Boral Limited
Build something great ™

Marulan South Limestone Mine Continued Operations
State Significant Development Application

ENVIRONMENTAL IMPACT STATEMENT | SUMMARY

Prepared for Boral Cement Limited | March 2019

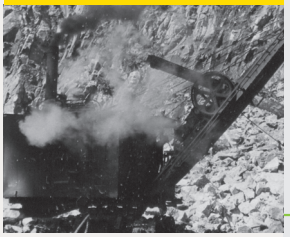
Figure 1
Brief history of limestone mining at Marulan South

When mining limestone at Marulan was first undertaken by James Hogg in the 1860s it was completed by hand with picks and shovels and hand–loaded into horse drawn wagons.

1860

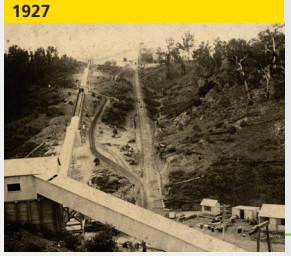
By the early 1900s, the rock was carted from the pits by approximately 25 horses, while mining was completed with steam shovels.

1900



The rail line from the Great Southern Railway to Marulan South was built between 1927 and 1928 and opened in 1928.

1927



The limestone mine was opened in 1929 to supply limestone for cement, manufacturing and steel making.

Marulan South was originally considered an isolated location and as the business grew, a village was established to house personnel. The earliest permanent resident of the now empty village at Marulan South was Les Cooper who arrived in 1929 to build his home.

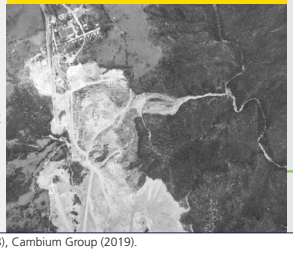
1929

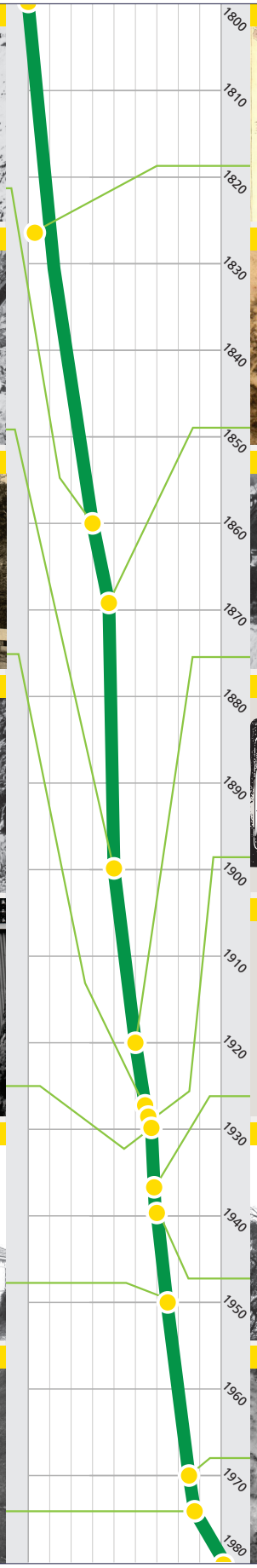
In the 1950s and 1960s Southern Portland Cement assisted in the creation of a local oval, community hall and tennis courts to further increase the facilities present for recreation. The community hall held a number of debutant balls as well as touring entertainers.

1950

In 1974 Blue Circle and BHP merged their operations to form Blue Circle Southern Cement Ltd (BCSC). In 1987 Boral Limited purchased BCSC and retains ownership of the company as a wholly owned subsidiary. In 2010, BCSC changed the company name to Boral Cement Limited.

1974





1826

By March 1826 it was clear that the deposits of limestone in the Marulan South area were recognised and it was recommended that these areas were not included in settlers grants. Workings of the limestone began 'soon after' 1930, with the stone used for the production of marble.

1869

The area of Marulan South was bought by Mr Fuljames who purchased the land for its limestone deposits in the early nineteenth century. By 1869 the limestone quarries were worked by three parties.

In 1875, the first commercial lime was produced from our site.

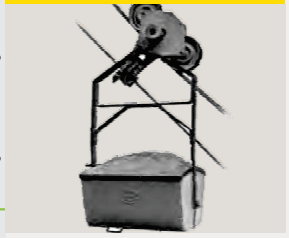
1920

Limestone mining north of Bungonia Gorge began in 1869 with major developments emerging in the 1920s to supply limestone for cement manufacturing and steel making.

1928

The area was then held under adjoining leases by Weenga Lime Limited, Hoskins Iron and Steel Limited and Southern Portland Cement prior to 1928 when the area was consolidated and worked by Southern Portland Cement.

1936



There was dispute between Metropolitan Products Ltd and the Commonwealth Portland Cement Company for access to build a dam, aerial ropeway and pipeline. Timber was cleared in preparation for the installation of an aerial ropeway sometime before October 1936.

1939

Although disputes over access continued into 1939, the aerial ropeway was operating to the west of the mine. Problems with a bend in the alignment resulted in the rope breaking on a regular basis and stopping works.

1970

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

Source: Boral Cement Limited (2018), EMM (2018), Cambium Group (2019).

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Boral Cement Limited (Boral) is seeking development consent for a State significant development (SSD 7009) to continue operations at its Marulan South Limestone Mine (the Project), an open cut limestone mine in the Southern Highlands of NSW.

Limestone mining north of Bungonia Gorge began soon after the limestone deposit was discovered in 1830 with the stone used to produce marble. A contract was awarded for provision of material for flux to the Fitzroy Falls Iron Works and the first commercial lime was produced in 1875. Major developments emerged in the 1920s to supply limestone for cement manufacturing and steel making.

The limestone mine was opened in 1929 to supply limestone for cement, manufacturing and steel making. By 1953 two main pits (northern mine pit and southern mine pit) were well established and by the early 1970s the facets of the business included limestone for cement, steel making, agriculture, glass making, lime manufacturing, quicklime and hydrated lime. **Figure 1** presents a brief history of limestone mining at Marulan South.

The mine produces up to 3.38 Million tonnes (Mt) of limestone-based products per year for the cement, steel, agricultural, construction and commercial markets. Boral proposes to mine approximately 120 Mt over 30 years in an extension of the existing pit towards the west.

SITE DESCRIPTION

The Project site is in Marulan South, 10 km south-east of Marulan village and 35 km east of Goulburn. It is in the Goulburn Mulwaree Local Government Area (LGA).

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

The Project site and surrounds are characterised by rolling hills of pasture interspersed with forest to the west, contrasting with the heavily wooded, deep gorges that begin abruptly to the east of the mine, forming part of the Great Escarpment and catchment of the Shoalhaven River.

Access is via Marulan South Road, which connects the mine and Boral's Peppertree Quarry with the Hume Highway approximately 9 km to the north-west. Boral's private rail line connects the mine and Peppertree Quarry with the Main Southern Railway approximately 6 km to the north.

The Project site covers historical and proposed future areas of disturbance and comprises two geographically separate areas:

- the existing mine including the proposed 30-year mine footprint and associated infrastructure; and
- the proposed Marulan Creek Dam to be on Marulan Creek, within Boral landholdings approximately 2.5 km north of the mine entrance.

Most of the Project site is zoned RU1 - Primary Production under the Goulburn Mulwaree Local Environmental Plan (LEP) 2009. Mining and extractive industries are permissible in this zone with consent. The remaining area is zoned E3 - Environmental Management. Mining and extractive industries are prohibited in this zone. However, as agriculture is permitted in the E3 zone with consent, mining is also permitted in this zone under the Mining SEPP with consent.

PROJECT OVERVIEW

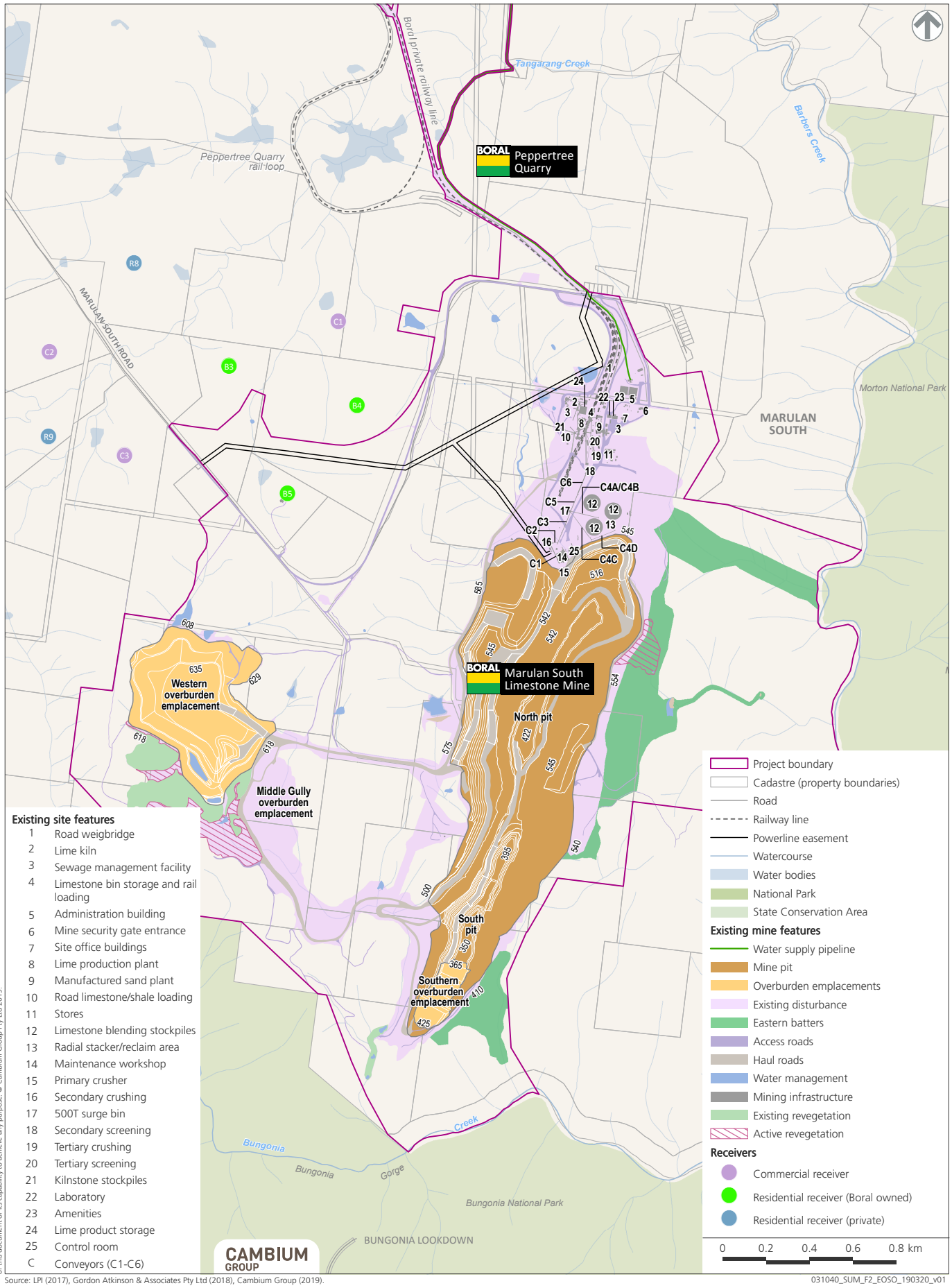
Proposed operations associated with the continuation of mining for a further 30-years are compared with existing operations in Table 1. Existing operations are also presented in Figures 2 and 3 with the proposed Project presented in Figures 4 and 5.

