



Marulan South Limestone Mine Continued Operations

Biodiversity Development Assessment Report

Prepared for Boral Cement Limited May 2020



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Cover photograph: General location photo for the Marulan South Limestone Mine Continued Operations Project



Executive summary

Context

Boral Cement Limited (Boral) owns and operates the Marulan South Limestone Mine (the Mine). It is a long standing open cut Mine that has produced up to 3.38 million tonnes of limestone based products per year for the cement, steel, agricultural, construction and commercial markets.

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.

The Mine operates under Consolidated Mining Lease No. 16 (CML 16), Mining Lease No. 1716, Environment Protection Licence (EPL) 944 and a combination of development consents issued by Goulburn Mulwaree Council and continuing use rights.

Due to changes between the *Mining Act 1992* and the *Environmental Planning & Assessment Act 1979* (EP&A Act), when mining moves beyond the area covered by the current Mining Operations Plan, a development consent under the EP&A Act will need to be in place.

Boral is seeking approval for a 30 year Mine plan, including associated overburden emplacement areas, Mine water supply dam, and various associated infrastructure (the Project). A development application for a State Significant Development (SSD) is required along with an environmental assessment.

Aims

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Boral to assess the ecological values and impacts associated with the Project, and provide a Biodiversity Development Assessment Report (BDAR). This BDAR has applied the OEH (2017) Biodiversity Assessment Methodology (BAM) to describe and assess the ecological values within the Study Area and surrounds, and determine how the Project is likely to have an impact on threatened biodiversity listed under the NSW *Biodiversity Conservation Act 2016* (BC Act). This report also has assessed the potential impacts of the Project on Matters of National Environmental Significance (MNES) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In addition to requirements under the BAM and Commonwealth environmental approvals process, this biodiversity assessment addresses specific requirements provided in the Secretaries Environmental Assessment Requirements (SEARs) for the SSD application relating to biodiversity, issued in June 2015.

Study area

The Project site includes the Study Area as shown in Figure 5, current mining lease area CML 16 and the proposed 30 year disturbance footprint, whist the Study Area includes the area of direct and indirect impacts from the following key Project elements:

- Western Overburden Emplacement
- Northern Overburden Emplacement
- Southern Overburden Emplacement
- Road Sales Stockpile Area
- Marulan Creek Dam
- Marulan South Road Realignment



- Access roads
- Sediment basins and water storage dams
- Surface water drainage lines
- Marulan Creek Dam and proposed Marulan Creek Dam Inundation Area.

The Study Area is approximately 252.4 ha, consisting of a mix of areas of native bushland, cleared pasture land, dams and existing infrastructure. In total, approximately 182.4 ha is regarded as native vegetation as per the OEH (2017) Biodiversity Assessment Methodology (BAM) noting that most of it is of a relatively low vegetation integrity score (<25).

Survey overview

Numerous surveys have been completed by Niche since 2013 within the Study Area. Flora and fauna field survey work was conducted and performed broadly in four phases:

- 1. Preliminary site assessment was conducted in November 2013. These surveys were conducted within a footprint that exceeded the current Study Area to identify constraints, and assist with clarification of impact assessment requirements for the proposed Mine layout.
- 2. Survey of proposed disturbance areas and the Study Area in 2014 2015
 - a. Flora survey (November 2014)
 - b. Fauna survey (February 2015)
 - c. Additional surveys for the Marulan South aquatic ecology assessment during which, opportunistic or targeted terrestrial fauna survey was conducted within the Bungonia and Shoalhaven gorges and their tributaries (March 2015).
- 3. Additional field survey activities to clarify potential impacts for certain matters such as vegetation alignment and fauna habitat (May 2015).
- 4. Additional field survey within the Northern Overburden Emplacement in February 2018.
- 5. Re-assessment of the existing flora plots which used the OEH (2014) Framework for Biodiversity Assessment (FBA) methodology. These plots were updated using the BAM in August 2018.

Fauna survey undertaken was consistent with various State and Federal Government guidelines including OEH's (2004) Working Draft Threatened Biodiversity Survey and assessment. The survey involved targeted fauna trapping, including camera traps, Anabats, harp traps, and bird, reptile and amphibian survey. The survey was conducted to target both ecosystem credit and species credit species as identified by the BAM.

Native vegetation Assessment

Vegetation within the Study Area has been mapped previously as part of the Native Vegetation of South Eastern NSW (Tozer et al. 2006). Vegetation validation of this mapping was undertaken. The validation confirmed that the Study Area contained the following Plant Community Types (PCT):

- PCT 1334 Yellow Box Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670)
- PCT 778 Coast Grey Box stringybark dry woodland on slopes of the Shoalhaven Gorges -Southern Sydney Basin (SR534)
- PCT 1150 Silvertop Ash Blue-leaved Stringybark shrubby open forest on ridges, north east South Eastern Highlands Bioregion (SR624)
- PCT 731 Broad-leaved Peppermint Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion (SR524).



One Threatened Ecological Community (TEC) listed under the BC Act and EPBC Act was recorded in the Study Area: White Box Yellow Box Blakely's Red Gum Woodland. The TEC coincides with the occurrence of PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670). Three different condition classes of the TEC were recorded within the Study Area. In total approximately 88.6 ha of the TEC listed under the BC Act and 80.7 ha listed under the EPBC Act would be impacted by the Project.

Vegetation alignment was confirmed and discussed on-site during consultation with OEH on the 16th June 2015.

Threatened flora

During the field survey, one threatened flora - *Solanum celatum*, listed as threatened under the BC Act was recorded within the Study Area. A large population of *Solanum celatum* is known to occur throughout the Bungonia region. No other threatened flora were detected.

Threatened fauna

Sixty-four threatened fauna have been recorded or have predicted habitat within 10 km of the Study Area. Of those species listed under the BC Act, 15 are regarded as 'species credit species' which, unlike 'ecosystem credit species,' cannot be assumed to be present based on the presence of habitat surrogates.

Seven threatened fauna were recorded from the Study Area (Diamond Firetail, Eastern Bent-wing-bat, Greater Broad-nosed Bat, Large-eared Pied Bat, Scarlet Robin, Eastern Free-tail Bat and Yellow-bellied Sheathtail-bat). A further 12 species were recorded outside the Study Area during the survey (Eastern False Pipistrelle, Golden-tipped Bat, Southern Myotis, Grey-headed Flying-fox, Koala, Powerful Owl, Sooty Owl, Turquoise Parrot, Varied Sittella, Glossy Black-Cockatoo, Rufous Fantail, and Yellow-bellied Glider). Most of these species were recorded away from the Study Area in the extensive and intact habitat features of the Shoalhaven River.

A number of additional threatened fauna have the potential to occur within the Study Area but were not recorded, most likely due to their potential use of the Study Area or wider locality being limited to sporadic occurrences (e.g. nomadic birds).

Of the species credit fauna, the Koala and Large-eared Pied Bat were found to occupy the Study Area. The Koala has an area of 132.4 hectares of occupiable habitat within the Study Area, whilst the Large-eared Pied Bat has been attributed an area of 140.3 hectares, based on foraging habitat within the Study Area. These areas of habitat have been regarded in this assessment as the species polygon, which has been used to generate the species credits required for the development.

No further Species Credit Species are likely to be impacted by the Project.

SEPP 44. Koala habitat

The Study Area contains *potential Koala habitat* as defined under SEPP44, given Schedule 2 tree species meet at least 15% of the total number of trees within portions of the Study Area.

The site does not constitute Core Koala habitat given the absence of a resident population of koalas utilising the Study Area. A discussion on SEPP 44 Koala habitat is provided in section 4.9.



Impacts – Native vegetation

The main impact on biodiversity associated with the Project is clearing of native vegetation and removal of habitat within the Study Area. The extent of clearing of native vegetation communities is estimated at 182.4 ha. An offset for the impact to native vegetation has been proposed in this assessment as per the requirements of the BAM.

One TEC will be impacted by the Project – White Box Yellow Box Blakely's Red Gum Grassy Woodland. Approximately 88.6 ha of the TEC under the BC Act and 80.7 ha under the EPBC Act would be directly impacted, with the majority of the vegetation comprised of highly degraded condition classes and assisted regeneration areas comprising of planted tubestock among native pasture. An offset for the impact on this TEC has been proposed as per the requirements of the BAM.

An Assessment of Significance under the EPBC Act has also been conducted for the impact on the TEC. The Assessment concluded the Project is likely to significantly impact the TEC. An offset would be provided for the impact to this TEC to satisfy the Commonwealth offset requirement.

Impacts – Threatened flora

One individual of *Solanum celatum* would be impacted by the Project. No other threatened flora would be impacted by the Project given the lack of suitable habitat and results of the targeted field survey. It is therefore unlikely that the Project will result in a significant impact to any threatened flora.

Impacts – Threatened fauna

Twenty-six threatened and migratory fauna are considered to be affected by the Project. Most of these species are likely to utilise the foraging habitat of the Study Area on an intermittent basis.

In accordance with the BAM, the Koala and Large-eared Pied Bat are the only species credit fauna affected by the Project. Approximately 132.4 ha of Koala habitat, and 140.3 ha of Large-eared Pied Bat habitat would be impacted by the Project.

The remainder of threatened fauna considered to be affected by the Project are regarded as ecosystem credit fauna.

Those threatened fauna which are listed under the EPBC Act that may be impacted include: Great Egret, Cattle Egret, Rainbow Bee-eater, Black-faced Monarch, Rufous Fantail, Large-eared Pied Bat, Koala and Greyheaded Flying-fox. An EPBC Act Assessment of Significance for each of these species has been completed. Based on the results of the Assessments, a significant impact to the Koala is considered likely. A significant impact to other threatened fauna listed on the EPBC Act are considered unlikely. The Regent Honeyeater was also identified in correspondence by the Department of Environment and Energy (DoEE) as likely to utilise the Study Area. However, it should be noted that the species was not detected during the field survey and no historic records within or immediately surrounding the Study Area.

