that the bund should be removed before starting a new drop cut to clean up the berm.

In the upper benches of the North pit PSM has advised to treat the area with geotechnical parameters as "extremely weathered sediments" this includes 50-degree batter angles on 15m wall and 9m berms.

Prior to overburden emplacement in the southern end of the "South Pit" PSM investigated in October 2018 the potential impacts, particularly on seepage rate below the proposed 350m final mine "floor" level. Even with an expected loss of seepage area and likely slowing of the seepage rate as overburden is backfilled into the "South Pit" this is not considered significant as increased storage and seepage area will be provided in the adjoining "North Pit". The proposed 30-year mine plan in fact creates a large "sedimentation" basin in which options for pre-treatment of surface waters directed into the mine void become available.

Erosion and Sediment Control

The site sediment and erosion control system would be managed through erosion and sediment control plans that would be progressively developed over the life of the mine. The effectiveness of the plans would be assessed through monitoring and by a formal auditing process.

Erosional stability would be a key requirement of site rehabilitation and closure works design. The operational sediment and erosion control works would be retained and maintained during the rehabilitation and revegetation establishment phase. Following the establishment of self-sustaining, stable final landforms, key elements of the operational sediment control structures would either be left as passive water control storages (if practicable) or would be removed if they could not be left without an ongoing maintenance requirement.

Following the reported (31st January 2018) erosion and sedimentation issue from the 1970's former Bryce's Gully overburden emplacement, PSM have undertaken major geotechnical investigation of this emplacement area as detailed in their "Sediment Management at Bryce's Gully – Characterisation and Solution concept Designs" report dated 14 June 2019. (Refer to **Appendix 8**).

Soil Types and Suitability

Three (3) separate soil surveys have been undertaken for the mine. These were conducted during 2005 and 2006 and are described below.

The Marulan South Limestone Mine is located over steep, rocky limestone outcrops considered to have a Class VIII land capability. There are also areas of undulating land suited only to careful pastoral use under a Class VI and Class VII classification.

The soil surveys conducted provide wide coverage of soils for the entire site. The most dominant soil landscapes are both the Yellow and Red Duplex soils. All samples taken from the soil surveys were found to have desirable textural characteristics for use as a revegetation media. The soil & waste materials have textures that are neither too coarse nor too fine thus allowing for a compromise between sufficient water holding capacity and effective drainage.

Flora and Fauna

The Marulan South area is located within the South-Eastern Highlands Bioregion of NSW an area of nearly 5 million hectares that occupies approximately 6.11% of the state. Both soils and vegetation vary across the bioregion in relation to altitude, temperature and rainfall.

The Marulan South Limestone Mine that currently occupies an area of 616.5 hectares within CML No.16 or 0.01% of the South-Eastern Highlands Bioregion, separates the extensively cleared farming areas immediately to the west from the adjoining Bungonia State Recreation Area to the south and Morton National Park to the east.

Vegetation within the 3,971-hectare Bungonia State Recreation Area is described by the former NSW DEC – NPWS, 1998 as consisting of woodland on the ridges and steep slopes and open forest on the moderate slopes and plateau. The area is considered to provide a large area of wildlife habitat and contain three species, (*Haloragis exalata*, *Pterostylis calceolus* and *Acacia chalkerii*) of rare and threatened plants, one of which, (*Pterostylis calceolus*) is protected only within the state recreation area. A Koala (*Phascolarctos cinereus*) population is present in the state recreation area and the Brush-tailed Rock Wallaby (*Petrogale penicillata*) has been sited. Bungonia's limestone caves provide bat wintering and nursery sites for several bat species including a population of the vulnerable Large Bent-wing Bat, *Miniopterus schreibersii*. In addition, the unique karst landscape and extensive cave structure is known to contain rare invertebrate cave species endemic to the state recreation area.

Flora and fauna surveys have been conducted over the Marulan South Limestone Mine on a number of occasions as detailed below and have to date indicated that in the areas investigated no threatened plant or animal species have been recorded and that none are expected to be present within the immediate areas disturbed by mining activities.

In support of this 2019 – 2023 MOP, a Review of Environmental Factors REF (2019) including a Biodiversity Impact Assessment by Niche (2019) was undertaken to investigate the potential impact on flora and fauna within the nominal 5 ha area (Area C2) to be cleared in and around the existing middle gully overburden emplacement.

The vegetation within the study area was validated during Niche (2019) and has been aligned to the Plant Community Type (PCT) 1150 - Silvertop Ash - Blue-leaved Stringybark shrubby open forest on ridges, north-east South Eastern Highlands Bioregion. (Refer to **Plan 1B**). This vegetation type is not listed as a Threatened Ecological Community (TEC) under either the BC Act or EPBC Act.

The field survey confirmed that the study area does not contain the threatened plant – *Solanum celatum* which has been recorded extensively within the surrounding landscape. No other threatened flora are likely to be present.

The field survey confirmed that the habitat of the study area does not consist of important limiting habitat for threatened fauna, given the extensive habitat to the south of the study area which adjoins Bungonia Conservation Area and Morton National Park. However, the habitat within the study area may be used on occasion for foraging associated with a number of threatened fauna species, including: Diamond Firetail, Eastern Bentwing-bat, Yellow-bellied Sheath-tail Bat, Greater Broad-nosed Bat, Large-eared Pied Bat, Scarlet Robin, Eastern Freetail Bat, Eastern False Pipistrelle, Golden-tipped Bat, Grey-headed Flying-fox, Koala, Powerful Owl, Rufus Fantail, Varied Sittella, Gang-gang Cockatoo, Speckled Warbler and Rainbow bee-eater.

Recommendations by Niche (2019) to minimise or mitigate potential impacts to flora, fauna and their habitats are included in Section 2.3.2 – Land preparation.

Flora

The following flora surveys have been completed in and around the Marulan South Limestone Mine since 1994 with typical (non-threatened) flora species recorded as detailed below.

Sinclair Knight Merz, 1994

Investigations on the west side of the North Pit in 1994 by Sinclair Knight Merz identified dry sclerophyll woodland as typical of the vegetation communities throughout the general region. A tree canopy to a height of approximately 25 metres dominated by Apple Box (*Eucalyptus bridgesiana*), Yellow Box (*Eucalyptus melliodora*) and narrow-leaved Stringybark (*Eucalyptus oblonga*) was identified together with a moderately dense mid-storey of regenerating eucalyptus and wattles including *Acacia falciformis*, *implexa* and *ulicifolia*. Groundcover identified in gullies included *Persoonia mollis subsp ledifolia*, the Mat Rushes (*Lonmandra glauca* and *longifolia*), Blachthorn (*Bursaria Spinosa*) and Sweet Pittosporum (*Pittosporum undulatum*). The site subject to disturbance was considered to have little or no conservation significance.

No threatened or endangered plant species were recorded from the area investigated at the time and none were expected to be present.

Gunninah Environmental Consultants, 1997

Vegetation communities recorded in and around a western section of the North Pit by Gunninah Environmental Consultants in 1997 included Woodland/Low Woodland, and Open Woodland / Savannah consisting of Yellow Box, Apple Box and Narrow Leaved Stringybark. Given the high levels of disturbance from previous mining operations and agricultural activities it was considered by Gunninah Environmental Consultants extremely unlikely that threatened plant species would occur on the mine site. No Rare or Threatened Australian Plants (ROTAP) have been recorded within 5 km of a western section of the North Pit that was surveyed in 1997.

Goulburn TAFE Natural Resource Management Faculty, 2004

Revegetation studies conducted since 2004 by students from the Natural Resource Management Faculty of Goulburn TAFE have identified similar species as detailed above on un-disturbed areas to the east of the South Pit.

URS, 2006

Additionally, an assessment titled "Marulan South Limestone Mine Expansion of Mining Operations of the North Pit – Flora and Fauna Assessment" (URS, 2006) was undertaken in an area of approximately 25 ha on the western side of the North Pit. The URS (2006) assessment found similar vegetation communities, with tall woodlands to open forests dominated by Yellow Box (*Eucalyptus melliodora*), Forest Red Gum (*E. tereticornis*) and Thin-leaved Stringybark (*E. eugenoides*) within these areas. This assessment, in conjunction with reviews of previous assessments also found no threatened plant taxa.