Table 1 - Comparison of existing and proposed operations

Project component	Existing	Proposed
Hours of operation	24-hours per day, 7 days per week. Blasting is conducted during daylight hours on weekdays, excluding public holidays.	No change.
Blasting frequency	One blast per day on weekdays, excluding public holidays, totaling five blasts per week.	No change.
Capital investment value	Historical capital investment is unknown as records were not regularly kept during the Mine's lifetime.	$111 million.
Mining method	Overburden including clay shale is removed using excavators and front-end loaders. Limestone is extracted using open-cut drill and blast techniques. Limestone is loaded using excavators and front-end loaders and hauled either to stockpiles or the primary processing plant using haul trucks. Oversized material is stockpiled and reduced in size using a hydraulic hammer attached to an excavator, before being introduced to the processing plant.	No change.
Resource	Mining was focused on the approximately 200-300 m wide Eastern Limestone and was split between a north pit and a south pit. A limestone wall rising almost to the original land surface divided the two pits. The north and south pits were recently joined in 2016/2017 by mining the centre ridge to form a single contiguous pit, approximately 2 km in length. However, the areas are still referred to as north pit/south pit.	The proposed 30-year mine plan accesses approximately 120 Mt of limestone down to a depth of 335 m AHD. The mine footprint focuses on an expansion of the north pit westwards to mine the Middle Limestone and to mine deeper into the Eastern Limestone. As the Middle Limestone lies approximately 70 m to 150 m west of the Eastern Limestone, the 30-year mine plan avoids mining where practical the interburden between these two limestone units thereby creating a smaller second, north-south oriented West Pit with a ridge remaining between. The north pit will also be expanded southwards, encompassing part of the south pit, leaving the remainder of the south pit for overburden emplacement and a visual barrier.
Project site and disturbance area	CML 16 (which encompasses ML 1716), covers an area of 616.5 ha. Existing mining has disturbed approximately 341.5 ha.	The Project site is approximately 846.4 ha. The Project would result in an additional disturbance footprint of approximately 256.5 ha.
Annual production	Subject to market demand the mine has typically produced up to 3.38 Million tonnes of limestone and up to 200,000 tonnes of shale per annum.	Limestone will be extracted at a rate of up to 4 Mtpa for a period of 30 years. Clay shale will also continue to be extracted at a rate of up to 200,000 tpa.
Mine life	Mining commenced around 1830.	Project life 30 years.
Management of mining waste (overburden)	Overburden from stripping operations is emplaced in the Western Overburden Emplacement (WOE), west of the open cut pits.	The proposed 30-year mine plan will generate approximately 108 Mt of overburden. Overburden will be emplaced both within 'in-pit' and 'out-of-pit' overburden emplacements including: • a vertical and northerly extension of the existing WOE; • a new Northern Overburden Emplacement (NOE) to the west of the lime production plant and kiln; • a new Southern Overburden Emplacement (SOE) within and west of the south pit.
Operational workforce	Approximately 191 full time personnel are currently employed by Boral in connection with the mine, including lime manufacturing, administration and logistics. This includes 118 personnel on-site (excluding contractor personnel) and another 73 that are employed at other locations e.g. Berrima and Maldon Cement Works and North Ryde that would otherwise not be employed if it weren't for the mine.	The Project will provide continued direct employment for 118 people on the mine site and 73 offsite.

Project component	Existing	Proposed
General infrastructure	The existing mine includes access and haul roads, limestone handling and processing equipment, limestone product stockpiling and reclaim areas, conveyor network, lime production and processing plant, limestone sand plant, rail loading and despatch infrastructure, administration offices and visitor/ employee car parking facilities, electricity supply and distribution, utility infrastructure, workshop, stores and ablution buildings, underground diesel storage, heavy vehicle servicing, parking and washdown facilities.	The Project will require the following key infrastructure changes: • relocation of a section of high voltage power line to accommodate the NOE; • realignment of a section of Marulan South Road, to accommodate the WOE; • relocation of the processing infrastructure and the stockpile and reclaim area at the northern end of the north pit to allow the northward expansion of the pit; and • development of a shared Road Sales Stockpile Area including a weighbridge and wheel wash to service both the mine and Peppertree Quarry.
Product transport	A single line rail track owned and maintained by Boral links the Project site to the Great Southern Railway at Medway Junction. A 1.2 km long passing line was constructed at Medway Junction as part of construction of the Peppertree Quarry. This line will also be used by the mine to enhance access to the Main Southern Railway. Boral currently transports most finished products by rail, with up to six trains departing the mine per day. Annual road transport volumes along Marulan South Road to the Hume Highway are approximately: • Lime products – 130,000 tpa. • Limestone aggregates – 50,000 tpa. • Clay shale – 80,000 tpa. • Fine limestone – 70,000 tpa. Annual road transport volumes along Marulan South Road to the agricultural lime manufacturing facility are approximately 120,000 tpa. Annual road transport volumes of crushed and air classified limestone sand along internal roads to Peppertree Quarry are approximately 500,000 tpa.	The majority of limestone products will continue to be transported to customers by rail for cement, steel, commercial and agricultural uses. Boral seeks to maintain the approved rail transportation limit of six trains departing the mine per day. Manufactured sand will continue to be transported by truck along a dedicated internal road, across Marulan South Road and into Peppertree Quarry for blending and dispatch by rail. The mine currently produces approximately 500,000 tpa for Peppertree Quarry and proposes to increase production of manufactured sand to approximately 1 Mtpa. Agricultural lime, quick lime and fine limestone products will continue to be transported by powder tanker, bulk bags on trucks or open tipper trucks along Marulan South Road. Shale, limestone aggregates, sand and tertiary crushed products will be transported by predominantly truck and dog along Marulan South Road. The adjoining Peppertree Quarry is currently approved to transport all products by rail. Boral will seek to transport approximately 150,000 tpa of Peppertree Quarry's products from the mine to customers via Marulan South Road. This could be achieved by back loading to the new shared road sales product stockpile area by the trucks carrying the limestone sand to Peppertree Quarry. In total, Boral is seeking to transport up to 600,000 tpa of limestone and hard rock products along Marulan South Road to the Hume Highway, as well as 120,000 tpa of limestone products to the agricultural lime manufacturing facility, which is approximately 1 km west along Marulan South Road.
Total resource recovered	Extraction to date is unknown as records were not regularly kept in early years of mining.	Up to 120 Mt of limestone and up to 5 Mt of shale resource extracted over 30 years.
Beneficiation	Processing of 3.38 Mtpa of limestone to create various limestone and lime products including limestone aggregates and sand, hydrated lime and quick lime.	Processing of 4 Mtpa of limestone to create various limestone and lime products including limestone aggregates and sand, hydrated lime and quick lime.

Figure 2
Existing operations - Stage 0 (Pre SSD approval)



Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2019).

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Figure 3
Existing operating parameters

1869

Mine in operation since 1869

24/7

24/7 operation

191 employees

118 employees on site
73 employees off site

450,000 tonnes

450,000 tonnes per annum by road
330,000 via Hume Highway
120,000 to agricultural lime manufacturing facility

145 million tonnes

Approximately 145 million tonnes of limestone extracted since 1869

500,000 tonnes

500,000 tonnes per annum of manufactured limestone sand transported across the road to Peppertree Quarry

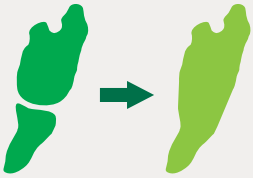
3.38 million tonnes

Up to 3.38 million tonnes of limestone per annum
Up to 200,000 tonnes of shale per annum

2.5 million tonnes

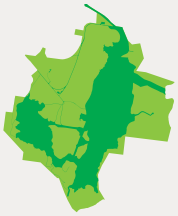
2.5 million tonnes per annum by rail

2016



Mining occurred in north and south pit. In 2016 centre ridge was mined out to create one pit

341.5 hectares



341.5 hectares of ground disturbance associated with historical mining activities

Mining focused on eastern limestone

5.2 million tonnes

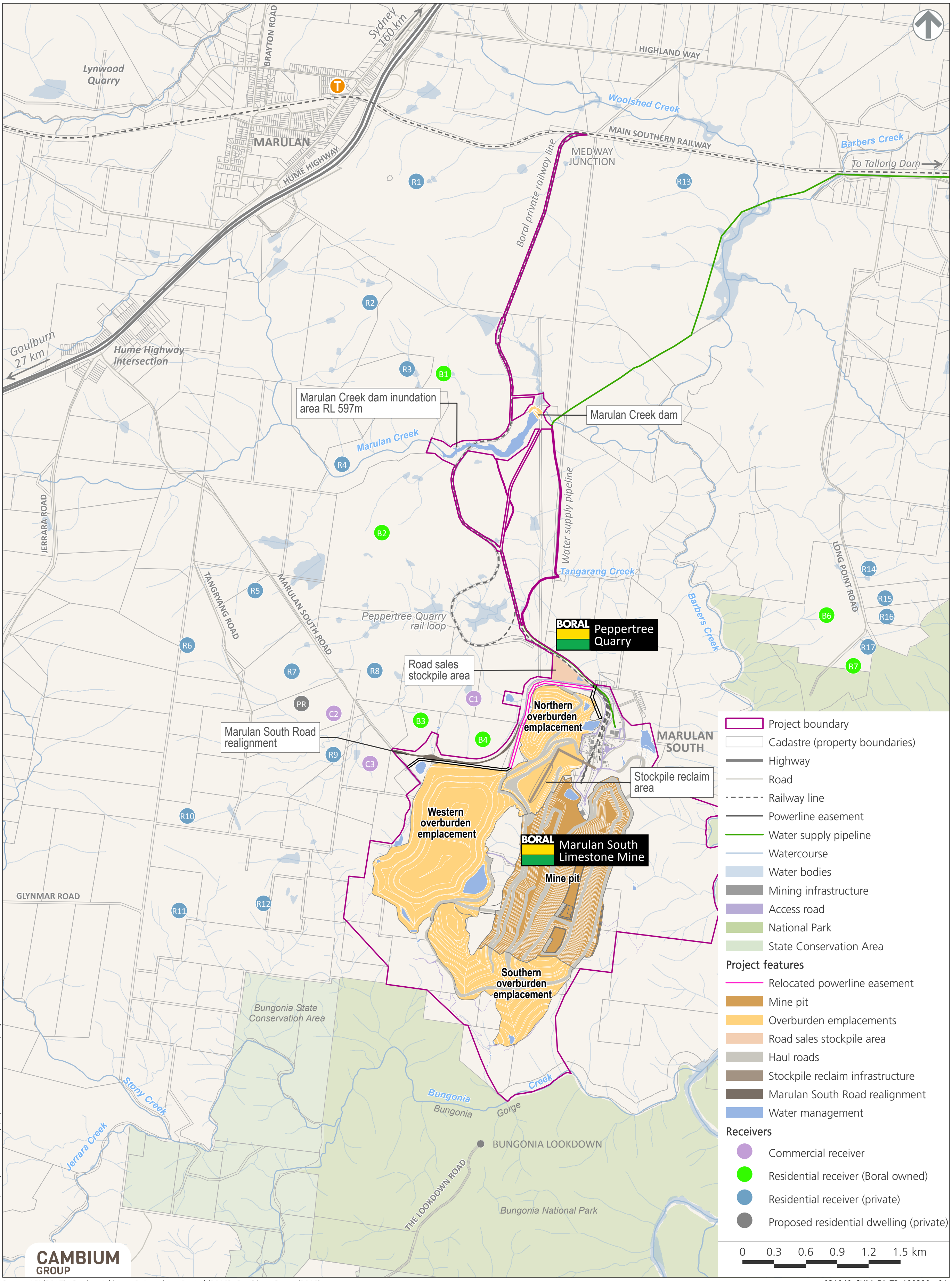
Largest limestone mine in Australia
Annual production 3.38 million tonnes of limestone and 1.8 million tonnes overburden = 5.2 million tonnes

Largest limestone mine in the world (Rogers, Michigan) extracts 10.2mtpa

CAMBIUM GROUP

Source: Boral (2018), Cambium Group (2019).