Impacts – Bungonia National Park, Bungonia Conservation Area, Morton National Park

No impacts to biodiversity within Bungonia National Park, Bungonia Conservation Area or Morton National Park are likely as a result of the Project. At the closest point, proposed vegetation clearing occurs approximately 350 m from Bungonia National park and State Conservation Reserve, and over 750 m from Morton National Park. The Study Area is further separated from the conservation areas by gorges, Bungonia Creek, Barbers Creek and bushland. It is unlikely that the existing indirect impacts (noise, dust) currently operating at the Mine would increase as a result of the Project to such a level that would result in significant impacts to fauna or threatened biodiversity within the conservation areas.



Avoidance and minimisation

Based on the results of the risk assessment and preliminary studies, alternative designs were considered, however were dismissed by Boral largely dictated by the availability of the resource location, Boral owned land, within the development consent boundary, that is not required for other mining operations, and is located as far as possible from constraints such as neighbouring residences. Each of the alternatives are detailed in section 6 of the report, along with the reason for dismissal, and justification for the current Project design. Biodiversity values of each alternative are discussed where relevant. Where significant features could not be avoided, identification of mitigation measures to minimise impacts have been proposed.

Mitigation and management

The Project will reduce impacts to biodiversity through the following mitigation measures which are described in detail in Section 6.3:

- Biodiversity Management Plan which will include the following protocols and guidelines:
 - o pest management
 - o weed management
 - o procedures for pre-clearing assessments in accordance with the Vegetation Clearance Protocol
 - fencing and signposting erected around construction zones and areas of native vegetation to be retained.
- Rehabilitation Management Plan
- Air Quality Management Plan including dust suppression measures
- Update of the existing Boral (2015) Bushfire Management Plan
- Spill management procedures
- Management and removal of all rubbish from the Study Area
- Directing artificial lighting into the Study Area to minimise light spill

Quantifying offset of impacts

The BAM identifies the Biodiversity Credit Calculator as the appropriate tool for quantifying the precise nature of the offsets required in both ecosystem and species credit terms.

The ecosystem credits required to offset the Project equate to the following:

- Total of 1,466 credits for PCT 1334 Yellow Box Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670)
- Total of 1,042 credits for PCT 778 Coast Grey Box stringybark dry woodland on slopes of the Shoalhaven Gorges -Southern Sydney Basin (SR534)
- Total of 260 credits for PCT 1150 Silvertop Ash Blue-leaved Stringybark shrubby open forest on ridges, north east South Eastern Highlands Bioregion (SR624)
- Total of 325 credits for PCT 731 Broad-leaved Peppermint Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion (SR524).

The species credits required for the Project include:

- A total of 2,941 credits for the removal of 132.4 hectares of Koala habitat
- A total of 4,567 credits for the removal of 140.3 hectares of Large-eared Pied Bat habitat.
- A total of 2 credits for the removal of 0.1 hectares of *Solanum celatum* (based on a buffer of 30 metres around the one individual recorded as per the requirements of the BAM).

Offset strategy

An offset strategy has been discussed in section 7. Boral propose to offset the Project using a range of offsetting mechanisms including:



- Property 1 Boral owned Stewardship Site (BCT Case No. 0001191) Establishing a Stewardship Site at a property Boral have purchased in the Bungonia Subregion. This property would be used to offset the following biodiversity offset liability:
 - PCT 778 Coast Grey Box stringybark dry woodland on slopes of the Shoalhaven Gorges -Southern Sydney Basin (SR534)
 - PCT 1150 Silvertop Ash Blue-leaved Stringybark shrubby open forest on ridges, north east South Eastern Highlands Bioregion (SR624)
 - o Koala EPBC Act offset requirement
 - o Large-eared Pied Bat EPBC Act offset requirement
 - Partial NSW offset for Koala and Large-eared Pied Bat (residual State offset liability to be paid into Biodiversity Conservation Payment Fund)
- Property 2 Private owned (BCT Case No. 00011444, 00011437, 00011449, 00011453) currently submitted to the Biodiversity Conservation Trust to formaly establish as a Stewardship Site. These Stewarship Site would offset the PCT 1334 Yellow Box Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670) credits liability and satisify for the Commonwealth offset liability for the Box Gum Woodland TEC.
- Payment into the BCT Payment Fund for any residential credits to satisfy State offset liability.



Glossary

Term	Definition
Clearing area	The area directly impacted by the Project either by clearing of vegetation or trimming of vegetation.
Development envelope	The location of the proposed development. Direct impacts occur wholly within this area.
Direct impacts:	Those that directly affect habitat and individuals of a species, population or ecological community. They include, but are not limited to, death through predation, trampling, poisoning of the animal/plant itself and the removal of suitable habitat.
Indirect impacts	Indirect impacts can include loss of individuals through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, deleterious hydrological changes, increased soil salinity, erosion, inhibition of nitrogen fixation, weed invasion, fertiliser drift, or increased human activity within or directly adjacent to sensitive habitat areas.
Locality	The site and surrounds, nominally a 10 km radius from the Site.
Project	30 year Mine plan, including associated overburden emplacement areas, Mine water supply dam, and various associated infrastructure
Project site	The Study Area and 30 year Mine lease (CML 16)
Subject site (Site)	Means the area directly affected by the Project.
Study area	The area of direct and indirect impact

Abbreviations

Acronym	Term/Definition
BAM	Biodiversity Assessment Methodology
BDAR	Biodiversity Development Assessment Report
BAM Calculator	Biodiversity Credit Calculator
BC Act	Biodiversity Conservation Act 2016 (NSW)
ВМР	Biodiversity Management Plan
BOS	NSW Biodiversity Offsets Scheme
CEEC	Critically Endangered Ecological Community
DP&E	NSW Department of Planning and Environment
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)
ha	Hectare/s
IBRA	Interim Biogeographic Regionalisation for Australia
MNES	Matters of National Environmental Significance (from the Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>).
OEH	Office of Environment and Heritage (formerly DECCW, DECC, DEC)
PEA	Preliminary Environmental Assessment
РСТ	Plant Community Type
SAII	Serious and Irreversible Impacts
SEARs	Secretary's Environmental Assessment Requirements



Acronym	Term/Definition
SSD	State Significant Development
TEC	Threatened Ecological Community



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1. Introduction to Biodiversity Development Assessment

1.1 Introduction

Boral Cement Limited (Boral) owns and operates the Marulan South Limestone Mine (the Mine). It is a long standing open cut Mine that has produced up to 3.38 million tonnes of limestone based products per year for the cement, steel, agricultural, construction and commercial markets.

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.

The Mine operates under Consolidated Mining Lease No. 16 (CML 16), Mining Lease No. 1716, Environment Protection Licence (EPL) 944 and a combination of development consents issued by Goulburn Mulwaree Council and continuing use rights.

Due to changes between the *Mining Act 1992* and the *Environmental Planning & Assessment Act 1979* (EP&A Act), when mining moves beyond the area covered by the current Mining Operations Plan, a development consent under the EP&A Act will need to be in place.

An Environmental Impact Statement has been prepared by Element Environment Pty Ltd on behalf of Boral for submission to the Department of Planning and Environment to satisfy the provisions of Part 4 of the EP&A Act. Boral is seeking approval for continued operations at the site through a development application for a State Significant Development including a 30 year Mine plan, associated overburden emplacement areas and a Mine water supply dam (hereafter referred to as 'the Project').

Boral is seeking to continue operations at the site through approval of a proposed 30 year Mine plan, establishment of associated overburden emplacement areas and a Mine water supply dam (hereafter collectively referred to as the Project). The Project constitutes a State Significant Development (SSD) and requires an Environmental Impact Statement (EIS). This Biodiversity Assessment Report is part of the EIS.

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Boral to assess the ecological values and impacts associated with the Project, and provide a Biodiversity Development Assessment Report (BDAR). This BDAR has applied the OEH (2017) Biodiversity Assessment Methodology (BAM) to describe and assess the ecological values within the Study Area and surrounds, and determine how the Project is likely to have an impact on threatened biodiversity listed under the NSW *Biodiversity Conservation Act 2016* (BC Act). This report also has assessed the potential impacts of the Project on Matters of National Environmental Significance (MNES) under the Commonwealth Environment *Protection and Biodiversity Conservation Act 1999* (EPBC Act), addresses the Secretary's Environmental Assessment Requirements (SEARs), and identifies avoidance, mitigation and offsets for the Project.

1.2 The Project

1.2.1 Location

The Mine is located in Marulan South, 10 kilometres (km) south-east of Marulan, 35 km east of Goulburn and approximately 175 km south-west of Sydney, within the Goulburn Mulwaree Local Government Area (LGA) in the Southern Tablelands of NSW (Figure 1 and Figure 2).



Access to the Mine is via Marulan South Road, which connects the Mine and Boral's Peppertree Hard Rock Quarry (Peppertree Quarry) with the Hume Highway approximately 9 km to the northwest. Boral's private rail line connects the Mine and Peppertree Quarry with the Main Southern Railway approximately 6 km to the north.

Consolidated Mining Lease No. 16 (CML 16) 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 private land (Figure 2).

The Mine lease area has been subject to varying levels of disturbance associated with mining and agriculture works including vegetation clearing, Mine operations, installation of mining infrastructure, Mine access tracks, and power easements. 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 State Conservation Area to the south by Bungonia Creek which forms Bungonia Gorge and is separated from the Shoalhaven River and Morton National Park to the east by Barbers Creek (Figure 2).