RPS Harper Sommers O'Sullivan (RPS), 2009

An ecological assessment has recently been conducted by RPS Harper Sommers O'Sullivan (RPS), to assess the potential impacts on terrestrial ecology as a result of the continued placement of overburden in the approved waste emplacements areas during the term of this MOP.

Following five (5) days of fieldwork on the 9th to the 13th February 2009 and a literature review RPS 2009 determined that no threatened flora species had been identified on the site.

There were five (5) vegetation communities identified on the site. These are summarised below as:

- Brittle Gum Stringybark;

- Forest Red Gum Stringybark Woodland;
- Coastal Grey Box Forest Red Gum Woodland;
- Cleared/Disturbed Planted Vegetation; and
- Planted Trees and Shrubs.

Fauna

The following fauna surveys have been completed in and around the Marulan South Limestone Mine since 1997 with typical (non-threatened) fauna species recorded as detailed.

Gunninah Environmental Consultants, 1997

Mammal species recorded in and around the western area of the North Pit by Gunninah Environmental Consultants in 1997 included the Echidna, Common Wombat, Sugar Glider, Mountain Brushtail Possum, Swamp Wallaby, Eastern Grey Kangaroo, Common Wallaroo and Red-necked Wallaby. These according to Gunninah Environmental Consultants, 1997 are all common to abundant species, which occur over extensive distributional ranges, and are regularly recorded in areas affected by agricultural or other pursuits. The same species are found in the Bungonia State Recreation Area.

Two species of microchiropteran bats, the White-striped Mastiff Bat and the Little Forest Bat have been recorded and other small terrestrial mammals including the Brown Antechinus and the Bush Rat could also be present.

The occurrence of both the Koala and Brush-tailed Rock Wallaby within the vicinity was noted by Gunninah Environmental Consultants, 1997. Neither species was considered likely to be present in the area investigated at the time because no unique or critical resources required by these species are apparent.

A number of native bird species typical of open forest and woodland habitats, or of disturbed grassland areas were recorded by Gunninah Environmental Consultants during their 1997 fauna assessment. These included Crimson and Eastern Rosellas, Tawny Frogmouth, Kookaburra, White-throated Tree-creeper, Superb Fairy-wren, Spotted and Striated Pardalotes, White-browed Scrubwren, Brown Thornbill, Little Friarbird, Noisy Miner, yellow-faced Honeyeater, Rufous Whistler, Grey Fantail, Black-faced Cuckoo-shrike, Olive-backed Oriole, Pied Butcherbird, Pied Currawong and White-winged Chough. All of these species recorded are common to abundant and widespread.

Few reptiles or amphibians were recorded during field investigations. Those identified included the Short-necked Tortoise, Perron's Tree Frog, the Spotted Grass Frog and Garden Skink.

Introduced species recorded include the Cat, Fox, Goat and Rabbit that also occur in the adjoining Bungonia State Recreation Area. Goats cause significant damage to native vegetation, contribute to erosion and may compete for shelter with the threatened Brush-tailed Rock Wallaby.

URS, 2006

The URS (2006) assessment recorded 11 mammals, 36 birds, 2 frogs and 1 reptile through opportunistic survey methods. This survey identified two areas of potential Koala habitat and the presence of Koala's was indicated through scratch marks and scats, although there were no sightings in either of the potential habitats. No further threatened fauna was recorded in the study area. This assessment concluded that due to similar habitat adjoining the mine and disturbance areas, the impact upon fauna species was likely to be minimal.

RPS Harper Sommers O’Sullivan (RPS), 2009

The RPS (2009) flora and fauna assessment identified a total of 8 mammals and 47 birds that could be reasonably expected to be found within the site at some occurrence, and only one mammal species was observed during the field work being (*Antechinus stuartii* – Brown Antechinus). From those species identified, ten (10) threatened fauna species were considered likely to occur within the project areas (at least on an occasional basis). The following table summarises the threatened fauna species that are considered likely to occur within, or use the project area.

No threatened species including those “likely to occur” threatened species as listed in **Table 3.2.1** were recorded within the study areas assessed by RPS during February 2009.

Table 3.2.1 Likely Threatened Fauna Species (RPS 2009)

Common Name	Scientific Name
Gang-Gang Cockatoo	<i>Callocephalon fimbriatum</i>
Glossy Black-Cockatoo	<i>Calyptorhynchus lathamii</i>
Swift Parrot	<i>Lathamus discolor</i>
Squirrel Glider	<i>Petaurus norfolcensis</i>
Koala	<i>Phascolarctos cinereus</i>
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>
Eastern Bentwing Bat	<i>Miniopterus schreibersii oceanensis</i>
East Coast Freetail-bat	<i>Mormopterus norfolkensis</i>

4 POST MINING USE

4.1 Regulatory Requirements

The Marulan South Limestone Mine's continuing operations are governed by two 1970's development consents and existing use rights as described in **Section 1.2.1**. The development consents that apply to the mine, do not contain conditions for post mining land use. In addition, CML No.16 is a consolidation of some 66 former mining authorities with conditions that pre-date both the current MOP rehabilitation and mine closure plans and the former mining, rehabilitation and environmental management process.

Boral's commitment in lodging State Significant Development (SSD 7009) application for a further 30-year continuation of the Marulan South Limestone Mine together with proposed application for new Mining Authority(s) presents the pathway forward in replacing existing approvals with an updated set of modern approvals with revised conditions of consent, lease or licence.

In the interim, current post mining land use and rehabilitation objectives consistent with existing regulatory requirements have been addressed in the *Marulan South Limestone Mine Rehabilitation Strategy* report prepared by GSSE (2010). Refer to copy in **Appendix 7**.

This rehabilitation strategy provides a methodology for mine closure through the decommissioning of infrastructure, plant and buildings. While this strategy assumes that some of the existing infrastructure will be used post mining, focus is placed on how the following components of the mine maybe decommissioned including:

- Site services;
- Infrastructure and buildings;
- Roadways, car parks and hardstands;
- Fuel farms and chemical storage areas; and
- Dams and surface water features.

This strategy currently provides detail on conceptual final landform, including final void configuration and how these features will be managed but will be revised in accordance with the 30-year State Significant Development (SSD 7009).

Regulatory requirements specific to land use and rehabilitation for CML No. 16 and ML 1716 are summarised in the following two sections.

Consolidated Mining Lease No. 16

Consolidated Mining Lease No. 16 (1992) includes various rehabilitation and post mining land use conditions as outlined in **Table 4.1.1** below:

Table 4.1.1 Consolidated Mining Lease Conditions relating to Rehabilitation and Land-use

Condition	Requirement
1(1)	Mining operations, including mining purposes, must be conducted in accordance with a Mining Operations Plan (MOP) satisfactory to the Director-General. The plan, together with environmental conditions of development consent and other approvals will form the basis for: - a) Ongoing mining operations and environmental management; and b) Ongoing monitoring of the project