Figure 4
The Project



Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2019).

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Figure 5
Project overview

233 million tonnes

Expansion of mine void to extract 120 million tonnes of limestone, 5 million tonnes of shale and 108 million tonnes of overburden. Mining of eastern limestone, upper, middle and lower limestone members.

4.5 hectares (Road sales stockpile area)

Road sales stockpile area to store and despatch finished product by truck.

4 million tonnes

Produce up to 4 million tonnes of limestone and extraction of up to 200,000 tonnes of clay/shale per annum.

24/7

Operates 24 hours per day, 7 days a week.

720,000 tonnes by road per annum

600,000 tonnes per annum by road via Marulan South Road to the Hume Highway and 120,000 tonnes per annum to the agricultural lime manufacturing facility immediately west of the mine.

6 up to six trains departing the mine per day

Continued reliance on rail for the majority of finished product transport (up to six trains departing the mine per day).

108 million tonnes

New overburden emplacement areas to store up to 108 million tonnes of overburden.

$165 million

Net social benefits to Australia of $485 to 640 million over 30 years.

Net social benefits to NSW of $165 to 320 million over 30 years.

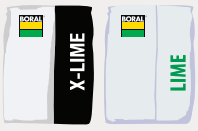
1.4 kilometre realignment

Proposed realignment of a section of Marulan South Road. Deregistration of Marulan South Road east of the Agricultural lime manufacturing facility.

118 megalitres

Proposed water supply dam on Marulan Creek (north of Peppertree Quarry).

1 million tonnes



1 million tonnes per annum of manufactured limestone sand transported across the road to Peppertree Quarry.

80 kilometres per hour

Upgrade of Marulan South Road.

Filling of south pit and rehabilitation to partially screen mine void from the Bungonia Lookdown.

1.4 kilometres

Realignment of high voltage powerlines.

256.5 hectares

256.5 hectares of new disturbance associated with the proposed 30 year mine plan.

191 full time staff

Continue to employ 191 full time personnel in connection with the mine. 118 on site and 73 off-site.

CAMBIUM GROUP

Source: Boral (2018), Cambium Group (2019).

Project component	Existing	Proposed
Vehicle movements	Approximately 278 light vehicle movements (two way trips) per day and 150 heavy vehicle movements (two way trips) per day and 8-10 heavy vehicle movements (two way trips) or 4-5 truckloads (one way trips) per hour.	An additional 68 heavy vehicle movements (two way trips) or 34 truckloads (one way trips) per average day, which equates to an additional 4–6 heavy vehicle movements (two way trips) or 2 – 3 truckloads (one way trips) per average hour. An additional 116 heavy vehicle movements (two way trips) or 58 truckloads (one way trips) per worst case day, which equates to an additional 10 heavy vehicle movements (two way trips) or 5 truckloads (one way trips) per worst case hour. Therefore, existing and proposed vehicle movements will total 266 heavy vehicle movements (two way trips) or 133 truckloads (one way trips) per worst case day and 20 heavy vehicle movements (two way trips) or 10 truckloads (one way trips) per worst case hour. Light vehicle movements won't change as employee numbers will remain the same.
Water management	The main clean water source for the mine is the 'external' source of Tallong dam, an 85 ML water storage dam leased from the State Rail Authority and located 10 km to the north. Water is transferred to the mine from Tallong Weir via a pipeline. Mine water supply is supplemented by surface runoff collected in water storage dams that is used for dust suppression and two on-site groundwater bores. An agreement was also in place with a local landholder to supply water from a large farm dam, Glenrock dam, should the site ever reach a minimum onsite supply level. This agreement has never been implemented. Potable water supply is provided in 15 L water bottles issued to the mine by the store.	Water supply for the Project, including dust suppression, processing activities and some non-potable amenities will be from existing and new on-site dams and a proposed new 118 ML water storage dam on Marulan Creek. This dam will be on Boral owned land north of Peppertree Quarry and will use Boral's adjoining Tallong water pipeline to transfer water to the mine. This dam will require the purchase of water entitlements. Mine water demand in the earlier stages of the 30-year mine operations will also be supplemented by Tallong dam via the Tallong water pipeline and the groundwater production wells (WP16 and 17) north of the pit. Surface water runoff from active mining areas will drain to a network of sediment basins. Water captured in sediment basins will be pumped to the water storage dams to service the mine's water demand and to restore capacity in the sediment basins.

The 120 Mt to be mined is only part of a much larger limestone deposit identified and estimated by GeoRes to be 640 Mt. Of the estimated 640 Mt limestone resource approximately 438 Mt is available for mining as approximately 143 Mt is located to the south of the south pit toward Bungonia Gorge and is unavailable for mining due to environmental constraints and a further 72 Mt is estimated to also be unavailable for mining as it is buried when backfilling the south pit to create the SOE. Although complete extraction of this large limestone deposit is unlikely when considering environmental impacts, it is anticipated that operations will continue well beyond the initial 30-year Project period with a further 110 Mt of limestone available for mining by extending the mine pit north, north-west and to a depth and elevation of 300 m AHD.

This post 30-year mine development would require additional infrastructure relocation and the removal of some 141 Mt of overburden. An estimated 60 Mt of the 141 Mt to be removed can be emplaced by extending the in-pit SOE backfill northwards before impacting upon the extended mine development down to 300 m AHD.

The rehabilitation of land disturbed by mining activities is a standard requirement of mining project approvals and mining leases issued by the NSW government. A conceptual rehabilitation and mine closure strategy has been prepared (**Figure 6**) for the orderly transition from a mining land use to a stable and beneficial post mining use. This conceptual strategy applies to the proposed 30-year mine development and includes the likely option of continued post 30-year mine operations.

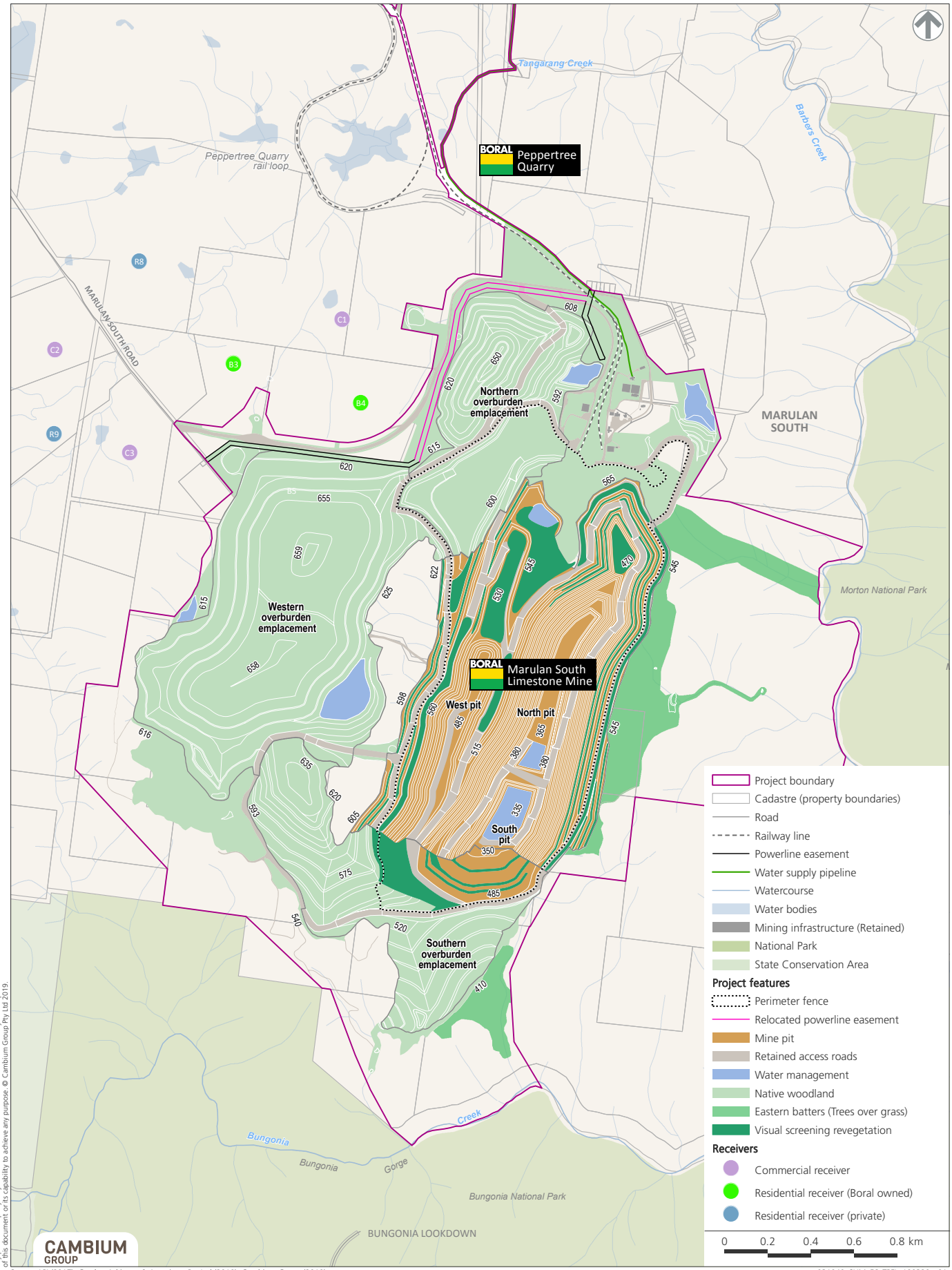
DEVELOPMENT APPLICATION

Two approvals are required for the Project:

- development consent for the Project (SSD 7009) under Part 4, Division 4.7 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act); and
- controlled action approval under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for impacts on listed threatened species and communities (sections 18 and 18A of the Act).

An environmental impact statement (EIS) has been prepared to accompany the application for SSD 7009 and addresses the requirements of State agencies under the EP&A Act and the Commonwealth Department of Environment and Energy.

Figure 6
The Project - Final landform



CAMBIUM GROUP

Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2019).

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POLYCENTRIC APPROACH

The judge presiding over the appeal of the NSW Land and Environment Court's refusal of the major project application by Warkworth Mining Limited for an open cut coal mine near Broke explained that, when grappling with the task of assessing a major project, we are dealing with a polycentric problem and stated:

"A polycentric problem such as determining whether to approve or disapprove a mining project, cannot be resolved by identifying each issue and sequentially resolving it; the resolution of one issue has repercussions on other issues."

With 17 environmental issues each requiring specialist consideration, the Project's planning and assessment team agreed from the beginning that this Project requires a polycentric approach to ensure that the mine planning, community and stakeholder engagement, technical studies and environmental impact assessment process is conducted in a truly integrated manner.

Two project definition and constraints workshops were attended by Boral's mining and planning teams, the technical study leads, the EIS delivery team and an independent 'challenger' (a mining approvals specialist appointed to challenge the Project team).

The Project team were introduced to Boral's objective of continuing mining limestone at the site then considered the key issues in their fields of expertise, and developed an environmental, social and economic values and constraints framework to inform development of the 30-year mine plan and associated infrastructure.