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 Boral. 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 properties (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. These properties are separated from the Mine by the deep Barbers Creek gorge.

1.2.2 Description

Boral proposes to continue mining limestone from the Mine at a rate of up to 4 million tonnes per annum (mtpa) for a period of up to 30 years. This represents an increase in extraction rate from historic levels (peak of 3.38 mtpa) due to forecast increased demand from the construction industry. Shale will continue to be extracted at a rate of up to 200,000 tonnes per annum (tpa).

The proposed 30 year Mine plan accesses approximately 120 million tonnes 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.

In addition to mining approximately 5 million tonnes of shale, the extraction of the limestone requires the removal of approximately 108 million tonnes of overburden over the 30 year period. This material will be emplaced within existing and proposed overburden emplacement areas.

Limestone will continue to be mined using drilling and blasting methods. Shale will continue to be mined by excavator/front end loader. Limestone, shale and overburden will be transported to the primary crusher, stockpile areas and overburden emplacements respectively, using the load and haul fleet of trucks.



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

The limestone sand plant, produces a crushed and air classified limestone sand for use in concrete. The Mine currently produces 500,000 tpa for Peppertree Quarry and propose to increase production of manufactured sand to approximately 1 million tpa.

Boral's adjoining Peppertree Quarry currently has approval to emplace some of its overburden in the South Pit Mine void. As the South Pit is required for the emplacement of over 30 million tonnes of overburden from the Mine after the removal of accessible limestone, Boral proposes to emplace up to 15 million tonnes of overburden from Peppertree Quarry within the Northern Overburden Emplacement.

1.2.3 Associated Infrastructure

Processing

The existing facilities for processing limestone will continue to be utilised to produce a series of graded and blended limestone products that are despatched from site for use primarily in cement manufacture, steel making, commercial and agricultural applications.

Limestone processing facilities include primary and secondary crushing, screening, conveying and stockpiling plant and equipment located north-west of the North Pit and extending to the tertiary crushing, screening, bin storage and despatch (rail and road) systems that form part of the main processing facilities.

Kiln stone grade limestone will also continue to be processed on site through the existing lime plant comprising kiln stone stockpiles, rotary lime kiln, hydration plant and associated auxiliary conveying, processing, storage, despatch plant and equipment.

Processing infrastructure and the reclaim and stockpile area at the northern end of the North Pit will be relocated during the life of the 30 year pit to enable full development of the Mine plan. The timing and location of this is presented in the EIS.

Shale and white clay will not be processed and will be stockpiled directly from the pit, ready for dispatch by road to the Berrima and Maldon cement operations.

Water Supply

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 water supply dam on Marulan Creek. This dam would be located on Boral owned land north of Peppertree Quarry and utilises Boral's adjoining Tallong water pipeline to transfer water to the Mine. This dam would require the purchase of water entitlements.

Mine water demand will also be supplemented by Tallong Weir via the Tallong water pipeline.

Rail

No changes are proposed to the existing rail infrastructure. A 1.2 km long passing line was constructed at Medway Junction during construction of the Peppertree Quarry, which will also be used by the Mine to enhance access to the Main Southern Railway.



Road

Road access from the Mine to the Hume Highway is via Marulan South Road. The proposed Western Overburden Emplacement extends northwards over Marulan South Road. Boral propose to realign a section of Marulan South Road, to accommodate the northern portion of the proposed Western Overburden Emplacement.

All public roads within the former village of Marulan South as well as the section of Marulan South Road between Boral's operations and the entrance to the agricultural lime manufacturing facility will be deproclaimed.

Power

Power supply to the Mine is via a high voltage power line that commences at a sub-station on the southern side of Marulan South Road, immediately west of the Project boundary. A section of this power line will be relocated to accommodate the proposed Northern Overburden Emplacement.

Transport

The majority of limestone products will continue to be transported to customers by rail for cement, steel, commercial and agricultural uses. Boral seeks no limitation on the volume of products transported by rail.

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.

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 a new shared road sales product stockpile area by the trucks carrying the limestone sand to Peppertree Quarry. A new shared road sales product stockpile area is proposed on the northern side of Marulan South Road, immediately west of the Mine and Peppertree Quarry entrances. This shared finished product stockpile area, includes a weighbridge and wheel wash and will service both the Mine and 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.

1.3 Study area

The Study Area includes the area of direct and indirect impacts from the infrastructure described in section 1.2.3 (Figure 3, Figure 4, Figure 5) including:

- Western Overburden Emplacement
- Southern Overburden Emplacement
- Northern Overburden Emplacement
- Stockpile Areas



- Marulan Creek Dam
- Marulan South Road Realignment
- Access roads
- Sediment basins and water storage dams
- Surface water drainage lines
- Marulan Creek Dam/proposed Marulan Creek Dam Inundation Area.

The Study Area is approximately 252.4 hectares in area. This BDAR has assessed all impacts to biodiversity that occur within the Study Area.

1.4 Interaction with Peppertree Modification 5 Project

As detailed in the EIS for the Project, overburden emplacement at Peppertree Quarry is approved in a number of above ground overburden emplacements surrounding the quarry pit. Peppertree Quarry's development consent allows for remaining overburden that cannot be accommodated in the approved overburden emplacements, to be trucked to and emplaced in the mine's south pit.

Mine planning for the mine has ruled out emplacement of Peppertree Quarry's remaining overburden in the south pit in the required timeframes. There is some limestone remaining in the south pit and extraction of this will continue beyond Peppertree Quarry's need for additional overburden emplacement space. Additionally, as much in-pit space as possible needs to be created in the south pit to minimise the need for future out of pit emplacements at the mine. The mine is proposing to emplace approximately 30 Mt of the mine's overburden in the south pit.

Therefore, the mine is seeking to hold up to 15 Mt of overburden for Peppertree Quarry, in the northern part of the NOE with the southern part of the NOE being a flattened platform for the relocated stockpile and reclaim area. However, the mine's SSD application is unlikely to be determined before Peppertree Quarry runs out of overburden emplacement space. Therefore, Boral Resources (NSW) Pty Ltd (owner of Peppertree Quarry) is seeking earlier approval to emplace their overburden in the mine's NOE under Modification 5 to their development consent. For spatial orientation reasons, Peppertree Quarry are referring to the northern part of the NOE as their proposed South-west Overburden Emplacement (SWOE).

The mine staging plan as detailed in the EIS shows the NOE being completed over approximately 5 years in Stage 1. If Peppertree Quarry obtain approval to commence emplacement of their overburden in the Northern part of the NOE before the mine receives development consent for their continued operations and associated 30-year mine plan, then some of the northern part of the NOE would likely be constructed in Stage 0 (pre SSD approval) and the remainder within Stage 1 of the 30-year mine plan.

All potential impacts of developing the entire NOE have been fully assessed in this BDAR. All potential impacts of developing the northern part of the NOE (or SWOE as referred to in the Peppertree Quarry Modification 5) have also been fully assessed in the Peppertree Quarry Modification 5 environmental assessment and subsequent BDAR.

1.5 Approval Process

1.5.1 Application of the BAM

This BDAR has applied the BAM to describe and assess the ecological values within the Study Area and surrounds, and determine how the Project is likely to have an impact on threatened biodiversity listed under the BC Act and the EPBC Act.



This assessment has used the BAM Calculator (version 1.2.1.00).

1.5.2 Commonwealth requirements

An approval under the Commonwealth EPBC Act is required for the Project due to identified impacts on listed Matters of National Environmental Significance (MNES). A Referral has been submitted to the Commonwealth Department of the Environment and Energy (DoEE) in accordance with the requirements of Part 8 of the EPBC Act. This report provides a stand-alone chapter (Appendix 8) detailing the approach to the assessment of Commonwealth listed threatened biodiversity. Assessments of Significance for those MNES that may be impacted by the Project have been attached to Appendix 8.

1.5.3 Secretary's environmental assessment requirements (SEARs)

In addition to requirements under the BAM and Commonwealth environmental approvals process, this biodiversity assessment addresses specific requirements provided in the SEARs for the SSD application relating to biodiversity, issued in June 2015 and re-issued in June 2018 by the Department of Planning and Environment (DP&E). Table 1 below cross-references this report with the relevant SEARs.



Table 1. SEARs addressed in Assessment

Requirement	Section addressed in report
NSW Department of Planning and Environment (DPE) (25 th June 2018)	
The Department has reviewed the SEARs issued on the 10th June 2015 and is satisfied that they can be relied upon for the completion of the EIS, provided the EIS is finalised and submitted by 20th December 2018. However, the SEARs will be subject to the following adjustments: Under the transitional provisions of the Biodiversity Conservation (Savings and Transitional Regulation 2017, any EIS submitted on or after 25 February 2019 must be prepared in accordance with Par 7 of the Biodiversity Conservation Act 2016.	We have utilised the Biodiversity Assessment Methodology for this assessment to streamline the offsetting requirement for the Project.
NSW Department of Planning and Environment (DPE) (10 th June 2015)	
 An assessment of the likely impacts of the development on the environment, focussing on the specific issues identified below, including: a description of the existing environment likely to be affected by the development, using sufficient baseline data; an assessment of the potential impacts of all stages of the development, including any cumulative impacts, taking into consideration relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practice; a description of the measures that would be implemented to mitigate and/or offset the potential impacts of the development, and an assessment of: whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented; the likely effectiveness of these measures; and whether contingency plans would be necessary to manage any residual risks; a description of the measures that would be implemented to monitor and report on the environmental performance of the development if it is approved; 	Description of the environment – sections 1 and 2. Impact Assessment – section 5 and Appendix 1 and Appendix 6. Cumulative impacts- section 6.4. Mitigation measures – section 6.3 Offsets – section 7. Monitoring and reporting – section 6.4
Consideration of the development against all relevant environmental planning instruments (including Part 3 of the State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007)	
 The EIS must address the following specific issues: Biodiversity – including: an assessment of the likely biodiversity impacts of the development, having regard to the principles and strategies in the NSW Biodiversity Offsets Policy for Major Projects and the requirements of OEH; measures taken to avoid, reduce or mitigate impacts on biodiversity; accurate estimates of proposed vegetation clearing; and a comprehensive offset strategy to ensure the development maintains or improves biodiversity values of the region in the medium to long term. 	This assessment follows the structure of the BAM. Description of the environment – sections 1 and 2. Impact Assessment – section 5 and Appendix 1 and Appendix 6. Mitigation measures – section 6.3 Offsets – section 7.