1(4)	<p>The Plan must present a schedule of [proposed mine development for a period of up to (7) years and contain diagrams and documentation which identify: -</p> <ol style="list-style-type: none"> a) Area(s) proposed to be disturbed under the plan; b) Mining and rehabilitation method(s) to be used and their sequence; c) Areas to be used for disposal of tailings/waste; d) Existing and proposed surface infrastructure; e) Existing flora and fauna on site; f) Progressive rehabilitation schedules; g) Areas of environmental, ecological and cultural sensitivity and measures to protect these areas; h) Water management systems (including erosion and sediment controls); i) Proposed resource recovery; and j) Where the mine will cease extraction during the term of the plan, a closure plan including final rehabilitation objectives/methods and post mining land use/vegetation.
2(2)	<p>The AEMR must be prepared in accordance with the Director-Generals guidelines current at the time of reporting and contain a review and forecast of performance for the preceding and ensuring 12 months in terms of:</p> <ol style="list-style-type: none"> a) The accepted Mining Operations Plan; b) Development consent requirements and conditions; c) Environmental Protection Authority and Department of Infrastructure, Planning and Natural Resources licenses and approval; d) Any other statutory environmental requirements; e) Details of any variations to environmental approvals applicable to the lease areas; and f) Where relevant, progress towards final rehabilitation objectives.
16(a)	<p>Rehabilitation; Land disturbed must be rehabilitated to a stable and permanent form suitable for a subsequent land use acceptable to the Director-General and in accordance with the Mining Operations Plan so that:</p> <ul style="list-style-type: none"> ▪ There is no adverse environmental effect outside the disturbed area and that the land is properly drained and protected from soil erosion; ▪ The state of the land is compatible with the surrounding land and land use requirements; ▪ The Land forms, soils, hydrology and flora require no greater maintenance than that in the surrounding land; ▪ In cases where revegetation is required and native vegetation has been removed or damaged, the original species must be re-established with close reference to the flora survey included in the Mining Operations Plan. If the original vegetation was not native, any re-established vegetation must be appropriate to the area and at an acceptable density. ▪ The land does not pose a threat to public safety.
16(b)	<p>Any topsoil that is removed must be stored and maintained in a manner acceptable to the Director-General.</p>
17	<p>The lease holder must comply with any direction given by the Director-general regarding the stabilization and revegetation of any mine residues, tailings or overburden dumps situated on the lease area.</p>

19	<p>Prevention of Soil Erosion and Pollution</p> <p>Operations must be carried out in a manner that does not cause or aggravate air pollution, water pollution (including sedimentation) or soil contamination or erosion, unless otherwise authorized by a relevant approval, and in accordance with an accepted Mining Operations Plan. For the purposes of this condition, water shall be taken to include any watercourse, waterbody or groundwaters. The lease holder must observe and perform any instructions given by the Director-General in this regard.</p>
23	<p>Access tracks must be kept to a minimum and be positioned so that they do not cause any unnecessary damage to the land. Temporary access tracks must be ripped, top soiled and revegetated as soon as possible after they are no longer required for mining operations. The design and construction of access tracks must be in accordance with specifications fixed by the Department of Infrastructure, Planning and Natural Resources.</p>

Mining Lease 1716

Table 4.1.2 presents the condition, included in ML 1716, relating to rehabilitation of the site.

Table 4.1.2 Mining Lease 1716 - Requirements relating to Rehabilitation and Mine Closure

No.	Mining Lease	Condition	Requirement
1	Mining Lease 1716	2	Any disturbance resulting from the activities carried out under this mining lease must be rehabilitated to the satisfaction of the Minister.

4.2 Post Mining Land Use Goal

As indicated in **Section 4.1** post mining land use goals for the Marulan South Limestone Mine are currently presented as various options and discussed in The *Marulan South Limestone Mine Rehabilitation Strategy* report prepared by GSSE (2010). Plans 6, 7 and 7-1 referenced by this mine rehabilitation strategy are included in this 2019-2023 MOP as **Plan 4, Plan 5 and Plan 5-1**.

Collectively these plans show a conceptual final landform with the proposed final configuration of the void. The conceptual final void (“80-year final mine design”) covers an area of approximately 120ha and will be approximately 2000m in length, and between 400 and 800m in width. The final void will be some 400m in depth, ranging from 200m AHD to 600m AHD in elevation. The total capacity of the void to ground level is estimated to be approximately 190 million bcm.

The primary objective of the conceptual final void management section of the Rehabilitation and Decommissioning Strategy is to:

- propose mitigation measures to minimise potential off-site impacts associated with the conceptual final void at the mine;
- propose measures to be incorporated in the conceptual final landform which aim to minimise potential safety hazards to the general public; and
- present options for final land use of the conceptual void following the completion of mining.

4.2.1 Final Land-use Options (Final Void)

The options available for post mining land uses are generally determined by the location and nature of the void. In addition, and due to the fact that mine closure is not due for many years the options presented at this time are considered conceptual. More appropriate options at mine closure will be considered at that point in time.

At this point in time, possible options for the final void are to leave the void as temporary water storage, for use as a potential land-fill, or as a potential recreation area consistent with adjacent State recreational and National Park areas. As mine closure approaches a more detailed mine closure plan will be developed which will further address the issue of final void use and preferred use options.

Final Land-use options will be revised and updated in the 30-Year State Significant Development (SSD 7009) application.

4.3 Rehabilitation Objectives

Until new conditions of consent, lease and licence are issued in accordance with both the 30-Year State Significant Development (SSD 7009) application and grant of a new Mining Authority the overriding objective with respect to rehabilitation at the Marulan South Limestone Mine is to re-establish vegetation on the disturbed areas (excluding the voids) to as closely as practical to the pre-mining vegetation communities.

Specifically, the Rehabilitation Strategy has been assigned the following key objectives:

- Achievement of acceptable post-disturbance land use suitability – Mining and rehabilitation will aim 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 will be 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 postmining land use(s); and
- 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.

To achieve this, it will necessitate a well-coordinated and practical approach that will include, but not be limited to:

- Conducting proven and resilient revegetation techniques that acknowledge altered landform and soil conditions and frequent drought events;
- Protecting newly revegetated areas from stock and feral grazing animals for at least five (5) years (or until vegetation is sufficiently established);
- Undertaking sound landform and surface water management design;
- Implementing effective soil management techniques including stripping, stockpiling, re-spreading and appropriate weed control; and
- Establishing a recognised (statistically viable) monitoring program that can compare the progression of revegetated areas against analogue sites and demonstrate that the rehabilitated areas are moving towards a successful outcome.

5 REHABILITATION PLANNING AND MANAGEMENT

5.1 Domain Selection

The Primary Domains (operational) for the 2019 – 2023 MOP term are defined on **Plan 2** and described in **Section 2.2** and in **Table 4**.

These primary Domains comprise existing;

- 1 northern infrastructure area that include limestone processing and lime manufacturing plant and equipment,
- 2 waste lime storage area,
- 3 water management areas
- 4 existing western and new southern overburden emplacement areas,
- 5 stockpiled material (included in infrastructure and mine void areas)
- 6 existing limestone mine (open cut void)
- 7 progressive rehabilitation areas

No underground mining areas or conservation and biodiversity offset areas are currently applicable.

No Secondary Domains (post mining land use) have been defined for this 2019 – 2023 MOP period on the basis that final land use planning is currently conceptual as detailed in the current *Marulan South Limestone Mine Rehabilitation Strategy* report prepared by GSSE (2010) and as presented in **Plan 4** and **Plan 5**. In addition, Primary Domains as identified on **Plan 2** will be revised in accordance with the 30-Year State Significant Development (SSD 7009) application with significant changes to the limestone mine void, overburden emplacement and infrastructure disturbance footprints.

Primary Domain selection as indicated in **Section 2.2** is based on the maximum disturbance within the 2019-2023 MOP term and are for the purpose and use in determining the Rehabilitation Cost Estimate included as **Appendix 6**.

5.2 Domain Rehabilitation Objectives

Until Domain definition is better defined as proposed in the 30-Year State Significant Development (SSD 7009) application rehabilitation objectives remain as defined in the *Marulan South Limestone Mine Rehabilitation Strategy* report prepared by GSSE (2010).

The overriding objective with respect to rehabilitation at the Marulan South Limestone Mine is to re-establish vegetation on the disturbed areas (excluding the voids) to as closely as practical to the pre-mining vegetation communities. Specifically, the Rehabilitation Strategy has been assigned the following key objectives:

- **Achievement of acceptable post-disturbance land use suitability** – Mining and rehabilitation will aim 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 will be 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.

5.3 Rehabilitation Phases

Rehabilitation progression at the Marulan South Limestone Mine is identified in Domain 4 and in Domain 7 as shown on **Plan 2** 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.