This allowed the implications of one decision, influenced by a certain issue to be considered by the other technical specialists, the challenger and Boral's mining and planning teams, to ascertain the impacts on the other issues. This facilitated in-depth discussion and consideration of why one issue should be attributed greater value than another issue.

Stakeholder and local community input into the planning process for the continuation of a mine is essential to polycentric problem solving as they may identify additional or different issues to the Project team or attribute higher values to certain issues.

Stakeholders and the community have been engaged over a four-year period and outcomes of this engagement have been carefully considered in developing the proposed 30-year mine plan and in deciding which issues should be attributed greater value than others.

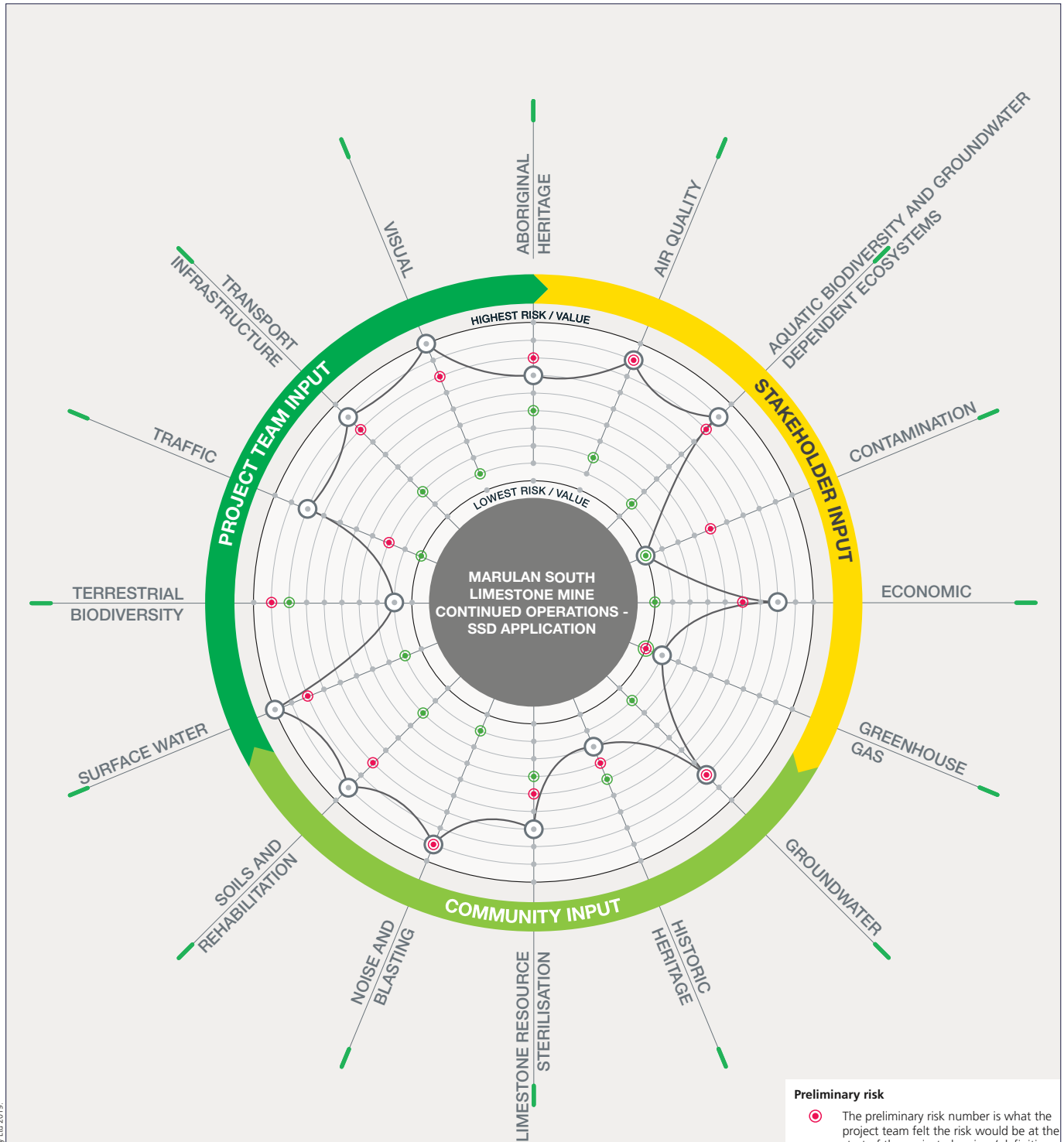
Boral's mine planning and operations team and technical study leads have been regularly updated on outcomes from other technical studies and issues raised by stakeholders and the community. The weighting of values assigned to each issue identified in early project planning and consultation was revaluated and decisions made as to whether further changes should be made.

An example of this iterative process is the interaction between the visual and traffic specialists and mine planner. The visual specialist identified that the overburden emplacements would be barely visible from private and public viewpoints if they are below a certain height. The mine planner redesigned the emplacements to reduce their height and advised that extra emplacement areas would be required, which were found after negotiation with a neighbour. The extra emplacement area would require realignment of a section of Marulan South Road, which was assessed by traffic specialist who advised the realignment would have improved safety compared to the existing alignment.

By following this process, the 30-year mine plan and the avoidance, minimisation, mitigation and offsetting of environmental and social impacts outlined in this EIS are considered an optimum solution to a complex, polycentric problem.

The polycentric approach adopted for the Project planning process is presented in **Figure 7**.

Figure 7
Polycentric approach



CAMBIUM GROUP

Source: Boral (2018), Cambium Group (2019).

IMPACT ASSESSMENT

Surface water and hydrology

Surface water is managed in accordance with the water management system and is based on segregating 'clean' and 'dirty' water and capturing stormwater runoff for use in the mine processes, dust suppression and environmental controls.

The main water source for the Project will be runoff, which will be collected in the sediment basins and mine water storage dams. Collected runoff will be supplemented primarily by Marulan Creek dam, with Tallong dam and the groundwater bore providing further supplementation early in the mine life. Groundwater inflow to the pits would not provide significant water supply as most of it will evaporate.

Marulan Creek dam will be maintained near full capacity except during the constant riparian release and transfers to the water management system. There would be a significant water supply shortfall without the dam, which could supply up to 182 ML/year.

The water balance model demonstrated that the range of existing and proposed water sources will meet operational water demands.

In terms of flooding, an average of 583 ML/year of runoff from the pit catchment and overflows from the water storage dams and sediment basins S1 and W2 will drain to a sump at the base of the pit. The average water level in the pit will be 0.5 m for most of the time which will increase up to 7.9 m during heavy rain, which will quickly seep into the pit floor.

Marulan Creek dam will not significantly increase flooding risks at the railway bridge approximately 1 km upstream of the proposed dam wall or on private property further upstream.

The Project will increase the Tangarang Creek catchment area and alter the Marulan Creek catchment with construction of Marulan Creek dam. The dam will alter flows along Marulan Creek, so a riparian flow of 0.3 ML/day will be maintained via seepage from the base of the dam.

There will be approximately 1.6 days of overflows from sediment basins to natural receiving waters per year, which is within the guidelines for sediment basins designed to capture fine or dispersive sediments in runoff from a 95th percentile rainfall event.

The principal surface water management measure is design and implementation of the water management system. However, operation of the Project (including Marulan Creek dam) will be subject to a Mining Operations Plan (MOP), which will include a water management plan. The plan will include protocols for monitoring discharges from sediment basins and quarterly monitoring in waterways adjacent to the Project site, and a trigger action response plan if monitoring indicates water quality values have been exceeded.

The Project is in the area of the Greater Metropolitan Region Unregulated Area Water Sharing Plan and Boral will apply for transfers and entitlements to account for Marulan Creek dam and groundwater return flows/recharge.

Air quality and greenhouse gases

- Particulate matter, or dust, is the main air pollutant of concern from mining. Dust can be defined by the following sub-categories:
- total suspended particles (TSP), which comprises the total mass of all particles suspended in the air;
- particulate matter with an aerodynamic diameter of 10 µm or less (PM_{10});
- particulate matter with an aerodynamic diameter of 2.5 µm or less ($PM_{2.5}$); and
- deposited dust, which is dust that has settled from the atmosphere onto surfaces.

Other air pollutants potentially associated with the Project are nitrogen dioxide (NO_2) and sulphur dioxide (SO_2), which could be generated at the processing facilities, hydration plant and kiln.

Worst case pollutant generation scenarios over three of the mining stages were assessed (Stage 4 will have reduced operations and was not assessed) using emissions reduction factors, which assume the application of management measures.

The Project, in combination with other local emissions sources, will not result in exceedances of particulate matter and dust deposition criteria at any privately-owned sensitive receivers. The annual average PM_{10} criterion will be exceeded at a Boral owned receiver during Stage 1. Dust generated by the Project will not impact more than 25% of any privately-owned property.

Stack emissions from the Project will be minimal and well below the criteria. When combined with background levels, cumulative levels will also be below the criteria.

Greenhouse gases will be generated by the following sources during construction and operation of the Project:

- fuel combustion by construction machinery and site vehicles;
- fuel combustion and electricity use during mining operations and lime production;
- lime production; and
- fuel combustion from transportation of the lime products off-site by road and rail.

The construction emissions of 14,179 tCO_2-e are substantially less than the operational emissions. Operational activities of the Project are estimated to generate 122,703 tCO_2-e per annum.

The Project's total construction GHG emissions of 14,179 tCO_2-e (0.014179 $MtCO_2$-e) will equate to 0.095% of the national 'Metal ore and non-metallic mineral mining and quarrying' sector's 14.8 $MtCO_2$-e of annual GHG emissions.

The Project's annual operational GHG emissions of 122,703 tCO_2-e (0.122703 $MtCO_2$-e) will equate to 0.83% of the national 'Metal ore and non-metallic mineral mining and quarrying' sector's 14.8 $MtCO_2$-e of annual GHG emissions.

Soils and land capability

Soils in the Project site were surveyed and mapped using 63 samples and observations made over 13 test pits and six archaeological test pits to identify suitable soil for use during rehabilitation and to determine the Project site's land and soil capability.

There are a mix of texture contrast and shallow soils across the main Project site and Marulan Creek dam site. The duplex soils comprise Kurosols in lower sections and Sodosols on mid and upper sections. The shallow soils comprise Tenosols and Rudosols on steep slopes and ridges and there are narrow areas of Alluvial Rudosols along Barbers and Bungonia creeks.

There are land capability classes V to VIII in the Project site, which are moderate/low to extremely low capability land. Land uses in these land and soil capability classes are severely to extremely limited. There is no biophysical strategic agricultural land in the Project site.

Only the A1 horizon of the duplex soils is suitable for stripping, of which there will be 245,510 m^3 available for rehabilitation. Given the low pre-disturbance land capability classes (V, VII and VIII) of the land proposed to be disturbed, the Project will have minimal negative impact on the overall land capability. Further, there is only infrequent and temporary agricultural activity in the Project site, comprising occasional grazing associated with a lease over a section of the Project site.

Contamination

Existing and potential contamination from past and present land use was identified so that recommendations for future investigation, management and remediation to protect human health and the environment could be provided.

Eighteen potential sources of contamination were identified and three were assessed to have potential to impact human health and the environment, comprising petroleum hydrocarbons, asbestos and methylene blue active substances. It was determined the petroleum hydrocarbons and methylene blue active substances had negligible migration or human health risks.

There is a potential human health exposure pathway for asbestos at the former Marulan South township. One of the analysed fragments was friable and had potential to liberate asbestos fibres, which could occur during lawn mowing and landscaping. Implementation of management measures will prevent migration or human health risks from the asbestos.