Requirement	Section addressed in report
 Relevant documents: NSW Biodiversity Offset Policy for Major Projects (OEH) Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians (DECCW 2009) Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft (DECC 2004) Threatened Species Assessment Guidelines: the Assessment of Significance (DECC 2007) Guidelines for Threatened Species Assessment (DoP 2005) BioBanking Assessment Methodology (OEH) Environmental Offsets Policy (Commonwealth DoE) State Environmental Planning Policy No. 44 – Koala Habitat Protection 	Referred to throughout this report.
NSW Department of Planning and Environment (DPE) – Revised SEARs (27 th October 2015)	
The proponent must undertake an assessment of all the protected matters that may be impacted by the development under the controlling provision identified in Item 1. A list of protected matters that the Department of the Environment considered likely to be significantly impacted is provided at Attachment A to these Guidelines. Note that this may not be a complete list and it is the responsibility of the proponent to ensure any protected matters under this controlling provision, likely to be significantly impacted, are assessed for the Commonwealth decision-maker's consideration.	MNES have been considered in the Impact Assessment. Assessments of Significance provided in Appendix 8.
 The EIS must address the following issues: the precise location and description of all works to be undertaken (including associated offsite works and infrastructure), structures to be built or elements of the action that may have impacts on matters of national environmental significance (MNES). an assessment of the likely impacts of the development on each EPBC Act-listed species and/or ecological community where there is likely to be a significant impact from the proposed development. 	MNES have been considered in the Impact Assessment. Assessments of Significance provided in Appendix 8.
 The EIS must address the following issues in relation to Biodiversity including: identification of all EPBC Act listed threatened species and community likely to be located in the Project area or in the vicinity; and identification of all EPBC Act listed threatened species and community likely to be significantly impacted by the development in accordance with the Matters of National Environmental Significance – Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999 (Significant Impact Guidelines). 	MNES have been considered in the Impact Assessment. Likelihood of occurrence provided in Appendix 1. Assessments of Significance provided in Appendix 8.



Requirement	Section addressed in report
 For each of the relevant EPBC Act listed threatened species and community likely to be significantly impacted by the development the EIS must provide: a description of the environment (including identification and mapping of suitable breeding habitat, suitable foraging habitat, important populations and habitat critical for survival), with consideration of, and reference to, any relevant Commonwealth guidelines and policy statements including listing advice, conservation advice and recovery plans; details of the scope, timing and methodology for studies or surveys used and how they are consistent with (or justification for divergence from) published Australian Government guidelines and policy statements; and specifically: i. identification and details of habitat critical for survival of the koala in accordance with the EPBC Act referral guidelines for the vulnerable Koala (Department of the Environment 2014) for both the impact site and any proposed offset site; ii. Detailed mapping identifying the extent and quality of the EPBC Act listed critically endangered White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grasslands in accordance with the EPBC Act listing criteria and policy statement for that community for both the impact site and proposed offset site. 	 MNES Assessments of Significance completed for those species likely to be impacted by the Project (Appendix 8). Critical habitat for Koala detailed in Appendix 8. Mapping of CEEC provided in Figure 12.
 For each of the relevant EPBC Act listed threatened species and community likely to be significantly impacted by the development the EIS must provide a description of the impacts of the action having regard to the full national extent of the species or community's range including; a detailed assessment of the extent, nature and consequence of the likely direct, indirect and consequential impacts – refer to the Significant Impact Guidelines for guidance on the various types of impact that need to be considered; a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible; and a description of any likely cumulative impacts, where potential Project impacts are in addition to existing impacts of other activities (including known potential future expansions or developments by the proponent and other proponents in the region and vicinity). 	MNES Assessments of Significance provided in Appendix 8.
 For each of the relevant EPBC Act listed threatened species and community likely to be significantly impacted by the development the EIS must provide information on proposed avoidance and mitigation measures to manage the relevant impacts of the action including: a description of proposed avoidance and mitigation measures to deal with relevant impacts of the action; assessment of the expected or predicted effectiveness of the mitigation measures, and a description of the outcomes that the avoidance and mitigation measures will achieve. 	Impact Assessment –Appendix 1 and Appendix 8. Cumulative impacts- section 6.4. Mitigation measures – section 6.3 and Appendix 8 Offsets – section 7.
For each of the relevant EPBC Act listed threatened species and community likely to be significantly impacted by the development the EIS must provide reference to, and consideration of relevant Commonwealth guidelines and policy statements including conservation advice, recovery plans, threat abatement plans and wildlife conservation plans.	MNES Assessments of Significance provided in Appendix 8.



Requirement	Section addressed in report
 For each of the relevant EPBC Act listed threatened species and community likely to be significantly impacted by the development the EIS must provide: identification of significant residual adverse impacts likely to occur after the proposed activities to avoid and mitigate all impacts are taken into account. details of how the current published NSW Framework for Biodiversity Assessment (FBA) has been applied in accordance with the objects of the EPBC Act to offset significant residual adverse impacts; details of the offset package to compensate for significant residual impacts including details of the credit profiles required to offset the development in accordance with the FBA and/or mapping and descriptions of the extent and condition of the relevant habitat and/or threatened communities occurring on proposed offset sites. [Note: For the purposes of approval under the EPBC Act, it is a requirement that offsets directly contribute to the ongoing viability of the specific protected matter impacted by a proposed action i.e. 'like for like'. In applying the FBA, residual impacts on EPBC Act listed threatened ecological communities must be offset with Plant Community Type(s) (PCT) that are ascribed to the specific EPBC listed ecological community. PCTs from a different vegetation class will not generally be acceptable as offsets for EPBC listed communities.] 	Impact Assessment – Appendix 1 and Appendix 8. Cumulative impacts - section 6.4. Mitigation measures – section 6.3 and Appendix 8 Offsets – section 7.
Any significant residual impacts not addressed by the FBA may need to be addressed in accordance with the Environment Protection and Biodiversity Conservation Act 1999 Environmental Offset Policy. http://www.environment.gov.au/epbc/publications/epbc-act-environmental-offsets-policy. [Note if the EPBC Act Environmental Offset Policy is used to calculate proposed offsets for a threatened species or community you may wish to seek further advice from the Department of Planning and Environment.]	Offsets – section 7.
Office of Environment and Heritage (OEH) (12 May 2015)	
Biodiversity impacts related to the proposed Project are to be assessed and documented in accordance with the Framework for Biodiversity Assessment unless otherwise agreed by OEH, by a personal accredited in accordance with s142B(1)c of the TSC Act.	BAM used in this assessment.
 Impacts on the following species, populations and ecological communities will require further consideration and provision of the information specified in s9.2 of the FBA: White Box Yellow Box Blakely's Red Gum Woodland – EEC Eastern Bent-wing bat, <i>Miniopterus schreibersii oceanensis</i> Koala, <i>Phascolarctos cinereus</i> 	BAM used in this assessment. SAII has been completed for these species.
The assessment for the Eastern Bent-wing bat must assess the impacts of the proposed development on foraging habitat for this species, as the Project is within an important ecological area for this species. Impacts to the karst system that the Eastern Bent-wing bats utilise in the area will be assessed outside of the FBA as described below.	Species impacts have been addressed in section 5 and SAII has been completed as a precautionary approach.
Audrey Kutzner (Ranger) Bungonia SRA has been monitoring Koala records within the adjoining SCA lands and should be consulted on assessing the Bungonia local Koala population numbers.	Consultation in section 1.6. Koala impacts – section 5 and SAII completed.



Requirement	Section addressed in report
 The EA must identify: The natural features (both surface and sub-surface) that could be affected by mining activities or subsidence that the Eastern Bent-wing bat utilises for roosting, and breeding habitat. An assessment of the potential direct and indirect ecological impacts of the predicted mining activities in the short, medium and long term on the breeding habitat. Measures proposed to avoid, minimise, manage and offset the direct and indirect impacts, including an evaluation of the effectiveness and reliability of the proposed measures. 	Eastern Bent-wing bat in section 5 and SAII completed. Mitigation measures – section 5.1 Offsets – section 7.
 The EIS must identify: Matters to be considered outlined in the Guidelines for developments adjoining land and water managed by DECCW (DECCW 2010) and include: The nature of the impacts, including direct and indirect impacts. The extent of the direct and indirect impacts, The duration of the direct and indirect impacts. The objectives of the reservation of the land. Measures proposed to prevent, control, abate, minimise and manage the direct and indirect impacts including an evaluation of the effectiveness and reliability of the proposed measures. Residual impacts. 	Impacts – in section5. Cumulative impacts - section 6.4. Mitigation measures – section 5.1 Offsets – section 7.
DRE input into SEARs	
The flora, fauna and ecological attributes of the disturbed area should be recorded and placed in a regional context.	Landscape assessment – section 2. Result of field survey – section 3 and 4.
DPE (2019) Adequacy comments	
The Department notes that consultation with the Office of Environment and Heritage (OEH) regarding the preparation of the biodiversity assessment appears to have concluded in 2016, prior to the implementation of the Biodiversity Assessment Methodology (BAM). The Department also notes that OEH has recently provided detailed comments regarding the Biodiversity Development Assessment Report (BDAR) for Peppertree Quarry Modification 5. The Department requests that you carefully consider those comments, as they relate to SSD 7009, and consult with OEH (as required) prior to finalising the EIS.	Comments in relation to PeppertreeModofication5havebeenincorporatedthroughoutthisassessment.
Section 7.2 of the BDAR distinguishes between offsetting requirements under the Environment Protection and Biodiversity Conservation Act 1999 and credit liabilities under the BAM for matters of national environmental significance (MNES). Further discussion/explanation is required in this regard.	Section 7 details the biodiversity offsetting strategy inrelation to both Commonwealth and State requirements



Requirement

Section 7.2 indicates that Biodiversity Stewardship Sites have been identified which will partially satisfy offsetting requirements. The Department will require further details regarding the number of credits available at these sites. However, this information may be provided at the Response to Submissions stage if details are not currently available. The Department also notes that the Commonwealth has not endorsed the Biodiversity Conservation Fund as an offsetting mechanism. Consequently, payment into the fund should not be relied on to satisfy offsetting requirements for MNES.