As indicated in **Table 5** below the majority of the Marulan South Limestone Mine is an active mine 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 as discussed in **Section 7.2** and as detailed in **Plans 3A to 3C/3D**.

Table 5 Summary of Rehabilitation Phases Proposed for Completion at the end of the 2019-2023 MOP

Domain Rehabilitation Phase	1 Infrastructure Area	1-1 Infrastructure – Roads	2 Waste Lime Storage	3 Water Management	4 OB Emplacement	5 Stockpiled Material	6 Open Cut Mine Void	6-1 Land Disturbance (early mining)	7 Rehabilitation Areas
Active Mining Area	✓	✓	✓	✓	✓	✓	✓	✓	✓
Decommissioning	x	x	x	x	✓	x	x	x	✓
Landform Establishment	x	x	x	x	✓	x	x	x	✓
Growth Medium Development	x	x	x	x	✓	x	x	x	✓
Ecosystem and Land Use Establishment	x	x	x	x	✓	x	x	x	✓
Ecosystem and Land Use Sustainability	x	x	x	x	x	x	x	x	x
Relinquished Lands	x	x	x	x	x	x	x	x	x

6 PERFORMANCE INDICATORS, AND COMPLETION / RELINQUISHMENT CRITERIA

6.1 Rehabilitation Success Criteria

The following success criteria (or closure criteria as they are often referred to) for the rehabilitation areas on the site have been determined based on the proposed final land use of woodland / grassland.

The success criteria are performance objectives or standards against which rehabilitation success in achieving a sustainable system for the proposed post-mine land use is demonstrated. Satisfaction and maintenance of the success criteria (as indicated by monitoring results) will demonstrate that the rehabilitated landscape is ready to be relinquished from the mine's financial assurance and could be handed back to stakeholders in a productive and sustainable condition.

An example of preliminary rehabilitation success criteria for overburden emplacements from the Rehabilitation Strategy (July 2010) is included in **Table 6.1** and comprise indicators for vegetation, fauna, soil, stability, land use and safety on a landform-type basis that reflects the nominated post-mine land use of a mosaic of woodland / grasslands.

For each element or domain, standards that define rehabilitation success at mine closure are to be provided. Based on the generic indicators in **Table 6.1**, each criterion will be further developed to be specific, measurable, achievable, realistic and outcome based, and to reflect the principle of sustainable development. This will be based on results of further research and ongoing monitoring of the progressive rehabilitation areas. The success criteria will be reviewed every three to five years with stakeholder participation to ensure the nominated success criteria remain realistic and achievable.

Table 6.1 Preliminary Rehabilitation Success Criteria

Rehabilitation Element	Indicator	Criteria
1. Overburden Emplacement		
Landform Stability	Slope Gradient	<ul style="list-style-type: none"> ▪ Where the slopes are steeper than 10°, additional water management structures will be utilised (as required). ▪ Where reject layers are present and exposed, the landform is capped with a minimum of 1.5m of inert material and be free draining.
	Erosion Control	<ul style="list-style-type: none"> ▪ Erosion control structures are installed at intervals commensurate with the slope of the landform. ▪ Average soil loss per annum is <40 tonnes/ha/yr (sheet erosion). ▪ Dimensions and frequency of occurrence of erosion rills and gullies are generally no greater than that in reference sites that exhibit similar landform characteristics.
	Surface Water Drainage	<ul style="list-style-type: none"> ▪ Use of contour banks and diversion drains to direct water into stable areas or sediment control basins. ▪ All landforms will be free draining except where specific structures (i.e.

Rehabilitation Element	Indicator	Criteria
		dams) have been constructed for the storage of water as required for sediment and erosion control or some post mining land-use.
Water Quality		<ul style="list-style-type: none"> ▪ Ensure receiving waters affected by surface water runoff have ▪ contaminant limits of electrical conductivity maximum of 1,500 µS/cm ▪ and pH range of 5.5 to 8.5
Topsoil	Salinity (Electrical Conductivity)	<ul style="list-style-type: none"> ▪ Soil salinity content is <0.6 dS/m.
	pH	<ul style="list-style-type: none"> ▪ Soil pH is between 5.5 and 8.5.
	Sodium Content	<ul style="list-style-type: none"> ▪ Soil Exchange Sodium Percentage (ESP) is <15%.
	Nutrient Cycling	<ul style="list-style-type: none"> ▪ Nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts. Adequate macro and micro-nutrients are present.
Vegetation	Land Use	<ul style="list-style-type: none"> ▪ Area accomplishes and remains as healthy native woodland or as sustainable grazing pasture (where required).
	Surface Cover	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ Species are capable of setting viable seed, flowering or otherwise reproducing. Evidence of second generation of shrub and understorey species. ▪ Vegetation develops and maintains a litter layer evidenced by 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.
Fauna	Vertebrate Species	<ul style="list-style-type: none"> ▪ Representation of a range of species characteristics from each faunal

Rehabilitation Element	Indicator	Criteria
		<p>assemblage group (e.g. reptiles, birds, mammals), present in the ecosystem type, based on pre-mine fauna lists and sighted within the three-year period preceding mine closure.</p> <ul style="list-style-type: none"> ▪ The number of vertebrate species does not show a decrease over a number of successive seasons prior to mine closure
	Invertebrate Species	<ul style="list-style-type: none"> ▪ Presence of representatives of a broad range of functional indicator groups involved in different ecological processes.
	Habitat Structure	<ul style="list-style-type: none"> ▪ Typical food, shelter and water sources required by the majority of vertebrate and invertebrate inhabitants of that ecosystem type are present, including: a variety of food plants; evidence of active use of habitat provided during rehabilitation such as nest boxes, and logs and signs of natural generation of shelter sources including leaf litter.
Safety		<ul style="list-style-type: none"> ▪ Risk assessment has been undertaken in accordance with relevant guidelines and Australian Standards and risks reduced to levels agreed with the stakeholders.

7 REHABILITATION IMPLEMENTATION

Rehabilitation activities during this MOP period will be conducted under the guidance of the rehabilitation strategy developed by GSS Environmental and detailed in the document titled “*Marulan Limestone Mine Rehabilitation Strategy*” dated July 2010. In addition, ongoing review and assessment of activities will assist in further improvement and development of the mine’s rehabilitation strategy.

7.1 Status at MOP Commencement

The extent of rehabilitation as at 1 September 2019, being the commencement date of this 2019- 2023 MOP is represented by the green shaded, **Domain 7** areas shown on **Plan 2** and cover an approximate area of 58 ha. Included are approximately 5.4 ha of “older” southern slopes of the western overburden emplacement and the 11.0 ha “1970’s” Bryce’s Gully area. Both these areas require revegetation maintenance and have therefore been reclassified as subject to further growth medium development as detailed on **Plan 1C**.

The status of mine rehabilitation together with details regarding current rehabilitation activities within these areas is recorded annually in an internal document prepared by BCL’s site environmental personnel. This information is then used to update and report rehabilitation activities and status in each AEMR. The current AEMR is being completed for the 12-month period ending 30 June 2019.

Detailed below are extracts from recent AEMRs that provide the status of existing rehabilitation areas including current detail of rehabilitation activities covering flora and fauna surveys, weed spraying and revegetation trials.

7.1.1 Western Overburden Emplacements

The western overburden emplacements as shown on **Plan 2** now comprise the former Main, Middle and Lower Gully emplacement areas that occupy an active emplacement area of 48.1 ha and a southern, progressive rehabilitation area of approximately 17 ha.

This southern section of the emplacement comprising a relatively flat area of 12 ha and a lower, slope area of approximately 5 ha has been progressively subject to a range of revegetation trials particularly since 2005 as shown in **Plate 1** and in **Plate 2** below.