Aquatic biodiversity

Threatened species databases were searched and local streams were surveyed to assess the Project's potential impacts on aquatic biodiversity. Thirteen sites were surveyed upstream and downstream of the Project site along Barbers, Marulan and Bungonia creeks and the Shoalhaven River.

No threatened species were observed during the surveys. There were more macroinvertebrates at the downstream locations compared to the upstream locations in Bungonia Creek, which was likely due to the increased fine sediment and macrophytes in the downstream locations. There were no notable upstream/downstream differences in other waterways.

Barbers Creek had several pollution sensitive species present, indicating good stream health. Marulan Creek upstream of the Project site is in moderate health as there were several land use impacts on aquatic habitat, water quality and stream flow along the length of the waterway.

Fish communities differed between and within streams in the Project site. The introduced Mosquitofish (*Gambusia affinis*) was the only fish species observed in Marulan Creek. Barbers and Bungonia creeks showed longitudinal distribution of fish species, with Mountain Galaxias (*Galaxias olidus*) only observed upstream of the Project site in both systems.

Changes in flow regime will not adversely impact Tangarang Creek or Main Gully during or after mining and, therefore, there will be minimal impacts on aquatic habitat, flora, fauna or stream process.

The construction and operation of Marulan Creek dam is unlikely to have significant impacts as the system has already been altered by farm dams and water quality is relatively low from adjacent agricultural activities and low flows.

Except for the construction of Marulan Creek dam there is unlikely to be significant ecological impacts to these waterways resulting from the construction and operation of the Project. Impacts to Marulan Creek will not require offsetting as flows will be maintained after construction of Marulan Creek dam and the fish community in the creek mostly comprises introduced fish.

Waste management

- The Project will not generate significant quantities of general solid, hazardous or liquid waste. Any waste that is generated will be managed in accordance with the waste hierarchy in the NSW *Waste Avoidance and Resource Recovery Act 2001*.
- The Project will generate large quantities of overburden, which will all be managed onsite as described in the Project summary and rehabilitation sections.

Aboriginal heritage

Potential impacts of the Project on Aboriginal cultural heritage were assessed by searching OEH's Aboriginal Heritage Information Management System (AHIMS) for previous records of sites in and adjacent to the Project site, surveying the Project site for new sites and consulting Aboriginal parties. Some sites were also excavated to characterise sub-surface archaeological deposits.

According to AHIMS, there are 112 registered sites in a 10 by 10 km area around the Project site, 15 sites adjacent to the Project site and four items in the Project site.

The background environmental and cultural information was used to predict the following about the types of Aboriginal heritage items, and where they could occur, in the Project site:

- artefacts may be present as part of open camp sites or as isolated finds;
- rock shelters and art sites are not likely to be present due to the geology of the Project site;
- suitable landforms (eg elevated land, spurs and crests) next to reliable water will be of high archaeological potential; and
- culturally modified trees are rare but may be present where mature native trees remain.

The surveys targeted ground exposures on land near reliable watercourses; hill spurs and crests; and the relatively flat and undulating land near the proposed Marulan South Road realignment and the construction access road to the Marulan Creek Dam. All mature trees and rock outcrops along the survey transects were inspected for evidence of scars on trees and grinding grooves, rock pools or engravings on rocks.

Forty one new sites were recorded during the survey comprising 28 artefact scatters, 12 isolated finds and one potential scar tree. The potential scar on the tree was later determined not to be of Aboriginal origin. The survey team counted 236 artefacts, comprising 224 in scatters and 12 isolated finds. Effective survey coverage was not reliable due to the amount of surface cover and the incidence of artefact discoveries did not accurately reflect the potential for artefacts to exist in the Project site, given the amount of sensitive landscapes in the area.

Test pits were excavated as the survey was not sufficiently accurate to verify the predictive model. There were 539 artefacts in 17 of the 25 test pits, which represent 17 new sites. The pits with the highest amounts of artefacts were on broad spurs next to Marulan Creek (86% of all artefacts). The remaining 73 artefacts were recovered from 10 test pits in the main Project site, with over half of these from one location.

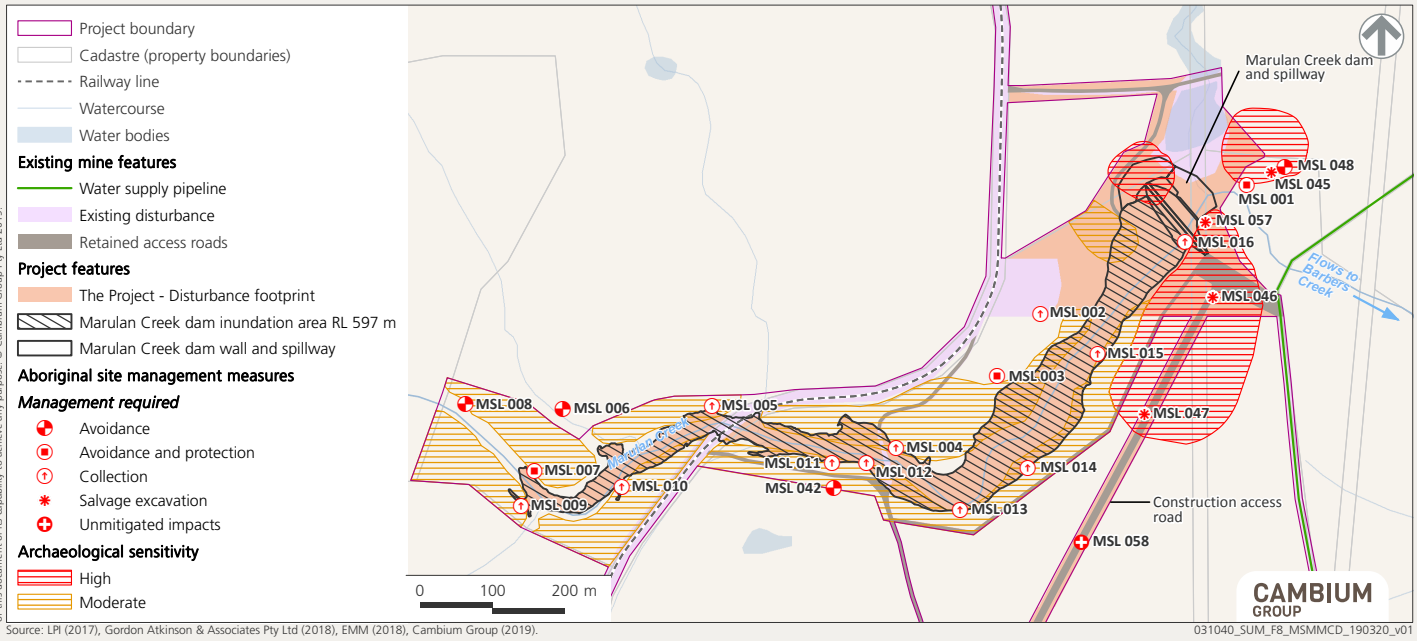
The test excavations demonstrated that the most extensive assemblages exist along reliable watercourses and that some artefact materials, including grey silcrete, were brought in through trade or importation. Marulan Creek appears to have been a focus of long term, sustained habitation, with frequent visitations to create a rich and varied artefact assemblage.
Forty nine sites will be impacted by the Project, comprising 39 which will be totally lost and 10 that will be totally disturbed. One site which will be totally lost has high archaeological significance and 11 of the sites to be totally disturbed/lost have moderate significance.

Thirty two sites comprising surface artefact scatters and isolated finds in the disturbance footprint will be collected by an archaeologist and RAPs, prior to disturbance by the Project.

An area of high archaeological sensitivity in the Marulan Creek Dam disturbance footprint and an area of moderate archaeological sensitivity in the main Project site will be salvaged as they are likely to contain relatively intact subsurface deposits which will assist in understanding the Aboriginal past in the Project site and will be totally lost during the Project. Sites close to the proposed Project disturbance footprint that will be avoided, will be protected by demarcation and signage.

Proposed Aboriginal site management for the Marulan Creek Dam and main mine area is presented in Figures 8 and 9 respectively.

Figure 8
Aboriginal site management - Marulan Creek dam



Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), EMM (2018), Cambium Group (2019).

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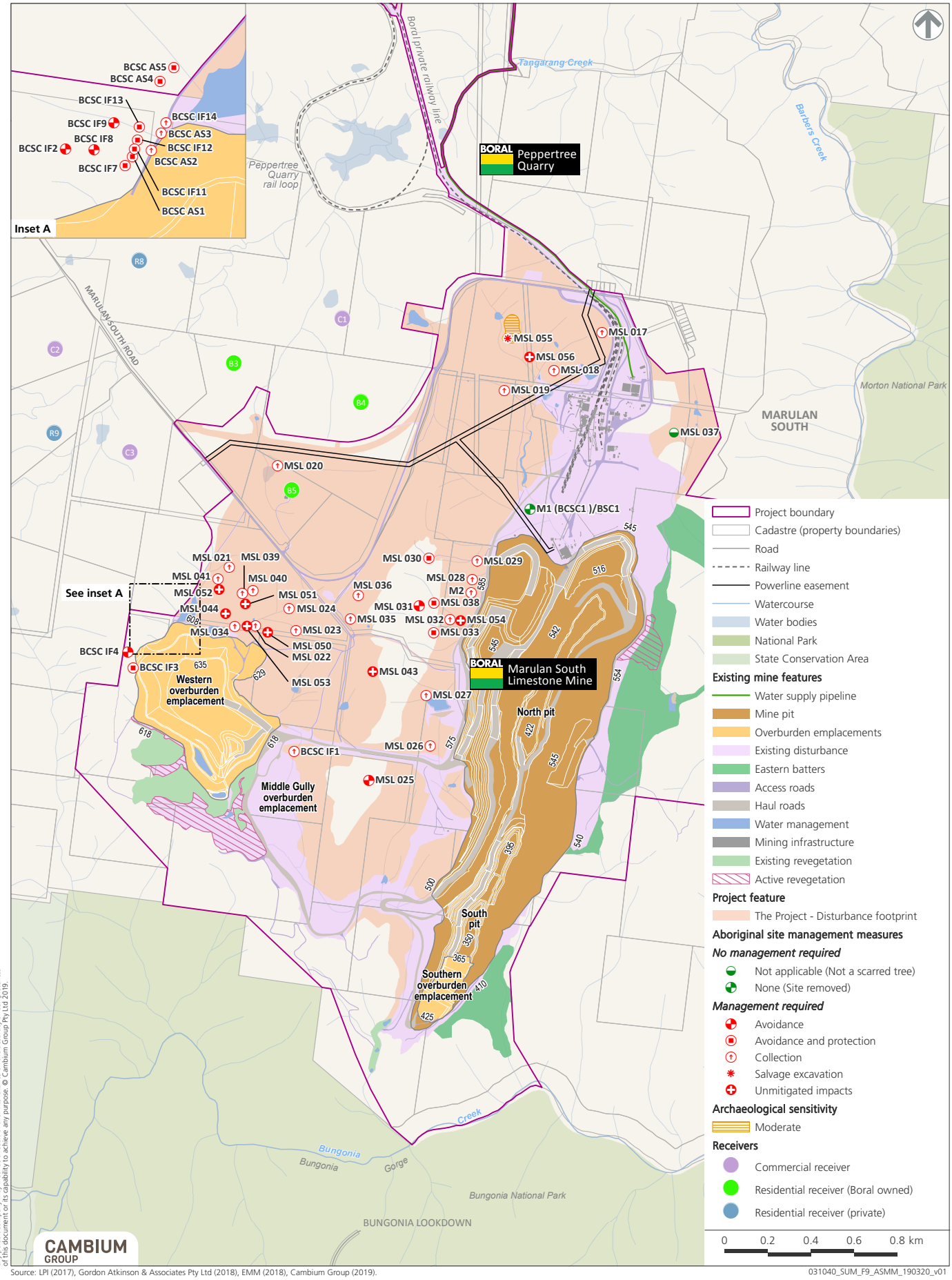
Figure 9
Aboriginal site management - Mine



Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), EMM (2018), Cambium Group (2019).