Section addressed in report

The exact number of credits generated at the Stewardsip Sites has not been provided in this assessment due to confidentiality reasons. Niche and Boral would be happy to provide the details in confidence, or alternatively, OEH and DPE would be able to discuss with the Biodiversity Conservation Trust regarding their review of the Stewardship Sites (Stewardship case numbers provided in section 7).



1.6 Consultation

A core requirement of the SEARs was to undertake consultation with relevant agencies and provide evidence that the proposed development and environmental assessment addresses the considerations of various agencies.

Table 2 below summarises the key issues covered during correspondence with various agencies including the OEH, DoEE, National Parks and Wildlife Service (NPWS) and Goulburn Mulwaree Council. Several meetings took place with key stakeholders from these organisations specifically to present information on the Project in regard to ecology and to seek advice regarding survey, impact assessment and offsetting requirements.



Table 2. Consultation

Dates of consultation	Agency	Relevant key issues/discussion points	How are the issues addressed in this report?
01/04/2015	Doee	Canberra meeting with Caitlin Ellis and Paula Banks (DoEE), Rod Wallace (Boral), Simon Tweed (Niche) and Neville Hattingh (Element Environment). Boral and consultants presented the Project along with environmental studies conducted to date. Feedback was sought and received regarding assessment of MNES, particularly an approach to major identified issues such as White Box Yellow Box Blakely's Red Gum Woodland and the Koala subject to Commonwealth Referral. Discussion of the bilateral agreement, offsetting requirements and the relationships between OEH and DoEE during the approvals process took place. The meeting was followed by a series of emails regarding Koala and White Box Yellow Box Blakely's Red Gum Woodland issues as well as liaison with several DoEE staff. The meeting discussed requirements for future survey.	Quantification, mapping and assessments of significance for MNES. Input and approach to offsetting strategy.
April-July 2015	OEH	Emails and conversations to BioBanking team (OEH). Clarification on application of the FBA process and technical requirements.	Correct assessment of corridors, linkages, offsetting calculations.
04/06/2015	OEH NPWS	 Phone call with Miles Boak (OEH) regarding White Box Yellow Box Blakely's Red Gum Woodland and other threatened species matters. Phone call with Doug Mills (OEH) regarding bat records, roost sites and previous research done. Phone call with Audrey Kutzner (NSW NPWS) regarding Koala records and surveys within Bungonia and surrounds as well as other threatened species issues including bats. Discussion of mapping of White Box Yellow Box Blakely's Red Gum Woodland. 	Information incorporated into assessments of significance for relevant threatened species matters.
09/06/2015 11/06/2015	GM Council	Phone call with Stewart Lloyd (GM Council). Enquired as to any Council mapping of vegetation with emphasis on EEC/CEECs. Council's mapping is limited – there is some collaboration between Council and the recent mapping Project by OEH led by John Briggs with a focus on identification of White Box Yellow Box Blakely's Red Gum Woodland. Discussion of other Marulan site issues. Emailed to request identification of any known important local or regional biodiversity corridors.	Consultation with OEH on latest mapping Project. Ensures vegetation mapping used for wider locality is the best available and that corridors are identified. Enabled Council's input regarding any



Dates of consultation	Agency	Relevant key issues/discussion points	How are the issues addressed in this report?
			concerns or issues for addressing.
11/06/2015	OEH NPWS	Email to Miles Boak (OEH), Audrey Kutzner (NPWS) and Doug Mills (OEH) – Request to obtain further information on bat roost locations and any important wildlife corridors.	Incorporated into assessments of significance.
16/06/2015	OEH	Site meeting at Maulan South Mine: Rod Wallace (Boral); Miles Boak, Allison Treweek and Susan Lamb (OEH); Simon Tweed (Niche). General overview of Project and field assessment conducted. Site inspection focusing on Box Gum Woodland areas. Discussion of assistance OEH and NPWS could provide regarding further information for key assessment items and identification of future offset lands.	Information has been incorporated throughout reporting particularly in impact assessment and offsets strategy.
June/July 2015	OEH NPWS	Ongoing email consultation and data exchange between Niche and relevant OEH/NPWS staff regarding survey effort, Box Gum Woodland and offsetting investigations.	Information incorporated as required, particularly in impact assessment and offset strategy.
9/6/2016	OEH	 Meeting on-site with Miles Boak, and John Briggs (OEH) regarding the difficulty with aligning the vegetation units recorded on-site with an appropriate Plant Community Type (PCT). Key conclusions from the meeting and site inspection include the following: Agreed that vegetation on-site was likely to align to the following best fit BVTs and their associated Tozer (2006) mapping unit: SR624 Silvertop Ash - Blue-leaved Stringybark shrubby open forest on ridges, north east South Eastern Highlands Bioregion (this is equivalent to P10. Eastern Tablelands Dry Forest). SR534 Coast Grey Box - stringybark dry woodland on slopes of the Shoalhaven Gorges, southern Sydney Basin Bioregion (this is equivalent to P27. Bungonia Slates Woodland). SR670 Yellow Box grassy woodland of the northern Monaro and Upper Shoalhaven area, South Eastern Highlands Bioregion (this is equivalent to P24. Tableland Grassy White Box Yellow Box Blakely's Red Gum Woodland). SR534 Coast Grey Box - stringybark dry woodland has an estimated cleared percentage of 15% within the CMA. Most of this vegetation community is within Bungonia State Conservation Area and Morton National Parks or Crown Land. Very restricted. It will therefore be difficult to find an offset for this BVT. Variation rule is likely to be accepted for this BVT. 	The conclusions from this meeting have assisted in aligning the vegetation to appropriate PCTs. The site inspection with OEH was vital in providing confidence in the PCT alignment.



Dates of consultation	Agency	Relevant key issues/discussion points	How are the issues addressed in this report?
		Likely have <i>Eucalyptus bosistoana</i> predominantly within the gullies/slopes with some <i>E. melliodora</i> amongst them. Very difficult to distinguish between the two species as both are occurring together. Likely that some of the Red Gums within the gullies/slopes area are <i>E. tereticornis</i> . SR624 Silvertop Ash - Blue-leaved Stringybark shrubby open forest is Dry Sclerophyll Forest Formation with 40% cleared within the CMA. All efforts to directly offset this BVT would be made. If unlikely to offset directly, a BVT of Dry Sclerophyll Forest Formation that has an equal or greater than 40% cleared would be proposed.	
11/02/2019	OEH	Phone meeting with Allison Treeweek (OEH), Tania Ashworth (OEH), Neville Hattingh (Element), Luke Baker (Niche) and Rachael Snape (Boral) to discuss the Marulan South Project in the context of Peppertree Modification 5 Assessment. The purpose of the meeting was to discuss the Marulan South Project development application, and how it relates to Peppertree Modificaiton 5. The meeting also discussed that the BAM was used for the assessments, and that biodiversity Stewardship Sites would be established as part of the biodiversity offset strategy.	-
27/04/2020	DPIE & BCD	Phone meeting with Lauren Evans (DPIE), Allison Treeweek (BCD), Lyndal Walters (BCD), Neville Hattingh (Element), Luke Baker (Niche) Les Longhurst (Boral) and Rachael Snape (Boral), to discuss the response from DPIE in relation to Commonwealth MNES. The purpose of the meeting was to understand the concerns of the BCD, and to discuss the approach to updated the BDAR in light of the comments. The outcome of the meeting was to separate the Commonwealth MNES into a separate chapter of the BDAR and to update the offsetting credits to reflect Peppertree Modification 5.	Separate Commonwealth Assessment provided as a standalone chapter in Appendix 8. Biodivesity offset credits associated with the Project and Peppertree Modification 5 provided in section 6.8.3.



1.7 Assessment objectives and format

The primary objective of this assessment is to use the guidelines and methodology provided in the BAM to determine the impact the Project would have on biodiversity, avoid and mitigate these impacts and then calculate the Project's biodiversity offset requirement. In addition, the SEARs for the Project have been addressed, and impacts on Commonwealth MNES are addressed through the process of the BAM and by assessments of significance for potentially impacted species.

This BDAR has two broad stages consistent with the BAM methodology:

Stage 1 – Biodiversity Assessment

- assessment of landscape features
- assessment of native vegetation
- assessment of threatened species and populations.

Stage 2 – Impact Assessment

- avoid and minimise impacts on biodiversity values
- consider impact and offset thresholds
- determine and calculate offset requirements.

Whilst not a requirement of the BAM, a biodiversity offset strategy has also been prepared to satisfy the requirements of the SEARs.