Plate 1 *Revegetation from direct seeding on western overburden emplacement*



Plate 2 *Hydro Seeding area on western overburden emplacement in February 2017*



The former “Middle Gully” overburden emplacement area of approximately 5 ha and labelled **4.2m** on **Plan 2** was hydro seeded, in part during the 2015-2016 AEMR period but to date has been unsuccessful, most likely due to the use of poorer quality overburden materials as a growth medium combined with inadequate final landform preparation. This area will be temporarily stabilised prior to continued overburden emplacement as part of the SSD 7009 project.

During 2017 an assessment of these areas was undertaken by land rehabilitation and revegetation consultants, Global Soil Systems and recommendations to improve rehabilitation success using direct seeding on flat areas and gentle to moderate slopes are currently being implemented including;

- better characterisation of overburden / growth medium materials to understand material variability, and
- use of ameliorants including trials with organic growth medium, (OGM)
- continued attention to landform design and final preparation including deep ripping
- use of quality seed and continued attention to the procurement and preparation of preferred seed species including groundcover
- improved revegetation planning, monitoring and reporting using current Ecosystem Function Analysis techniques or modifications of the same including new trial plot areas.

The lower, southern slope area (5 ha) of the western overburden emplacement has subsequently been “re-sheeted” with select overburden material and re-seeding commenced during November 2017.

7.1.2 Eastern Batter Overburden Emplacements

Existing rehabilitation areas of the older eastern batters comprise the former Bryce’s Dump to the north, the central Barbers Creek overburden emplacements and the south-eastern slopes of the southern mine as indicated on **Plan 2**. Summarised in the following section is the current status of these areas covering approximately 41 ha.

Bryce’s Dump

Bryce’s dump rehabilitation area occupying approximately 11 ha as indicated on **Plan2** and **Plans 3A to 3C/3D** was originally contoured and benched at least twenty (20) to thirty (30) years ago to look similar to the surrounding topography. It is very steep, rocky and free draining and therefore retains little moisture. It has been grassed to help prevent erosion. Mixed tube stock containing wattles, gums and she-oaks were planted. Of the original trees planted about 60% survived the first year however under drought conditions further plants were lost with only about 10% of the original planting surviving.

The area was again planted out commencing in 2005 using local endemic natives from this region. The first three benches were planted out with the help of students from the Goulburn TAFE College in association with the Site Environmental Officer with tube stock and water retaining crystals as well as a slow release fertilizer. Some 400 trees and shrubs were planted on the benches in 2005. Of these 400 trees about 50% survived helping to re-establish bushland corridors and to stabilize the first three benches reducing erosion and subsequent sediment release into creeks below.

As previously stated, this former rehabilitation area with poorer than expected revegetation success to date has been subject to ongoing erosion leading to sedimentation movement downslope into Barbers Creek as reported to the EPA on 31st January 2018. Investigation of Bryce’s Gully and the surrounding area has been undertaken by PSM as detailed in their “Sediment Management at Bryce’s Gully – Characterisation and Solution concept Designs” report dated 14 June 2019. (Refer to **Appendix 8**).

The difficult, steep terrain was accessed as not only having significant safety issues in regard accessibility but significant engineering challenges in attempting to formulate an effective engineered solution to reduce, capture or treat surface water run-off contributing to erosion.

The preferred option is a Rehabilitation Strategy specifically for Bryce’s Gully as included in **Appendix 8**.

Barbers Creek Dump

The Barbers Creek Dump currently occupies an area of approximately 19 ha and comprises the former PML 18 mullock dump of some 14ha covering the central and southern areas and the current, active 5 ha overburden emplacement to the north.

The former PML 18 is an old mullock dump area with similar characteristics as Bryce's Dump.

A southern section has previously been irrigated using a dripper irrigation system. Gums, wattles and she-oaks were planted as tube stock. Out of approximately 2,000 trees planted a loss of about 19% was incurred. Losses in this area have been replaced with mixed tube stock and the area is now fully fenced to keep feral and native animals out. Although revegetation progress is encouraging the area will require ongoing maintenance supported by additional plantings in areas not included in the 30-year mine development footprint.

Some grassed revegetation has assisted in stabilising north facing benched slopes in the central section but the majority of the area remains un-vegetated due to steepness of existing slopes that are subject to movement and slippage. The dump has remained active but un-worked for a period of time and was originally planned to contain up to 42 million tonnes of overburden emplaced over an area of 30 ha.

During the 2009-2015 MOP term an estimated 4 million tonnes of overburden was emplaced in the northern active section to stabilise old existing batters and to provide the opportunity for improved revegetation of outer dump slopes. This area once completed, in addition to the reduced "footprint" of disturbance estimated at less than half the original 30 ha will have both improved stability and reduced visual impact following successful revegetation.

South Pit Rehabilitation

In addition to the approximate 11ha area of natural regeneration occurring along the outer and south-eastern slopes of the South Pit (refer to area labelled **7.4e** on **Plan 2**) the following areas within the South Pit have been subject to rehabilitation trials due to their visual proximity in relation to the Bungonia National Park and State Recreational Area "look down".

The Southern Tip

The southern tip rehabilitation area has a solid rock base to which a significant quantity of sub soil and top soil materials have been previously placed and contoured. The area although small is directly below the Bungonia SRA "look down". Trees of mixed species have been planted with black she-oaks being the dominant species. An initial loss of 15% occurred in the first year, with that figure increasing to a total of approximately 40% in the year 2003 to 2004. This is due primarily to dry conditions. The trees that have survived are healthy.

At the end of 2005 over half of this area was deep ripped and seeded using the same method as the trial plots within Main Gully dump with guidance from GSS Environmental. Success to date has been limited due to drought conditions, insect attack and feral animals including rabbits and goats.

South-East South Pit Revegetation Trial Area

In association with the Natural Resource Management Faculty of the Goulburn TAFE a trial rehabilitation project coordinated by the Site Environmental Officer commenced in September 2004. An area of approximately 1.3 hectares was prepared and planted in November – December 2004 with local species using seed ball and tube stock planting methods.

Direct seeding trials have also been conducted on benches within this area during 2005 in addition to natural revegetation that has been observed to occur.

7.1.3 General Rehabilitation

The following “general rehabilitation” areas are situated outside the CML No. 16 boundary but are located on BCL land and form part of the surrounding buffer zone and visual screening for the limestone mine and processing site.

Freddy’s Hill

Freddy’s Hill is located on the west side of CML No. 16 adjacent to Marulan South Road. This area of tube stock revegetation developed in 1998 occurred in “in-situ” soil and amongst large stones or rocks that came to the surface when the area was deep ripped. The area had previously been grazed but improved considerably when grazing was stopped with large numbers of native ground covers re-establishing as well as native grasses. The mulch from establishing trees has also helped. The use of water retaining crystal has assisted tube stock plantings.

Some weeds persist in this area but will be slowly reduced as the tube stock establish. Native birds are starting to nest there and native reptiles are also present, including lizards. The area is naturally revegetating but monitoring will be maintained to record the fauna that are re-establishing habitat.

The Village

The former Marulan South village revegetation area commenced during 1999 to 2002 and has become progressively more established with good evidence of natural re-vegetation. Some trees and shrubs are still small but have survived drought conditions. Good rainfall will boost revegetation within this area that has a very good soil depth and structure and an established grass cover.

Tree watering was conducted in the first six months of planting. Two years on trees have survived with only mowing of the grass that surrounds them required and minor maintenance. This area is considered re-vegetated with only maintenance plantings as required.

North-western Buffer Zone “Weather Station Paddock”

Tree screen plantings and trials have been conducted directly north of the western overburden emplacement.

The northern buffer zone was originally direct and drill seeded using acacia species by Greening Australia in 2005. During 2008 the area was re-seeded and expanded to include approximately 10km of rip lines in length. Additional trial areas were completed in 2007 in conjunction with TAFE students doing a Diploma in Conservation and Land Management at the Goulburn Campus. BCL continue to allow and encourage the students to try their newly acquired skills in conservation work in selected areas such as these.

7.2 Proposed Rehabilitation Activities During the MOP Term

The majority of rehabilitation planned during the 2019-2023 MOP term is concentrated within **Domains 2** and **4** of the combined western and middle gully overburden emplacements and in particular the areas labelled **2**, **4.1w**, **4.2m** and new area **C2** in part as shown on **Plan 2**.