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Social impacts

Social impacts were assessed in the context of the Project's potential changes to people's way of life; community; access to and use of infrastructure, services and facilities; culture; health and wellbeing; surroundings; personal and property rights; decision making systems; and fears and aspirations.

The community was extensively consulted in 2015, 2016 and 2018 via correspondence, meetings, the media and social media to understand attitudes towards the mine and Project and issues of most importance to the community. Issues of concern to the community were noise, visual and dust impacts; access to property; road safety and traffic impacts; and livelihood concerns such as property values, employment opportunities and raw material supplied to business.

A social impact scoping exercise determined that some of these potential impacts required detailed assessment of impacts without management measures in the form of consultation with residents (noise, visual and dust impacts), visual impacts assessment, ethnographic content analysis (ECA – dust and traffic impacts), health impact assessment (HIA – road safety and livelihood impacts) and interviews with stakeholders (access to property and traffic impacts).

The following positive impacts were predicted:

- Way of life – local and regional employment and business opportunities.
- Personal and property rights – driveway access improvements along Marulan South Road.
- Access to and use of infrastructure, services and facilities – widening and upgrade of Marulan South Road.

The following negative impacts were predicted:

- Access to and use of infrastructure, services and facilities – cumulative and perceived risk of increased traffic volumes and impact to pavement condition along Marulan South Road.
- Health and wellbeing – perceived low frequency (cumulative noise) and disturbance from airbrakes.
- Surrounds – headlight spill into properties from re-aligned Marulan South Road.
- Personal and property rights – dust fallout causing damage to property asset (shed).

Terrestrial biodiversity

Biodiversity impacts were assessed in accordance with the NSW Office of Environment and Heritage's biodiversity assessment method (BAM) using the BAM Calculator. This comprised assessing the Project site's landscape features, native vegetation and threatened species and populations, followed by an impact assessment considering avoidance and minimisation of impacts, impact and offset thresholds and offset requirements.

There are five native and one non-native plant community types in the Project site, with one threatened ecological community; Yellow Box Blakey's Red Gum grassy woodland on the tablelands, South-eastern Highlands (**Figure 10**). This community is listed as an endangered ecological community (EEC) under the EPBC Act and a critically EEC under the EPBC Act.

The BAM Calculator predicted 31 threatened flora species could occur in the search radius, but it was determined only the *Solanum celatum* would occur, with one specimen recorded during the survey.

The BAM Calculator predicted 64 threatened fauna species could occur in the search radius, with 25 of these candidates for species credits (requiring offsetting if their habitat is present and/or habitat would be impacted). The list of candidate species was reduced to the Large-eared Pied Bat (*Chalinolobus dwyeri*) and Koala (*Phascolarctos cinereus*) after fieldwork. A further seven threatened species were recorded in or adjacent to the Project site.

The following direct impacts will result from the Project:

- clearing of native vegetation and associated habitat, estimated to be 182.4 ha, including 88.6 ha of White Box Yellow Box Blakely's Red Gum Grassy Woodland TEC;
- clearing of associated species credit fauna habitat, comprising:
  - clearing of an estimated 132.4 ha of Koala habitat;
  - clearing of an estimated 140.3 ha of Large-eared Pied Bat habitat;
- removal of one individual *Solanum celatum*.

The assessments of significance had the following conclusions:

- the removal of TEC and impact to Koala habitat will have a significant impact and triggers the need to offset the impacts under the EPBC Act;
- offsets will not be required for the Large-eared Pied Bat under the EPBC Act, but offsets will be required under the BC Act; and
- impacts on the other threatened and migratory species listed under the EPBC Act will not be significant and will not require offsetting.

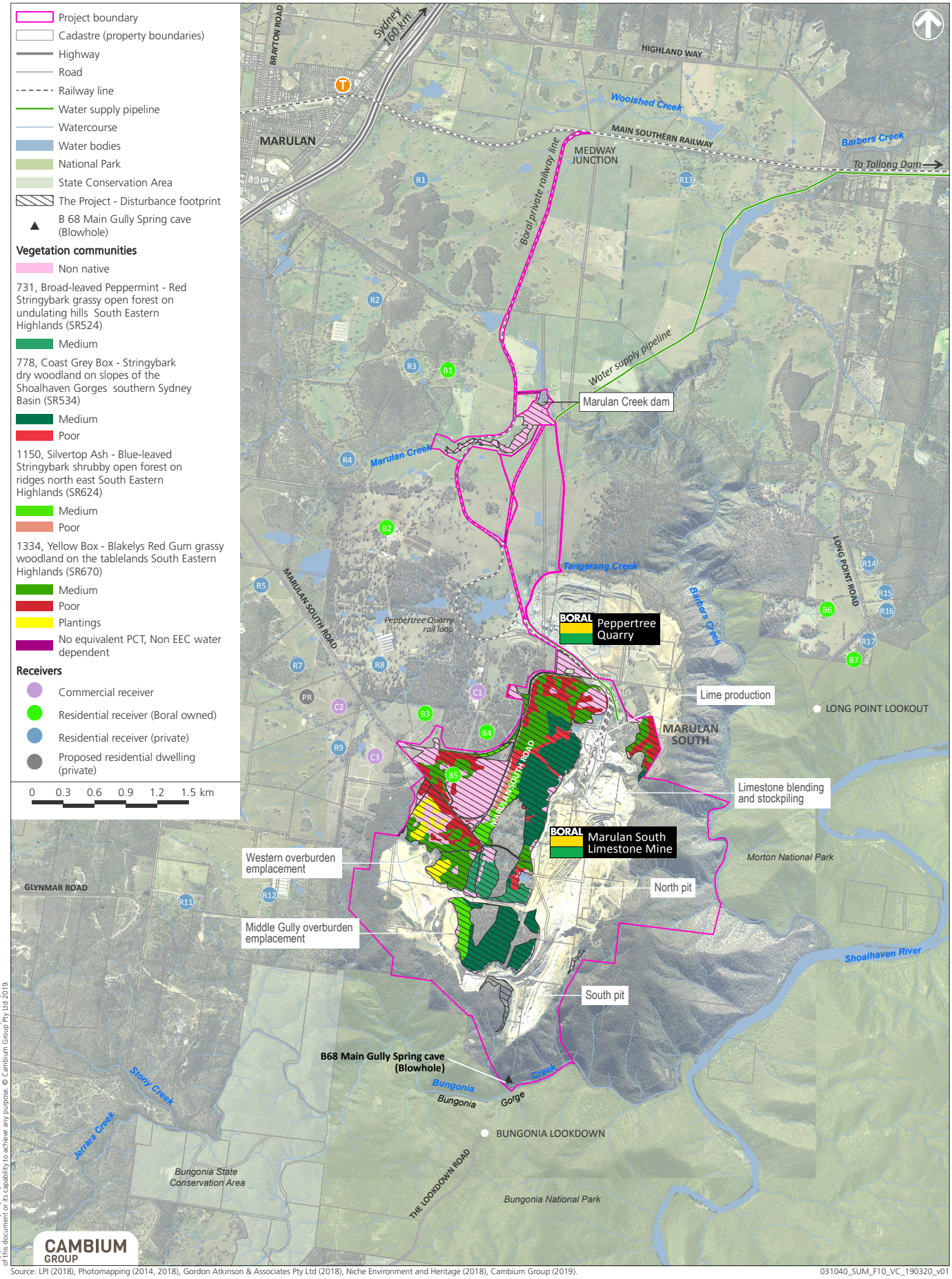
A biodiversity offset strategy has been prepared to offset the impacts of the Project on biodiversity. A total of 3,093 ecosystem credits and the following species credits will need to be retired:

- *Solanum celatum* – 2;
- Koala – 2,941; and
- Large-eared Pied Bat – 4,567.

Boral has investigated offsetting opportunities in the Bungonia subregion and adjacent subregions and has purchased a 1,000 ha property and a 360 ha property in the Bungonia subregion for this purpose. The properties would satisfy most of the BC Act offset liability and all of the EPBC Act liability.

The remaining credit liability will be paid into the BCT Fund.

Figure 10
Vegetation communities



Source: LPI (2018), Photomapping (2014, 2018), Gordon Atkinson & Associates Pty Ltd (2018), Niche Environment and Heritage (2018), Cambium Group (2019).

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Stygofauna

Groundwater can contain many highly sensitive, specialised and highly localised, endemic flora and fauna that cannot be found elsewhere and have little tolerance to change.

Impacts to stygofauna were assessed by using NSW Office of Water's aquifer risk assessment process. Eight groundwater monitoring wells in the Project site and several control bores outside the Project site were sampled for stygofauna. The hyporheic zones (the zone below and within the porous sand and gravel substrate of a riverbed) of streams and springs were sampled in 15 locations.

No stygofauna were found in any of the groundwater monitoring wells in the Project site. One species of stygofauna was found in a groundwater bore outside the Project site. Fifty species of macroinvertebrates were found in the spring and riverine habitats of Bungonia and Barbers creeks. The species are generally tolerant of moderate levels of disturbance.

Fauna were most abundant in the epigean zone (confined to surface water/creeks/rivers), especially at the springs. These species do not enter far into the deeper zones as they are poorly adapted to the low light/oxygen environment.

The largest zone in and around the Project site is the hypogean ecosystem (true groundwater) or aquifers but only one species of stygofauna was found in this ecosystem in a groundwater bore outside the Project site.

Four groundwater dependent ecosystem types were identified in and adjacent to the Project site.

The aquifer risk assessment process was applied to each of the stygofauna survey sites to determine the risk of stygofauna across the Project site being adversely impacted by the Project. All the groundwater monitoring wells/bores and the Bungonia Creek Upper site had low ecological value, while the remaining spring sites had high ecological value given the abundance and diversity of species and the ecosystem health.
The ecological risk was low at all sites as it is predicted that the groundwater table is likely to only reduce by up to 1 m within approximately 290 m of the eastern edge of the current mine pit as a result of mining during the 30-year mine life, and flows/water quality will be maintained at the springs. Additionally, none of the GDEs will be directly impacted by mining as they are outside the disturbance area.

Overall, the assessment determined the Project poses a low risk to stygofauna.

Noise and blasting

There will be vehicle, plant and blasting noise and vibration, associated with the Project which could impact sensitive receivers (**Figure 11**). Two worst case scenarios were assessed using the Environmental Noise Model:

- all fixed and mobile equipment operating 24 hours a day including four haul trucks transporting limestone to the crusher and two haul trucks transporting overburden; and
- all fixed and mobile equipment operating 24 hours a day including six haul trucks transporting overburden.

Noise trigger levels were determined in accordance with the *Noise Policy for Industry* and noise impacts assessed to determine if there were residual impacts. The significance of residual impacts were rated as negligible, marginal, moderate and significant. Negligible impacts are a less than or equal to 2 dBA difference between the predicted noise and trigger level and significant impacts are a greater than 5 dBA difference.

'Modifying factors' were also determined for noise sources in accordance with the *Noise Policy for Industry* to determine if low frequency noise will be generated.

Maximum noise level events were also considered as these could interrupt sleep.