1.8 Assessment resources and assessor qualifications

This BDAR has been prepared by the following accredited assessors or experts:

- Luke Baker Senior Ecologist/Ecology Team Leader/Accredited Biodiversity Assessor: flora and fauna field survey, data management, data entry, credit calculations, review of credit calculations, report preparation
- Simon Tweed Senior Ecologist/Ecology Team Leader/Accredited Biodiversity Assessor: Field survey
- Amanda Griffiths Senior Ecologist/Accredited Biodiversity Assessor: Field survey
- Alex Christie Ecologist/Accredited Biodiversity Assessor: Field survey and data management.

Other specialist staff involved in preparing the assessment include:

- Lucy Porter Ecologist: field survey
- Dr Ross Jenkins and Greg Tobin GIS Officer: mapping.



2. Landscape assessment

2.1 Landscape assessment - methods

As detailed in section 4 of the BAM (OEH 2017), a landscape assessment for the Project is required, and is completed within the BAM Calculator. Landscape value is an assessment of a number of factors including:

- native vegetation cover
- rivers, streams and estuaries
- areas of geological significance
- habitat connectivity.

For each factor the current state of the landscape is assessed, and compared with the state of the landscape if the Project were to proceed.

2.1.1 Landscape features and scoring

Table 3 below provides details of the landscape settings and scored landscape features for the Project.

Landscape features	Description	Figure reference
IBRA bioregion/subregion	South Eastern Highlands Interim Biogeographic Regionalisation for Australia (IBRA) region, and Bungonia IBRA subregion	Figure 7
Mitchell Landscapes	Two Mitchell landscapes occur across the Study Area: Bungonia Tableland and Shoalhaven Gorge. The Project predominantly occurs within the Bungonia Tableland Mitchell landscape and as such this Mitchell landscape has been used for the landscape assessment calculations.	Figure 7
Rivers, streams and estuaries and Strahler stream order	 Marulan Creek, which is a 4th order stream, occurs to the north of the Study Area at the location of the Marulan Creek Dam proposed Marulan Creek Dam Inundation Area and Marulan Creek dam spillway. A number of ephemeral drainage channels occur through the middle of the Study Area, which would only provide very limited flow during high rainfall events. There are a number of small farm dams which occur throughout the Study Area. These dams were empty during the warmer months of field survey. 	Figure 7
Wetlands within and adjacent to development	None	n/a
Cleared areas	The majority of native vegetation present within the Study Area has been subject to historic clearing and grazing. Regeneration of these areas has occurred over the past 40 years when logging ceased. As a result, much of the native vegetation contains a relatively open woodland/forest structure with eucalypts of a similar age. Areas that have extensively cleared are a combination of native pasture/introduced pasture with scattered eucalypts. These more open	Figure 8

Table 3: Landscape features and scoring under the NSW BAM



Landscape features	Description	Figure reference
	areas were typically used for foraging by goats, rabbits and kangaroos, which has resulted in portions of bare earth cover. Cleared areas are more prominent to the east where existing Mine Pit, and rail loop occurs.	
Connectivity features	From a regional perspective, the habitats within the Study Area are connected to extensive expanses of vegetation associated with the Shoalhaven Gorge and Bungonia State Conservation Area. To the east, the Study Area is predominately limited in connectivity due to the existing Mine Pit. The land to the west and north-west, is predominantly cleared for agriculture. However, scattered patches of native vegetation occur across the tableland areas, some of which is connected to the Study Area. The Project site has some capacity to act as a linkage between the vegetated reserve areas and the patchy vegetation of the tablelands. The most consolidated linkages are illustrated within Figure 8, with the most affected linkage being from the north-western corner of the Project site and extending for approximately 5 kilometres in the same direction. The Study Area does not form part of any national landscape corridors (SEWPaC, 2012a) and no identified OEH wildlife corridors occur within the vicinity of the Project site (OEH, 2011a). Land clearance for the Project would contribute to some fragmentation of fauna habitat, in particular through the combination of the Northern Overburden Emplacement and Western Overburden Emplacement reducing the connectivity width to patches of vegetation to the north-west. The amount of contiguous bushland remaining, however, means that most of the surrounding native vegetation cover would remain physically connected. Connectivity losses would occur for the life of the Mine with connectivity being progressively reinstated during Mine rehabilitation. However, the landforms reinstated during rehabilitation are likely to be a less favourable linkage for some fauna species due to their topography, heterogeneity and reduced quality in some areas. More mobile species such as birds and bats without highly specific habitat requirements (at least for certain lifecycle aspects) are likely to be most effective at using reinstated linkages. Vegetation to be disturbed for the proposed Marulan Creek Dam I	Figure 8
Buffer area (percent native vegetation cover)	A 1,500m buffer was applied to the site resulting in an overall buffer area of 3,489.5 ha. Aerial interpretation coupled with the results of the current field survey, was used to map the area of native vegetation, and introduced vegetation. In total, 1,356.9 ha is non-native vegetation (consisting of Mine pit, existing emplacement and infrastructure, residential and roads/rail links etc.) and 2,132.6 ha is native vegetation. Woody vegetation cover The native vegetation extent and cover of woody vegetation was	Figure 8
	determined via aerial photography interpretation based on canopy cover.	



Landscape features	Description	Figure reference
	For woody vegetation 52.2% of the buffer area was determined to support native woody vegetation with benchmark cover (1,823.9 ha). <i>Non-woody vegetation cover</i> For non-woody vegetation, experience of the Study Area was drawn upon in addition to aerial photography interpretation to estimate cover of native grassland vegetation. Areas that were naturally grassland correspond with high fertility depressions situated away from core infrastructure. It was conservatively estimated that 8.8 % of the buffer area contains native grassland (308.7 ha). <i>Total native vegetation cover</i> Combining the estimated woody and non-woody vegetation cover resulted in 61% of the buffer area supporting native vegetation. This falls into the 30-70% category within the BAM Calculator.	
Site context	Site based assessment as per BAM.	-
Geological significance and soils	One cave is known to occur within 900 m of the Study Area, known as Main Gully Spring (Bauer and Bauer 1998). Main Gully Spring is located beneath the Mine and it is known during periods of high discharge that this cave acts as an overflow. A number of chambers and tunnels are described by Bauer and Bauer (1998) as occurring in the cave including a chamber 1 m x 2.7 m wide, and a pool approximately 7 m from the entrance. The cave is inundated with water during periods of rainfall. Given the distance from the Study Area and safety restrictions, this cave was not inspected by Niche during the field survey, however Boral and Element Environment representitives inspected the cave with an experienced caver in August 2017. Photographs and videos of the cave were provided to Niche in order to gauge its usage as fauna habitat which is discussed later in section 6.2. Due to the distance from the Study Area, it is highly unlikely that the cave would be impacted by the Project. Mining and blasting, which is to occur approximately 900 m north of the cave, is unlikely to result in any impact to the cave system. This is supported by the fact that there are no known impacts to the cave system even though there has been an on-going history of mining and blasting within the existing Mine pit, especially the southern	Figure 7
	future proposed balsting would be. Therefore, the Project is not forecast to increase noise or vibration to the Main Gully Spring Cave or any other known caves in the locality. The cave would therefore not be impacted by the Project. Further discussion in relation to fauna habitat potential within the cave is provided	
	in section 6.2. There are no other areas of geological significance within the buffer area. There are no high hazard soil areas.	



3. Native vegetation and flora assessment

3.1 Bionet Atlas & EPBC Act Protected Matters Search

A review of spatial records of threatened flora within a 10 km radius of the Study Area was undertaken using data obtained from the Bionet Atlas, and predicted threatened biodiversity were generated from an EPBC Act Protected Matters Search.

Thirty-one threatened flora have been previously recorded or have modelled habitat within a 10 km radius of the Study Area (Appendix 1) according to the database searches. The results were considered during field survey planning and the likelihood of occurrence analysis, performed prior to field survey and updated post field survey.

The potential for these species to occur within the Study Area is discussed in section 3.3 and Appendix 1. Commonwealth listed threatened species as specifically detailed in Appendix 8.

3.2 Plant community delineation and mapping

Vegetation within the Study Area has been mapped previously as part of the Native vegetation of South Eastern NSW (Tozer et al. 2006) (Figure 10). The mapping units of the Tozer et al. (2006) mapping have been aligned by OEH to an associated PCT in the OEH Vegetation Information System (VIS) database. This mapping Project aided the initial preliminary vegetation mapping of the Study Area and surrounds, and was used initially to inform a constraints assessment for the Project in 2014.

Validation of the Tozer et al. (2006) mapping Project, and revision of the mapping was undertaken from the 3rd to the 6th of February 2015, with further refinements completed on the 12th February 2018 (Figure 11). The validated mapping utilised the methodology specified in the OEH (2014) Framework for Biodiversity Assessment, which entail assigning the vegetation on-site to an associated PCT and condition class.

The FBA required the collection of the following attributes which assisted in determining a relevant condition class to each vegetation polygon:

- native species richness (20 x 20 m)
- native over-storey cover (projective foliage cover at 5 m intervals along 50 m transect)
- native mid-storey cover (projective foliage Cover at 5 m intervals along 50 m transect)
- native ground cover (grasses) (frequency tally at 1 m intervals along 50 m transect)
- native ground cover (shrubs) (frequency tally at 1 m intervals along 50 m transect)
- native ground cover (other) (frequency tally at 1 m intervals along 50 m transect)
- exotic cover (as for native over-storey, mid-storey and groundcover)
- over-storey regeneration (proportion of overstorey dominants present as immature recruitment)
- number of trees with hollows (within 50 x 20 m plot)
- total length of fallen logs (within 50 x 20 m plot).

In addition to the prescribed FBA transect data collection above, within each 20 x 20 m plot all vascular plant species were identified (to species level where sufficient plant material was available) and assigned a cover abundance score.