In addition, the 11 ha Bryce's Gully area as indicated in Section 7.1.2 will undergo further rehabilitation in accordance with the Bryce's Gully Rehabilitation Strategy. This area will remain as a growth medium development domain until monitoring results confirm improved revegetation status. All other domains remain active as limestone mining and mineral processing operations continue. Proposed changes in disturbance and rehabilitation progression during this MOP are estimated and presented in **Table 6**.

As indicated on the rehabilitation data table, **Table 7** and as shown on **Plans 3A** to **3C/3D** it is proposed that the total increase in area of revegetation (14.5 ha) be progressed from Landform Establishment, through Growth Medium Development to the Ecosystem and Land Use Establishment rehabilitation phases.

As always rehabilitation activities are subject to the rate of overburden emplacement, climatic conditions and other impacts including insects and feral animals.

In the latter years (YR 3 and YR4) of this MOP term, Landform Establishment in the form of shaping the outer, 1 in 3 batters of the southern overburden emplacement maybe achievable if backfilling of the southern mine extends above the 410m rim elevation as shown on **Plan 3C/3D**.

In addition, other on-going rehabilitation activities during the 2019-2023 MOP term include weed spraying and feral animal control.

Table 6 Disturbance and Rehabilitation Progression During the Term of the MOP

Year / Date	Total Disturbance Area (ha) ¹	Total Rehabilitation Area (ha) (per MOP year) ²	Cumulative Rehabilitation Area	Comments / Explanation
At 01 Sep 2019	264.3	-	54.4	Refer to Plans 1C & 2
At 30 Jun 2020	260.8	8.5	62.9	YR1 Increase in disturbed area (5 ha) in and around MG & WOBE
At 30 Jun 2021	256.8	4.0	66.9	
At 26 Feb 2023	254.8	2.0	68.9	
total		14.5		

7.3 Summary of Rehabilitation Areas During the MOP Term

As discussed in Section 7.2 the majority of rehabilitation proposed is concentrated within **Domains 2** and **4** of the redesigned middle gully (MG) and western overburden (WOBE) emplacements and in particular the areas labelled **2**, **4.1w**, **4.2m** and new area **C2** as shown on **Plan 2**.

¹ Total Disturbance Areas of land which are within the following phases: Active and Decommissioning.

² Total Rehabilitation Area includes areas of land which are within the: Landform Establishment and Growth Medium Development, Ecosystem and Land Use Establishment, and Ecosystem and Land Use Sustainability.

During the MOP term the active area of the combined MG and WOBE reduces by 8.4 ha (from approximately 50.6 ha to 42.2 ha) including additional disturbance of 5 ha (Area C2) as the lower southern and western, 1 (vertical) in 5 (horizontal) slopes are progressively subject to growth medium development and ecosystem establishment as detailed on **Plans 3A to 3D/3C**.

Table 7 Rehabilitation Data Table

Primary Domain	Secondary Domain	Code	Rehabilitation Phase	Area at start of MOP (ha)	Area at end of MOP (ha)
4 Overburden Emplacement & 2 Waste Lime Emplacement	Proposed – Pasture (D) and/or Woodland (E) (To be confirmed)	4D or 4E	Undisturbed (C2)	5.0	0
			Active	50.6	42.2
			Decommissioning	0	0
			Landform Establishment	0	0.8
			Growth Medium Development	0	0
			Ecosystem Establishment	0.3	12.9
			Ecosystem Development	0	0
			Relinquished Lands	0	0
Total Domain 2 & 4				55.9	55.9
7 Rehabilitation (Eastern Batters)	Proposed – Pasture (D) and/or Woodland (E) (To be confirmed)	4D or 4E	Active	0	0
			Decommissioning	0	0
			Landform Establishment	2.4	3.5
			Growth Medium Development	11.0	11.0
			Ecosystem Establishment	23.7	23.7
			Ecosystem Development	0	0
			Relinquished Lands	0	0
			Sub-Total	37.1	38.2
7 Rehabilitation (Middle Gully and Western OBE)	Proposed – Pasture (D) and/or Woodland (E) (To be confirmed)	4D or 4E	Active	0	0
			Decommissioning	0	0
			Landform Establishment	0	0.0
			Growth Medium Development	5.5	0.0
			Ecosystem Establishment	11.5	17.0
			Ecosystem Development	0	0
			Relinquished Lands	0	0
			Sub-Total	17.0	17.0
Total Domain 7				54.1	55.2
Total Revegetation				54.4	68.9

7.4 Relinquishment Phase Achieved During MOP Period

As indicated in **Section 7.2** the majority of the Marulan South Limestone Mine is under active and continuing operation therefore it is unlikely that the relinquishment phase within the domains identified will be achieved during this 2019-2023 MOP period.

8 REHABILITATION MONITORING AND RESEARCH

8.1 Rehabilitation Monitoring

Following rehabilitation activities, BCL will undertake rehabilitation monitoring and where required, undertake the necessary maintenance. The monitoring program will be designed to demonstrate that the completion criteria have been met while also planning for remedial action, should monitoring demonstrate that the completion criteria are unlikely to be met.

The current monitoring methodology adopted by BCL is Ecosystem Function Analysis (EFA). EFA has the ability to compare the quality of rehabilitation against completion criteria and adjacent analogue areas by providing an indicative measure of how the rehabilitation is tracking against the chosen analogue sites and ultimately toward a self-sustaining landscape.

Three (3) analogue (or reference) sites were established in January 2011 as detailed in the report titled, “*Ecosystem Function Analysis – Marulan South Limestone Mine Rehabilitation Monitoring*” by GSSE, dated June 2011. These reference sites chosen to date are based on their merits of being representative baseline data for proposed final rehabilitation (vegetation and landform) targets or the starting point (i.e. year 0). A further five (5) sites were monitored as an initial assessment of the status of rehabilitation as at January 2011 on areas of the western overburden emplacement and older eastern batter locations.

The EFA monitoring program measured:

- Landscape Function Analysis;
- Vegetation Dynamics;
- Habitat Complexity; and
- Disturbance.

Key Landscape Function Analysis (LFA) and Ecosystem Function Analysis (EFA) indicators are outlined in **Table 8.1**.

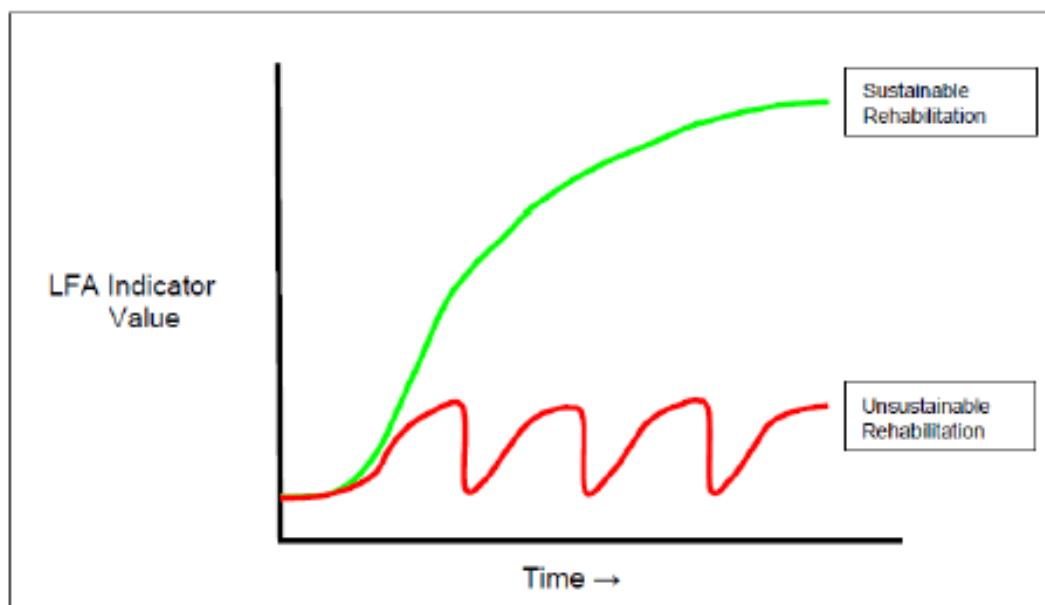
Table 8.1 LFA/EFA Methodology for Marulan South Limestone Mine