As there will be minor increase in traffic associated with the Project, traffic noise was assessed in accordance with RMS's *Road Noise Policy*. Two scenarios were assessed; the worst case of houses 75 m from the road and typical case of houses 180 m from the road.

Construction noise was assessed in accordance with the *Interim Construction Noise Guidelines*, which included derivation of noise management levels which apply to standard construction hours.

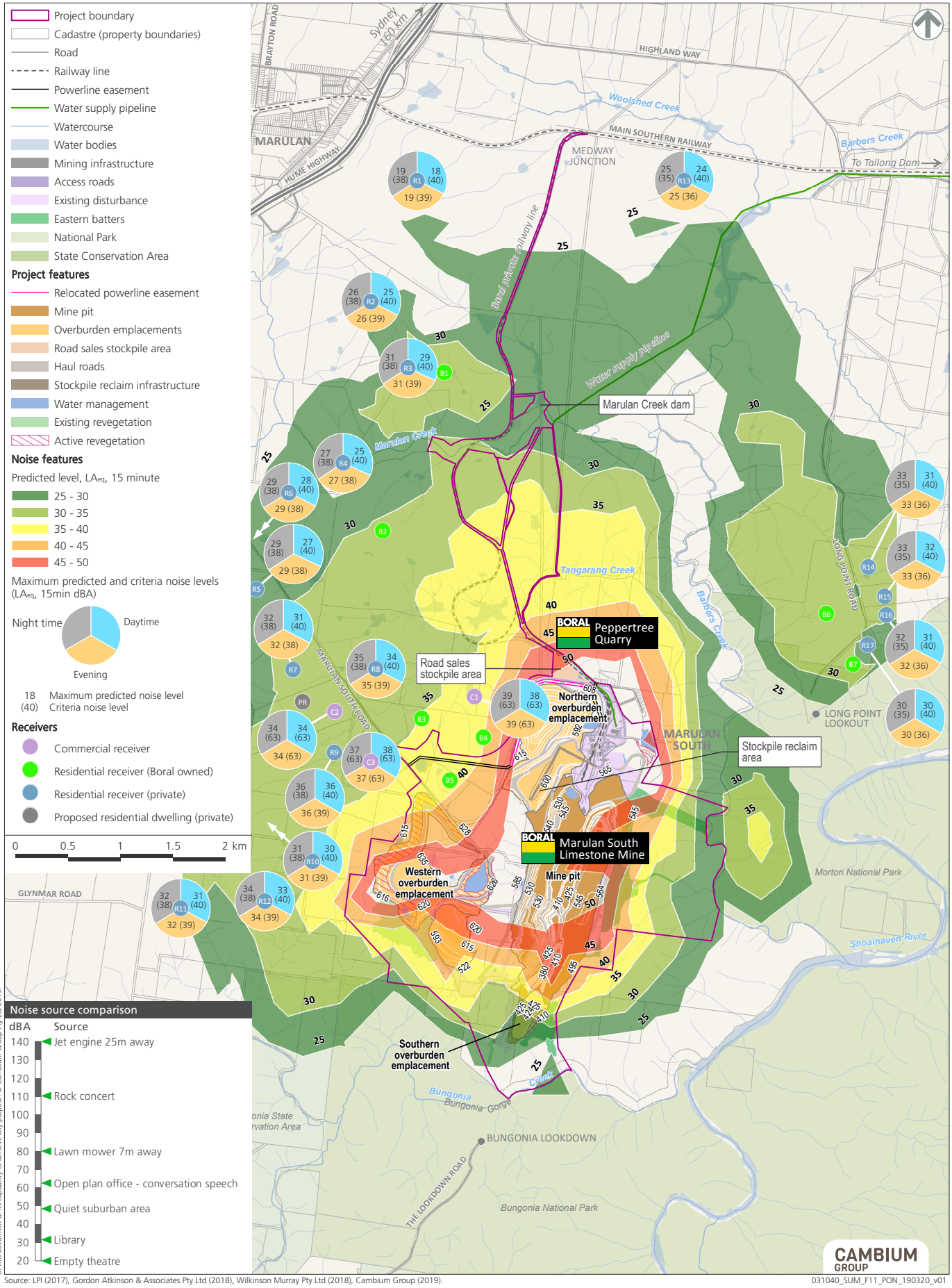
Operational and maximum noise levels will be below the noise trigger levels, and low frequency noise will be below thresholds, at all sensitive receivers during all mine stages and time periods. Therefore, there will be no residual operational noise impacts.

Noise from vehicles associated with the Project travelling on Marulan South Road will increase by 2 dBA during the day and 1 dBA during the night for both scenarios, which complies with the traffic noise criterion.

Construction noise will comply with criteria during standard construction hours at all sensitive receivers.

Predicted blast vibration and overpressure levels are below the human annoyance and discomfort, and building damage criteria, at all sensitive receivers. The vibration from blasting would be below the structural damage criterion at all non-mine-owned infrastructure, including the Jemena gas pipeline that supplies the mine with gas.

Figure 11
Predicted operational noise levels



Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Wilkinson Murray Pty Ltd (2018), Cambium Group (2019).

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Historic heritage

Potential impacts on items of historic heritage significance were assessed by searching State and Commonwealth heritage databases and surveying the Project site.

There are no registered heritage items in the Project site and the adjacent Bungonia State Recreation (Conservation) Area and nearby Glenrock Homestead and Outbuildings are listed under the LEP. Twelve items of local industrial, residential and road transport heritage significance were discovered in the Project site, all associated with historic mining. The Project will avoid five of the items and seven will be removed.

There is little opportunity to revise the proposed disturbance footprint to avoid impacts to heritage items due to the shape and orientation of the limestone resource. Therefore, it will not be possible to avoid impacts to items in the proposed disturbance footprint and alternative management measures will be required.

All items apart from one will be photographically archived and other measures such as archival recording, demarcation and signage will be applied to the other sites.

Hazards and risks

Hazardous substances to be used at the Project were screened against the thresholds in DPE's (2011) *Applying SEPP 33* to determine if the Project will be hazardous or offensive development under State Environmental Planning Policy No. 33 – Hazardous and Offensive Development (SEPP 33). The quantities of dangerous goods proposed to be stored and handled at the Project will be below the thresholds in *Applying SEPP 33*. Therefore, the Project will not be a hazardous development.

The Project could be an offensive development under SEPP 33 if in the absence of safeguards and controls, the mine could 'emit a polluting discharge that could cause a significant level of offence'. However, if the EPA were to issue a licence for the pollution, then it is demonstrated that the pollution will not be significant and can be controlled via mitigation and management measures. It is expected the existing environmental protection license will continue for the Project (including updates associated with the Project). Therefore, it is unlikely the Project will be offensive development.

Boral will update the existing emergency and bushfire management plans to reflect the Project, which will continue to be implemented at the mine to reduce hazards and risk associated with the continuation of mining operations.

Visual

The Project will have low overall visual exposure to its visual catchment. Of the 24 assessed viewpoints, only two will have medium impacts and the remainder will have low impacts. The viewpoints with medium impacts are Bungonia Lookdown Lookout and near Long Point Lookout.

Views from the affected viewpoints will improve over time as overburden emplacements are rehabilitated. Bungonia Lookdown Lookout has the most significant views to the mine, which will substantially reduce by Year 30 when the Southern Overburden Emplacement (SOE) is complete and being rehabilitated.

Traffic and transport

Impacts on traffic were assessed as the Project will include an increase in vehicle numbers over current levels, realignment of a section of Marulan South Road and construction of an intersection on Marulan South Road at the Road Sales Stockpile Area.

There will be an extra 34 truckloads (68 vehicle movements) on an average week day, and up to 58 truckloads (116 vehicle movements) on a worst case day along Marulan South Road. This will equate to up to three one-way trips in an average hour on an average day and up to five one-way trips in a worst case hour on a worst case day.

The additional traffic will have a relatively small impact on the level of service and average vehicle delay along Marulan South Road, and will not change average vehicle delays at the minor intersections along the road. Similarly, there will be a very small impact to traffic conditions on the Hume Highway.

Two intersection scenarios were assessed for the Road Sales Stockpile Area, with stop signs and with traffic signals. In both scenarios the level of service at the proposed intersection was A, which is the best possible intersection performance. The average vehicle delays were low, with a maximum of 13.5 seconds. The sight distances to and from the intersection will be longer than the guideline values.

Construction could result in up to 40 additional inbound and outbound vehicle trips (80 additional two-way trips) on some days. These will consist of light vehicle trips associated with additional construction workers, as well as heavy vehicle trips associated with the delivery of materials and equipment.

The Project is not expected to result in any negative impacts to other road users, including school buses, which use Marulan South Road in the morning and afternoon periods on school days. Upgrades to Marulan South Road will improve road safety and provide school bus stopping and turning facilities.

Groundwater

Groundwater sources in the Project site are shallow unconsolidated aquifers and deep consolidated aquifers. The main groundwater system in the Project site is the limestone targeted for mining. The predominantly north-south jointing/fracture pattern in the limestone is the main flow pathway in the limestone (Figure 12).

Groundwater storage and flow in the limestone body is influenced by fractures, jointing and solution-enhanced fissures. This results in rapid flow through fissures and solution cavities, while the limestone matrix itself is relatively impermeable.

The water table elevation up gradient from the mine is between 550 m and 600 m with a relatively low gradient. The hydraulic gradient of the water table steepens considerably closer to Bungonia and Barber's creeks with groundwater discharging into the gorge and 'daylighting' at springs on the northern face of the gorge. the recharge zone is likely to be the exposed limestone in the mine and outcrop, where higher permeability and exposure allows direct rainfall recharge.