In total, the vegetation validation completed to February 2018 resulted in over 30 FBA plots completed within the Study Area and within the immediate region.



Between the FBA plots, walking and driving transects were completed in order to determine the extent of each vegetation polygon. Given the prior clearing events and grazing pressures in portions of the Study Area, the transition between polygons was not clear in some instances, and thus topography and the PCT habitat descriptions, coupled with the Tozer et al. (2006) descriptions were used to map the extent.

The field survey presented a number of difficulties with eucalypt identification, due to the historic clearing of the site, and the overlap of *Eucalyptus bosistoana* and *E. melliodora* - which are quite similar in appearance. Similarly, the presence of *Eucalyptus tereticornis, E. Blakelyi* and *E. amplifolia* were in combination, thus also presenting identification difficulties. To assist in identification of the eucalypts and alignment to relevant PCTs and Tozer et al. (2006) mapping units, a site visit with John Briggs (OEH) and Miles Boak (OEH) was undertaken on 6th of June 2016 with Niche. The site visit and subsequent consultation (Table 2) assisted in aligning the PCTs within the Study Area.

Due to the changes in biodiversity legislation (commencement of the BC Act – enacted in August 2017), an update of the flora survey was completed from July 31st to the 1st of August 2018 which followed the BAM. The update of the flora survey to the BAM, streamlined the biodiversity development/offset credit ratios, which were not possible given no credit conversion tools were publically available.

The most recent flora survey effort consisted of 38 BAM plots/transects within the Study Area (Figure 11). The BAM plots collected the data detailed in Table 4.

Attribute	Survey requirement
Stratum and layer	Stratum & layer in which each species occurs
Growth form	Growth form for each recorded species
Species name	Scientific name and common name
Cover	Estimate the % foliage cover across the plot of each species rooted in or overhanging the plot.
Abundance rating	For species with cover less than or equal to 5%, count or estimate the number of individuals or shoots of each species within the plot, using the following intervals: 1,2,3,4,5,6,7,8,9,10,20,50,100,500,1000,1500,2000, etc.
Composition	Assessment of composition is based on the number of native plant species (richness) observed and recorded by the assessor within a plot for each growth form group.
Structure	Structure is the assessment of foliage cover for each growth form group within the 20m x 20m plot boundary. The assessor must record an estimate of the foliage cover for each native and exotic species present within the 20m x 20m plot. Foliage cover estimates for each species must draw from the following number series: 0.1, 0.2, 0.3,1, 2, 3,10, 15, 20, 25,100%. The assessor must assign high threat weeds.
Function	The number of large trees, tree stem size class, tree regeneration and length of fallen logs is recorded within a 1000m ² plot Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots evenly located along the central transect The number of trees with hollows is determined by counting the number of trees with hollows that are visible from the ground in the 20m x 50m plot.

Table 4. BAM attribute data requirement


Walking meanders were undertaken between plot locations. At a minimum, the combined foot traverses complied with the recommended number and length of traverses per area of stratification unit (vegetation community) according to DEC (2004) and OEH (2016) survey guidelines. The walking meanders were also used to survey for threatened flora species across the Study Area, in particular the presence of *Solanum celatum* which occurs widely across the locality.

The number of plots undertaken, along with the required survey effort as specified in the BAM is provided in Table 4 and shown in Figure 11.

The species list and transect data obtained during the field assessment is provided in Appendix 3 and Appendix 4.

3.2.1 Plant community delineation and mapping

As detailed above, the vegetation of the Study Area was validated using methods consistent with the BAM.

Within the Study Area five native vegetation types and one non-native vegetation type were identified. These vegetation communities were aligned to the relevant Tozer et al. (2006) vegetation unit, and Plant Community Types (PCTs) required for use with the BAM.

Different condition classes were assigned to vegetation where obvious differences in structure and quality occurred, resulting in two PCTs and four vegetation categories as shown in Table 5.

Descriptions for those communities which occur within the Study Area are provided in Appendix 2, and the updated vegetation community mapping is shown in Figure 11.



Table 5. Vegetation mapping and alignment for vegetation types within the Study Area

Vegetation zone no.	Plant Community Type (PCT)	Equivalent Tozer et al. (2006) mapping unit	Vegetation formation	Vegetation class	Threatened Ecological Community (TEC)*	PCT % cleared	Condition identifier input used in calculator	Total (ha)	Plots required	Plots completed
1		P24 Tablebard Course					Medium	48.8	4	10
2	Gum grassy woodland on the	White Box Yellow Box	Grassy	Southern	EEC under BC Act.	00	Poor	31.9	4	5
3	tablelands, South Eastern Highlands (SR670)	Blakely's Red Gum Woodland (best fit)	Woodlands	Voodlands	CEEC under EPBC Act.	92	Acacia	7.9	3	6
4	PCT 778 Coast Grey Box – stringybark dry woodland on slopes of the	P27. Bungonia Slates Woodland	Dry Sclerophyll Forests	Central Gorge	Not listed	15	Medium	57.9	5	5
5	Shoalhaven Gorges -Southern Sydney Basin (SR534)		(Shrub/grass subformation)	Forests	Nothisted	13	Poor	7.5	3	3
6	PCT 1150 - Silvertop Ash - Blue-leaved Stringybark shrubby open forest on	P10. Eastern	Dry Sclerophyll Forests	South East Dry Sclerophyll	Not listed	40	Medium	13.7	3	3
7	ridges, north east South Eastern Highlands Bioregion (SR624)	Tablelands Dry Forest	(Shrubby sub- formation)	Forests			Poor	2.6	2	2
8	731 - Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion (SR524)	P23. Tableland Hills Grassy Woodland	Grassy Woodlands	Southern Tableland Grassy Woodlands	Not listed	80	Medium	12.0	3	3
9	PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670) – Best fit equivalent based on surrounding land use and previous Tozer et al. (2006) mapping	No equivalent	Grassy Woodlands	Southern Tableland Grassy Woodlands	Not listed	92 – however no real equivalent for this vegetation community	Non EEC_water dependent	0.1	1	1
10	Non-native	-	-	-	-	-		70.0	-	
	Total							252.4		
	Total native vegetation							182.4		



3.2.2 Plant community descriptions

Refer to Appendix 2 for plant community descriptions and diagnostic species for each PCT.

3.2.3 Site values

Flora

Floristic data recorded from floristic plots performed throughout the identified vegetation zones is included within Appendix 3.

Plot and transect values

The results of the plot data and species list obtained during the field assessment is provided in Appendix 3 and Appendix 4.

Vegetation integrity scores

The Vegetation integrity assessment was carried out by entering plot data into the BAM Calculator. The data provides quantitative measures of composition, structure and function for each vegetation zone (Appendix 4). The BAM Calculator compares the values recorded with the benchmark for the vegetation class to provide the Vegetation integrity score. This score represents the overall condition of the vegetation compared against the benchmark (out of 100).

The score from these inputs, coupled with data in the following section of this report, is used to determine the number of ecosystem credits that are required to offset development.

All vegetation zones within the development envelope scored within the threshold for offsetting (15 out of 100 for threatened ecological communities and 17 out of 100 for non-threatened ecological communities). Ecosystem credit offsets are required for impacts to all native vegetation within the development envelope.

3.2.4 High threat and priority weeds

During the field surveys five high threat weeds as listed under the NSW *Biosecurity Act 2015* were recorded within the BAM plots.

High threat weed species recorded include: *Nassella trichotoma* (Serrated Tussock), *Lycium ferocissimum* (Africian Box Thorn), *Chloris gayana* (Rhodes Grass), *Hypericum perforatum* (St Johns Wart) and *Paspalum dilatatum* (Dallas Grass).

As indicated in the Flora plot results (Appendix 4), the abundance and cover of *Nassella trichotoma* (Serrated Tussock) was quite high across most of the flora plots, in particular those completed within the open areas which have been historically grazed. These areas typically coincide with the occurrence of PCT1334 Yellow Box - Blakely's Red Gum grassy woodland.

3.2.5 Threatened ecological communities (BC Act)

A list of Threatened Ecological Communities (TECs) occurring or potentially occurring within the locality as generated from the database searches detailed in section 3.1, is provided in Appendix 1. The database searches identified seven TECs that have been identified as potentially occurring within the locality.

Based on the results of the detailed vegetation validation, an analysis of existing vegetation mapping by Tozer et al. (2006), and review of the Conservation Advice of the TECs, one TEC was identified as being present within the Study Area:



• White Box Yellow Box Blakely's Red Gum Woodland and Derived Native Grassland (Endangered Ecological Community (EEC) under the BC Act and Critically Endangered Ecological Community (CEEC) EPBC Act).

The White Box Yellow Box Blakely's Red Gum Woodland community was identified as aligning to PCT1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670).

Based on the plot surveys within and surrounding the development envelope, three vegetation condition classes were attributed to the TEC:

- 1. Moderate condition: Consisting of clumps of scattered trees with a mix of native and introduced ground cover (vegetation integrity 40.4)
- 2. Poor condition: consisting of few scattered *Eucalyptus melliodora*, *E. bosistoana*, and *E. blakelyi* (vegetation integrity 23.7)
- 3. Acacia: consisting of planted and regenerating Acacias and occasional eucalypts (not a CEEC under the EPBC Act) (vegetation integrity 26.1)

In total, 88.6 ha of the TEC is listed under the BC Act which has been justified in detailed in Appendix 2. The location of the TEC has been provided in Figure 12.

3.2.6 Threatened ecological communities (EPBC Act)

Our validated vegetation mapping concluded that one EPBC Act listed TEC occurs in the Study Area – White Box Yellow Box Blakely's Red Gum Woodland. Details regarding alignment and description of the TEC is provided in Appendix 1 and Apepndix 8, and the location of the TEC shown on Figure 13.