Rehabilitation Element	Indicator	Methodology
Soil Assessment (LFA)	Soil Stability	<ul style="list-style-type: none"> ▪ Rain splash protection – assess the degree to which physical surface cover and project plant cover ameliorate the effect of raindrops impacting on the soil surface ▪ Slake Test – assess the stability of natural soil fragments to rapid wetting
	Nutrient Cycling	<ul style="list-style-type: none"> ▪ Perennial vegetation cover – estimate the ‘basal cover’ of perennial grass and/or the density of canopy cover of trees and shrubs ▪ Litter – assess the amount, origin and degree of decomposition of plant litter ▪ Cryptogam Cover – assess the cover of cryptogams visible on the soil surface
	Water Infiltration Capacity	<ul style="list-style-type: none"> ▪ Crust brokenness – assess to what extent the surface crust is broken, leaving loosely attached soil material available for erosion ▪ Texture – to classify the texture of the surface soil, and relate this to permeability.

	Erosion Potential	<ul style="list-style-type: none"> ▪ Soil Erosion type and severity – assess the type and severity of recent/current soil erosion ▪ Deposited Materials – assess the nature and amount of alluvium transported to and deposited on the query zone ▪ Soil surface roughness – assess the surface roughness for its capacity to capture and retain mobile resources such as water, propagules, topsoil, and organic matter ▪ Surface nature (resistance to disturbance) – assess the ease with which the soil can be mechanically disturbed to yield material suitable for erosion by wind or water
Vegetation Data (EFA)	Vegetation Dynamics	<ul style="list-style-type: none"> ▪ Density of plants per unit area for each life form ▪ For grasses, basal area m2 per unit area ▪ For trees and shrubs <ul style="list-style-type: none"> - Canopy area - Canopy volume, an index of growth - Horizontal cross-sectional area in height classes – an index for wind amelioration

The goal for BCL will be to demonstrate LFA/EFA criteria in the rehabilitation sites are trending towards criteria outlined in analogue sites. The expected trend of an ecosystem approaching stability and functionality are for LFA values to improve over time resulting in a parabolic trend toward pre-disturbance and/or analogue conditions (refer to **Figure 2**). Values should initially increase rapidly due to establishing vegetation and succession however the increase in values will likely slow over time as the vegetation community stabilises. Sites that are not improving or are declining would indicate that the site is not approaching a stable state and may require further remediation to achieve ecosystem functionality. In this instance, BCL will need to reassess areas of rehabilitation failure and undertake further rehabilitation or maintenance works.

Figure 1 Using LFA to assess Ecosystem Functionality



The program of rehabilitation monitoring is aimed to continue at the site until such a time as the monitoring records demonstrate that the site is no longer contributing, nor has the potential to contribute, pollutants to the surrounding environment, and that rehabilitation has achieved a satisfactory stage of maturity and ground cover.

In addition, for this MOP term regular field inspections (at least annually in conjunction with AEMR) will continue to be undertaken of all rehabilitated areas, particularly waterways, banks and sediment control dams, and diversions. Current inspections as reported in the 2016-2017 AEMR include the “*Marulan South Limestone Mine - Revegetation Strategy*” report by Global Soil systems dated June 2017.

8.2 Research and Rehabilitation Trials and Use of Analogue Sites

BCL has conducted a series of rehabilitation trials and research over the last 15-year period with varied success.

A brief description of the type and range of trials conducted includes the following:

- Greening Australia ACT

Preparation of a new area (approximately 0.9 ha) adjacent to original GSS Environmental 2005 trial plot for an Autumn 2008 planting. Preparation included ripping by dozer to 500mm depth then topsoil spreading over the area of approximately 2,500 tonnes, providing a seed bed of between 200 to 250 mm depth.

Plant species as listed below.

- | | |
|-------------------------------------|--------------------------|
| - <i>A. falciformis</i> | Broad leaf hickory; |
| - <i>A. mearnsii</i> | Black wattle; |
| - <i>A. decurrens</i> | Green wattle; |
| - <i>A. parramattensis</i> | Parramatta green wattle; |
| - <i>A. rubida</i> | Red stemmed wattle; |
| - <i>E. blakelyi</i> | Blakelys red gum; |
| - <i>E. agglomerata</i> | Blue leaved stringybark; |
| - <i>E. globoidea</i> | White stringybark; |
| - <i>E. macrorhyncha</i> | Red stringybark; |
| - <i>E. punctate</i> | Grey gum; |
| - <i>E. cinereal</i> | Argyle apple; |
| - <i>E. rossii</i> | Scribbly gum; |
| - <i>E. melliodora</i> | Yellowbox; |
| - <i>E. sclerophylla</i> | Scribbly gum; |
| - <i>E. radiata</i> | Narrow leaf peppermint; |
| - <i>E. piperita</i> | Urn fruit peppermint; |
| - <i>Dodonea cuneate</i> | Wedge leaf hopbush; |
| - <i>Allocasuarina verticillata</i> | Drooping sheoak; |
| - <i>Allocasuarina littoralis</i> | Black sheoak; |

- SprayGrass (Landscapes Australia Pty Limited)

Hydro-mulching during 2008 of approximately 2 ha of “Middle Gully” and 2 to 3 ha of “Main Gully” as per the specification provided in **Table 8.2**.

Table 8.2 Rehabilitation Trials (Hydro-mulching)

Type	Detail	Rate
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	Enviro tack	40kg/ha

- GSS Environmental

Direct tree seeding trial conducted in early November 2005 at three locations, (southern end of South Pit, eastern benches of South Pit and a section of the western, “Main Gully” waste emplacement). These areas totalling approximately 2 ha were sprayed for weed control, then deep ripped prior to seeding. The recommended seed mix was heat treated, scarified, dried and mixed with a specified quantity of fertiliser prior to application.

- Goulburn TAFE

An area of approximately 1.3 hectares located on the south-eastern slopes of the South Pit (Plan X) was prepared and planted in November – December 2004 with local species using seed balls prepared by Goulburn TAFE students and tube stock planting methods. Seed balls were distributed at 10 per square metre (or 100,000 per hectare). Approximately 1 cubic metre of clay, 200kg of compost, 20 kg of seed and water for mixing was used to produce 100,000 seed balls.

Seed used in the above trials has been both externally sourced and supplied locally from seed harvested from the mine area by the Site Environmental Officer in conjunction with Goulburn TAFE and previously stored in the on-site nursery at the time for use in revegetation.

In addition, reconnaissance soil surveys were undertaken during 2005 by GSS Environmental together with additional soil sampling in October 2006.

Information and knowledge gained from the above rehabilitation trials and surveys have been included in the initial development the “Marulan South Limestone Mine Rehabilitation Strategy” dated July 2010.

The use of analogue sites for developing rehabilitation criteria and in monitoring rehabilitation success has been discussed in **Section 8.1** covering Landscape Function Analysis and Ecosystem Function Analysis.

During this 2019-2023 MOP Term further assessment and review of rehabilitation monitoring techniques will be undertaken.

9 INTERVENTION AND ADAPTIVE MANAGEMENT

9.1 Threats to Rehabilitation

Rehabilitation activities will be undertaken as soon as practicable following the progressive completion of rehabilitation phases identified for the site. The issues and risks that may impact upon the ability of the Marulan South Limestone Mine to achieve rehabilitation goals successfully have initially been identified in the environmental risk assessment recently undertaken and discussed in **Section 3**.