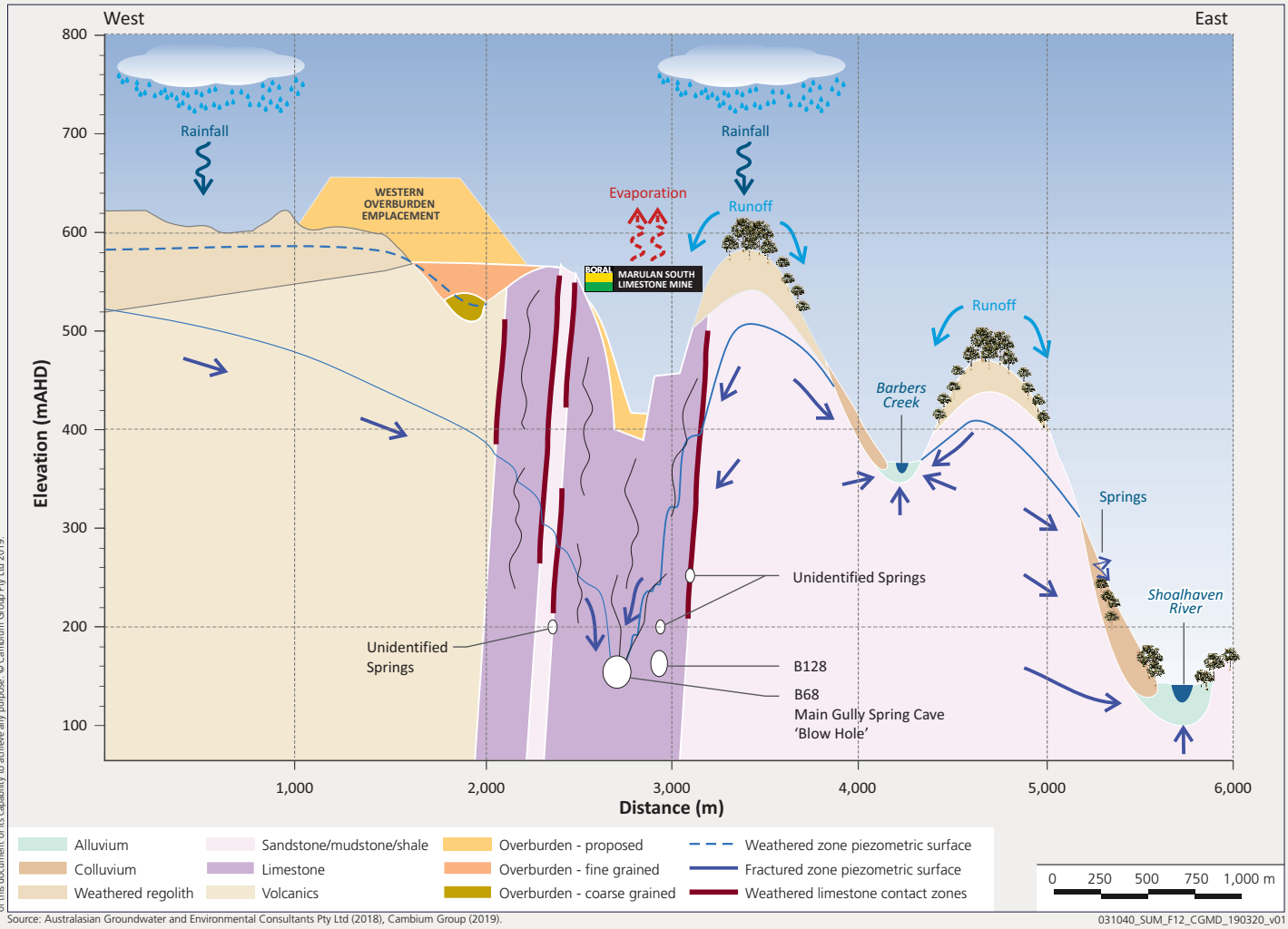
There are 22 bores registered on the NSW Government's Pinneena database around the Project site, which are for domestic water supply and a few for industrial use. There is Shoalhaven Gorge Forest in the southern (into Bungonia Gorge) and eastern (into Barbers Creek) slopes of the Project site, which has high potential for groundwater interaction. There is also spring dependent flora of high ecological value along Barbers Creek and Bungonia Gorge.

A numerical model was developed which demonstrated the Project will result in up to a 1 m drawdown of groundwater, which will not extend to bores held by other groundwater users. Therefore, 'make good' arrangements with surrounding land owners will not be necessary. Mining will result in a slight increase in groundwater inflows of 1 m^3/day over 30 years to the pits due to the increased groundwater gradient towards the pits. The increased pit inflows will result in a slight increase in spring flows down gradient.

The modelled level and extent of drawdown will be verified by groundwater monitoring, and changes will be investigated if drawdown is deeper or more extensive than predicted.

The Project will not change the current quality of groundwater as the current recharge pathways are not proposed to be altered. Changes to groundwater levels and quality will be investigated if monitoring results deviate from historical monitoring results.

Figure 12
Conceptual groundwater model domain (Simplified west-east cross section)



Source: Australasian Groundwater and Environmental Consultants Pty Ltd (2018), Cambium Group (2019).

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Rehabilitation strategy

The mine will be progressively rehabilitated to achieve a final landform based on the following objectives:

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

To achieve these objectives the site was divided into primary and secondary domains. The primary domains were operationally based e.g. overburden emplacements/infrastructure area, and the secondary domains were based on post-mining land use objective e.g. woodland (Figure 6).

The domains will be rehabilitated by reshaping and stabilising post-mining landforms, topdressing reshaped landforms and establishing and maintaining native woodland communities over the following phases.

- decommissioning;
- landform establishment;
- growth medium development;
- ecosystem and land use establishment;
- ecosystem and land use sustainability; and
- relinquishment.

The domains will be rehabilitated in the above phases to achieve the domain specific objectives described in the 2018–2023 MOP. Rehabilitation will be complete once the completion criteria for each rehabilitation element (landform stability, topsoil, vegetation, fauna, water quality and safety) are satisfied.

There will be 215,510 m^3 of stripped topsoil available for rehabilitation, which will not be sufficient to cover all rehabilitation areas. Therefore, topsoil will be prioritised for rehabilitation of the high and moderate erosion risk areas on overburden emplacement slopes and alternative growth media will be used on lower slopes and flats.

Decomposed granite from the Peppertree Quarry and weathered shale from the mine has been used as a growth medium in previous rehabilitation at the mine. The weathered shales have resulted in good tree germination rates, and the decomposed granite was useful in establishing ground cover vegetation.

The photomontages below and Figures 13 and 14 illustrate the expected landform changes from existing to Stage 4 and the visual effect of revegetation from Stage 1 to the end of Stage 4.The view from the Bungonia Lookdown (Viewpoint 20), was chosen as the viewing location that best illustrates the visual effects and staged rehabilitation of the Project, as it is the only publicly accessible location that has views of each of the features of the stages proposed.

Bungonia Lookdown staging photomontage

Analytical landform - Stage 1

Stage 1 revegetation

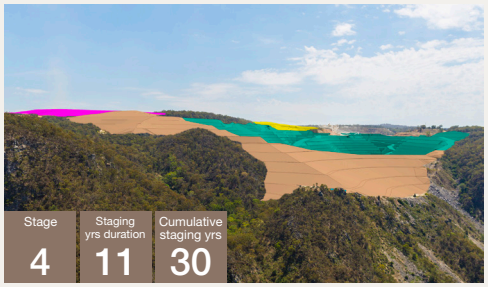
Analytical landform - Stage 2

Stage 2 revegetation

Mine pit
Northern overburden emplacement
Southern overburden emplacement
Western overburden emplacement

Analytical landform - Stage 3

Stage 3 revegetation



Analytical landform - End of Stage 4

Figure 13
Viewpoint 20 (Bungonia Lookdown): Existing view - Stage 0

Source: Photomapping (2014, 2018), Gordon Atkinson & Associates Pty Ltd (2018), Richard Lamb & Associates (2018), Cambium Group (2019).

031040_SUM_F13_BLES0_190320_v01

Figure 14
Viewpoint 20 (Bungonia Lookdown): Photomontage - End of Stage 4 + 5 years revegetation

Source: Photomapping (2014, 2018), Gordon Atkinson & Associates Pty Ltd (2018), Richard Lamb & Associates (2018), Cambium Group (2019).

031040_SUM_F14_BLPS4+5_190320_v01

Economics

Cost benefit analysis (CBA) and two forms of local effects analysis were used to assess the potential economic impacts of the Project in refence to the Project not being approved and the mine closing.

CBA is concerned with whether the incremental benefits of the Project exceed the incremental costs and, therefore, whether the community would, in aggregate, be better off 'with' the Project compared to 'without' it. The CBA compared the production and environmental costs with the production benefits, such as the value of the limestone and residual land values at the end of the Project.

The CBA determined the Project will have net social benefits to Australia of $643 million (M) and to NSW of $321 (M) including employment benefits and a 7% discount rate. Any unquantified residual impacts of the Project after mitigation, offset and compensation would need to be valued at greater than these amounts for the Project to be questionable from a national and NSW economic efficiency perspective.

The local effects analysis determined the Project is likely to have the following net local (LGA) benefits:

- 42 full time equivalent jobs;
- $3.1 M disposable wages per year; and
- $7.1 M of other non-labour expenditure.

The supplementary local effects analysis used an input-output (IO) table to identify the gross direct and indirect additional (positive) regional economic activity associated with a project in terms of indicators of economic activity – output, income, value-added and employment. The IO analysis determined the Project will make the following contributions to the region:

- $82 M in annual direct and indirect regional output or business turnover;
- $48 M in annual direct and indirect regional value added;
- $14 M in annual direct and indirect household income; and
- 198 direct and indirect jobs.

The IO analysis determined the Project will make the following contributions to NSW:

- $137 M in annual direct and indirect regional output or business turnover;
- $74 M in annual direct and indirect regional value added;
- $27 M in annual direct and indirect household income; and
- 364 direct and indirect jobs.

Impacts to property values and business revenue were discounted after detailed economic assessment and further engagement respectively. Other than environmental management controls to avoid other identified negative impacts, no mitigation is required to minimise impacts on property values. However, Boral will meet with the neighbour that raised this concern and will talk them through the results of the economics assessment, other technical studies and proposed mitigation measures. Boral met with the business owner concerned about the supply of raw materials was assured that their supply would not diminish.

Physical impacts to roads and road safety will be mitigated as described in the project description and transport sections of the EIS, and perceived traffic and safety impacts will be addressed by further consultation with stakeholders, including provision of the EIS.

Noise impacts will be managed as described in the noise section of the EIS, including provision of monitoring results to concerned stakeholders. The resident concerned about low frequency noise will continue to be consulted and sources investigated if necessary, which changes to mining operations implemented where reasonable and feasible.

Light spill onto private property will be addressed at the detailed design phase of the road re-alignment, with options including adjustments to the vertical alignment of the road and/or construction of earth bunds and planting of screening vegetation.

Dust impacts will be addressed as described in the air quality section of the EIS and ongoing consultation with concerned stakeholders, including provision of monitoring results.

JUSTIFICATION AND CONCLUSION

The mine is a strategically important asset for Boral, as it supplies the main ingredient for the manufacture of cement at Boral's Berrima Cement Works. This is also a strategically important operation for Sydney based consumers of these products as this represents around 60% of the cement sold in NSW and feeds into more than 30% of concrete sold in Sydney. Major projects previously or currently supplied include Sydney Opera House, Barangaroo, Sydney Metro, and Pacific Highway upgrades.

Without securing SSD approval for the 30-year mine plan and the continuation of mining, the mine will cease to operate after 26 February 2023, when CML 16 expires, resulting in the following negative impacts:

- the loss of approximately 191 direct full time employment jobs across Boral Cement operations in the Southern Highlands;
- loss of an estimated 229 other related jobs throughout NSW;
- loss of approximately 364 direct and indirect jobs within NSW;
- loss of net social benefits to Australia of between $488M and $643M, and net social benefits to NSW of between $166M and $321M;
- a potential 60% shortage in cement sold in NSW and a potential 30% shortage in concrete sold in Sydney;
- sterilisation of a valuable resource (remaining limestone resource estimated at 640 Mt with approximately 438 Mt available for mining); and
- significant implications to Boral's business, the NSW economy and construction industry in general, as well as local employees and service providers.

Without the Project it is also unlikely that:

- Marulan South Road would be upgraded including widening, vertical alignment and pavement improvements and improvements to resident's driveways and bus pick up and turning areas;
- there would be the same level of knowledge gained about Aboriginal occupation in the area;
- the significant Cultural heritage site along Marulan Creek would have been identified;
- additional knowledge of historic mining practices at the site and life at Marulan South would be obtained; and
- the south pit would be backfilled to the extent proposed leaving the mine pit visible to views from Bungonia NP and the Bungonia Lookdown in perpetuity.

As the mine contains a limestone deposit significant enough to support ongoing operations until the end of this century, it is critical to Boral to ensure continued operations at the site.

All potential amenity impacts from the Project on sensitive receivers, comprising noise, air quality and visual impacts, will be below relevant criteria or have low residual impacts. The Project will not have significant impacts on some biophysical aspects such as surface and ground water, and aquatic and stygofauna biodiversity. However, the Project will have residual impacts on terrestrial biodiversity, which will be compensated through the proposed biodiversity offset strategy.

The Project will also have residual impacts on Aboriginal and historic heritage. Areas of medium to high Aboriginal archaeological sensitivity will be salvaged and items of historic heritage significance to be impacted will be archivally recorded.

The Project will have significant economic and social benefits and is in the public interest.

CAMBIUM GROUP