Aspects identified included erosion of rehabilitated areas, potential weed infestation, the failure of seed to successfully germinate and establish and therefore the likelihood of not achieving closure and/or rehabilitation criteria and bush fire hazard resulting in the burning loss of revegetation areas.

Without management controls in place these aspects were assessed as high, risk threats to the success of rehabilitation as detailed in **Table 9.1**, an extract from the environmental risk assessment. Actions to be undertaken should these threats occur are detailed in **Section 9.2**.

Table 9.1 Aspects with Potential Threats to Rehabilitation

Activity	Ref	Aspect	C	P	R	Existing Controls	C	P	R		
Revegetation	OC-128	Erosion with sediment leaving site	2	b	2b	5 (H)	<p>Sediment controls implemented in accordance with Marulan Sediment Control Plan (CMT-ENV-007).</p> <p>Water quality monitoring undertaken in receiving waters.</p> <p>Monitor the status of the rehabilitation and repair where there are failures</p> <p>Undertake progressive rehabilitation so the area of disturbance is minimised.</p> <p>Refer Rehabilitation Strategy (GSSE 2010)</p>	4	d	4d	21 (L)
	OC-129	Potential to introduce weeds	3	b	3b	9 (H)	<p>Contractor protocol in place which requires contractors machinery to be free of soil and weed propagules before being brought onto site.</p> <p>A weed management program is in place which includes a control program in accordance with the GSSE Rehab Strategy (2010).</p>	3	e	3e	20 (L)
	OC-130	<p>Failure of seed to successfully germinate and establish.</p> <p>Failure to achieve closure/rehabilitation criteria</p>	3	b	3b	9 (H)	<p>GSSE Rehab Strategy (2010) in place and EFA monitoring program adopted.</p> <p>Ongoing revegetation monitoring and trials to improve methodology and success criteria.</p> <p>Note: The success and failure is subject to certain things (e.g. climatic conditions) that are outside of the control of BCL.</p>	3	c	3c	13 (M)
	OC-131	Bush fire hazard burning revegetated areas	3	b	3b	9 (H)	<p>Bushfire Management Plan</p> <p>Site Water truck and Local Fire Brigade truck available on the site</p> <p>Employees are trained to deal with Bushfire on the site.</p>	3	d	3d	17 (M)

9.2 Trigger Action Response Plan (TARP)

The Landscape Function Analysis and Ecosystem Function Analysis rehabilitation monitoring program as outlined in **Section 8.1** will be used as the tool to monitor and trigger response for any actions required to mitigate potential threats to the success of rehabilitation and whether further works are required to achieve the specific closure criteria.

In addition, annual inspections of rehabilitation areas by suitably qualified BCL employees supported by specialist rehabilitation consultants / contractors will continue during the MOP term and reported on as part of the AEMR process.

The following aspects of rehabilitation are typically reviewed as part of the LFA/EFA monitoring program or during other AEMR inspections:

- evidence of soil profile development (e.g. leaf litter, decomposition etc);
- visual assessment of surface materials (e.g. topsoil cover);
- evidence of and type of erosion;
- Success of erosion and sediment controls;
- Vegetation growth rates;
- evidence of plant mortality or die back;
- Rehabilitation species diversity (native and introduced);
- Evidence and emergence of exotic weed species;
- evidence of spontaneous combustion;
- photographic evidence of rehabilitation to provide annual comparisons.

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

- controlling weeds within areas under rehabilitation;
- management and control of feral animals (as required);
- management and control of erosion;
- revisiting rehabilitation methodologies in areas that may have failed;
- general maintenance (irrigation and fertilising - as required); and
- repair of fences, access tracks and other general related land management activities.

10 REPORTING

The principal reporting process which assesses rehabilitation progress against the rehabilitation schedule included in the MOP is the Annual Environmental Management Report or AEMR. The AEMR includes a summary of rehabilitation monitoring and reporting and is submitted annually to DPIE-DRG and other relevant stakeholders.

11 PLANS

Plans referenced and included in this 2019-2023 MOP are for a Level 1 mine and include the following list of plans that are appended to this document.

Plans 4 and 5 presenting final rehabilitation and post mining land use concepts are existing plans from the 2009 – 2012 MOP/REF.

Plans 1A, 1B and 1C – Project Locality

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Plan 2 – Mine Domains at Commencement of MOP

Plan 3A,3B and 3C/3D – Mining and Rehabilitation

Plan 4 – Final rehabilitation and Post Mining Land use

Plan 5 – Rehabilitation and Post Mining Land Use Plan and Cross Sections

12 REVIEW AND IMPLEMENTATION OF THE MOP

12.1 Review of the MOP

MOP documentation is reviewed annually as part of the AEMR process.

12.2 Implementation

The mine holder and operator is Boral Cement Limited.

The address of the Marulan South Limestone Mine is:

Hume Street,

Marulan South NSW 2579

Phone: 02 4820 3000.

The Marulan Site Manager is responsible for all mine site operational and environmental compliance obligations (**Table 12.2**).

Assisting the Marulan Site Manager is the Cement Environmental Manager, HSE Advisor, Environmental Officer and a team of senior site personnel as detailed below.

In addition, and as required, specialist advice is provided by a range of environmental consultants.

Table 12.2 Mine Contacts

Title	Position	Contact Details
Mark McCarthy	Marulan Limestone Site Manager (Acting)	Ph: (02) 4820 3061 Email: mark.mccarthy@boral.com.au
Robert Lasker	HSE advisor	Ph: (02) 48203023 Email: robert.lasker@boral.com.au
Julian Rodriguez Benitez	Limestone Technical Manager	Ph: (02) 4820 3056 Email: julian.rodriguez-benitez@boral.com.au
Ravi Mehrotra	Lime Technical Manager	Ph: (02) 4820 3017 Email: ravi.mehrotra@boral.com.au
Belinda Prideaux	Cement Environmental Manager	Ph: (02) 4820 3048 Email: belinda.prideaux@boral.com.au

13 REFERENCES

(AS/NZS ISO 31000:2009). Risk Management - Principles & Guidelines.

(NSW Government: Department of Trade and Investment September 2013). ESG3: Mining Operations Plan (MOP) Guidelines.

14 ABBREVIATIONS

Abbreviation	Definition
AEMR	Annual Environmental Management Report
AHD	Australian Height Datum
ANC	Acid Neutralising Capacity
APCMA	Australian Portland Cement manufacturers of Australia
BCL	Boral Cement Limited
BCM	Bank Cubic Metre
BCSC	Blue Circle Southern Cement
BHP	BHP Billiton
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
DA	Development Application
DP&I	NSW Department of Planning and Infrastructure
DRE	NSW Trade and Investment – Division of Resources and Energy
EC	Electrical Conductivity
EIS	Environmental Impact Statement
EFA	Ecosystem Function Analysis
EP&A Act	Environmental Planning and Assessment Act 1979
Ha	Hectare
HNO ₃	Nitric Acid
LEP	Local Environmental Plan
MBAS	Methylene Blue Active Substances
CML	Consolidated Mining License No. 16
ML	Mining Lease
MOP	Mining Operations Plan
MTPA	Million Tons per Annum
NAF	Non-Acid Forming
NOHSC	National Occupational Health and Safety Commission
NPWS	National Parks and Wildlife Service
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
OH&S	Occupational Health and Safety
PAH	Polycyclic Aromatic Hydrocarbons
REF	Review of Environmental Factors
ROM	Run of Mine
SPC	Southern Portland Cement
SRA	State Recreational Area
SSD	State Significant Development
SVOC	Semi Volatile Organic Compounds
SWMP	Surface Water Management Plan
TARP	Trigger Action Response Plan
TPA	Tons per Annum
TPH	Total Petroleum Hydrocarbon
TSC	Threatened Species Conservation Act (Repealed)
TSS	Total Suspended Solids
VOC	Volatile Organic Compound

ATTACHMENT 1

APPENDIX 1A

APPENDIX 1B

APPENDIX 2

APPENDIX 3

APPENDIX 4

APPENDIX 5

APPENDIX 6

APPENDIX 7

APPENDIX 8