In summary, the following two condition classes of PCT1334 that occur within the Study Area, meet that of the DEH (2006) guidelines for White Box Yellow Box Blakely's Red Gum Woodland:

- Moderate condition: occupies 48.8 ha of the Study Area.
- Poor condition: this condition classes occupies 31.9 ha of the Study Area.

Together, a total of 80.7 ha of the TEC occurs within the Study Area (see Appendix 8 for futher details).

3.3 Threatened flora (BC Act and EPBC Act)

Threatened flora with the potential to occur, as generated by the BAM Calculator, are presented in Table 7 and Appendix 1. This list was refined post field survey for the development envelope within the BAM Calculator on the basis of the vegetation types, condition and habitat features as well as the results of field survey. The list of predicted and candidate species generated via the BAM Calculator is in Table 6. A status for each species is provided which represents the basis for deciding whether a species was present or absent from the development envelope.

Walking meanders were used to survey for threatened flora species across the Study Area, in particular the presence of *Solanum celatum* (listed as Vulnerable under the BC Act), given the species has been previously recorded throughout the locality.

In total, approximately 14 hours of threatened flora random meanders per two ecologists were conducted between 3rd and 6th February 2015, and 5th February 2018. And a further 5 hours completed between 31st July and 1st August 2018.

During the field survey, one individual of *Solanum celatum* was recorded within the Study Area at the Southern Overburden Emplacement Area (Figure 15). The individual was recorded midslope along a shallow



gully, within vegetation mapped as PCT778 Coast Grey Box – stringybark dry woodland. The species is also known to be present within the locality with extensive records within the Bungonia State Conservation Area. Under section 6.1.4.29 of the BAM, a species polygon is to be established by the location of the individual plant or group of plants, and a 30m buffer area around the outside of the individual plant or group of plants. In the case of the *Solanum celatum* recorded, an area of 0.1 ha has therefore been attributed.

Threatened flora that have potential to occur in the habitat types of the Study Area are relatively conspicuous and are unlikely to remain undetected during the survey. Given the field survey was completed during the recommended survey times for those species identified in the BAM Calculator (Table 6), the flora habitat requirements, and the conspicuous nature of the species, it is highly unlikely that threatened flora occur listed on the BC Act or EPBC Act occur within the Study Area.

Further discussion regarding EPBC Act listed threatened flora has been provided in Appendix 8.



Table 6. Candidate threatened flora as generated by the Biodiversity Credit Calculator

Common Name	Scientific Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Status ¹
Flockton Wattle	Acacia flocktoniae	Yes	No – conspicuous species not detected during targeted field survey. Field survey completed during recommended survey time (November, February).											
Thick Lip Spider Orchid	Caladenia tessellata													No – no records within 10km of subject site. There is some marginal habitat within the Study Area within the areas containing Box Gum Woodland with an open understorey, however given the species was not detected during survey which was completed during the known flowering time (October), the species is unlikely to be present.
Buttercup Doubletail	Diuris aequalis										Yes	Yes	Yes	No – no records within the locality. Only known from 20 fragmented populations, none of which occur near the Study Area. The species can occur within Box Gum Woodland habitat, however was not detected during the field survey which was completed during the known flowering time for the species.
Pink Donkey Orchid	Diuris tricolor									Yes	Yes			No – no records within the locality. No habitat within the Study Area. The species was not detected during the field survey which was completed during the known flowering time for the species.
Paddys River Box, Camden Woollybutt	Eucalyptus macarthurii	Yes	No - conspicuous species that is unlikely to remain undetected during field survey.											
Superb Midge Orchid	Genoplesium superbum	Yes	Yes	Yes										No – no habitat present at site. No records within the locality. The species is restricted to the Central and Southern Tablelands of NSW where it has been recorded from 2 locations near Nerriga, c. 20 km apart, and north of Wallerawang. Surveys completed during the recommended survey period (February). Not recorded during field survey.
Cambage Kunzea	Kunzea cambagei	Yes	No – relatively conspicuous species unlikely to remain undetected during field survey. Field survey completed during recommended survey time (all year).											
Dwarf Phyllota	Phyllota humifusa	Yes	No – not detected during the field survey that was completed during the recommended survey time for the species (all year). Relatively conspicuous, and unlikely to remain undetected during the field survey.											
Bungonia Rice-flower	Pimelea axiflora subsp. pubescens									Yes	Yes	Yes	Yes	No – not detected during targeted flora survey which was completed during the recommended survey time (November). Unlikely to remain undetected during the survey.
Cotoneaster Pomaderris	Pomaderris cotoneaster	Yes	No – not detected during targeted flora survey which was completed during the recommended survey period (all year). Unlikely to remain undetected during the survey.											

¹ As determined by BAM calculator



Common Name	Scientific Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Status ¹
Delicate Pomaderris	Pomaderris delicata	Yes	No – not detected during targeted flora survey which was completed during the recommended survey time (November). Unlikely to remain undetected during the survey.											
Matted Bush-pea	Pultenaea pedunculata									Yes	Yes	Yes		No – not detected during targeted flora survey which was completed during the recommended survey period (November). Unlikely to remain undetected during the survey.
Solanum celatum	Solanum celatum									Yes	Yes	Yes		Yes – one individual detected during the field survey.
Silky Swainson-pea	Swainsona sericea	Yes	Yes							Yes	Yes	Yes	Yes	No – not detected during targeted flora survey which was completed during the recommended flowering period (November). Unlikely to remain undetected during the survey.



4. Assessment of fauna and fauna habitat

4.1 Bionet Atlas & EPBC Act Protected Matters Search

Similar to that in section 3.1, a review of spatial records of threatened fauna within a 10 km radius of the Study Area was undertaken using data obtained from the Bionet Atlas, and predicted threatened biodiversity were generated from an EPBC Act Protected Matters Search.

Sixty-nine threatened fauna have been previously recorded or have modelled habitat within a 10 km radius of the Study Area (Appendix 1) according to the database searches. The potential for these species to occur within the Study Area is discussed in section 4.3 and Appendix 1.

Specific discussions regarding Commonwealth listed threatened fauna is provided in Appendix 8.

4.2 Methods - field survey

The fauna field surveys incorporated both targeted survey using established survey techniques (as described in Table 7) and habitat-based assessment.

The fauna survey design had an emphasis on the detection of species credit fauna where habitat was present. Since ecosystem credit species (see Appendix 1) have a high likelihood of being present on the site (based on the presence of habitat surrogates), specific targeted survey was not always performed for these species. However, the survey design attempted to detect the range of fauna using the Study Area in order to assist with evaluating its importance to fauna more generally.

The fauna survey effort was conducted over four main fauna survey periods corresponding to the different Project components:

- Study area and surrounds surveyed over four days between 26th November and 1st December 2014. This included spotlighting, call playback, and habitat based assessment.
- Targeted fauna survey across Study Area from the 2nd to 6th February 2014. This included camera trapping, spotlighting, and habitat assessment.
- Amphibian and habitat survey along Barbers Creek, Bungonia Creek and areas of Shoalhaven River between the confluences with the above creeks. This was undertaken on the 2nd to 4th March 2015.
- Flora and fauna survey undertaken on 19th to 21st May 2015 and included Koala SAT surveys, spotlighting, call-play back, habitat assessment, bird surveys and Anabat analysis.
- Koala SAT surveys completed within the Northern Overburden Emplacement Area on 5th February 2018.

Habitat assessment considered the type and condition of habitats for fauna species. Habitat features recorded within the survey area included:

- Topographic features (such as slope, aspect and landscape position)
- Geology/soil type
- Dominant vegetation community composition, structure and condition of strata levels
- Form, quality and location of water sources
- The presence, number, size and condition of unique habitat features (such as tree hollows and crevices, loose tree bark, fallen timber mistletoe and any rock outcropping or scattered surface rock)
- The level of disturbance.



Details regarding the survey effort and techniques employed are provided in Table 7, and the location of each survey are shown on Figure 14.



Table 7. Fauna survey details and effort

Method	Effort and Timing	Total effort	Details	Target species (NSW)	Target species (Commonwealth)	EPBC species survey guidelines met in relation to Study Area? ²
Ultrasonic call recording for bats	Each unit set for 10 hour recording for one night: 3 units x 29/10/2014 3 units x 30/10/2014 3 units x 31/10/2014	90 hours	One Anabat II bat detector and two Anabat CF recorder unit was deployed at three separate sites. Each unit was left along potential flyways or watercourses. The location of the detectors has been provided in Figure 14.	Large-eared Pied Bat, Fastern False Pipistrelle.		
Ultrasonic call recording for bats	Each unit set for 10 hour recording: 5 units x 02/02/2015 3 units x 03/02/2015 1 unit x 04/02/2015 1 unit x 05/02/2015	100 hours	Wildlife Acoustics SM2BAT ultrasonic recorders were deployed at five sites and set to record from dawn to dusk (10 hours). The detectors were placed on the ground or elevated up to a metre where possible and, pointed upwards at approximately a 45 degree angle. The location of the detectors has been provided in Figure 14.	Golden-tipped Bat, Eastern Bent-wing-bat, Eastern Freetail-bat, Southern Myotis, Yellow-bellied Sheathtail-bat, Greater Broad-nosed Bat.	Large-eared Pied Bat	Yes guidelines met for Large-eared Pied Bat.
Harp Trapping	2 x nights; 02/02/2015 1 x night; 04/02/2015 1 x night; 05/02/2015 2 x nights 04/02/2015	72 hours	Harp traps were deployed overnight along identified flyways along tracks or close to waterways. The location of the harp traps has been provided in Figure 14.			
Diurnal bird surveys (2 hectare)	0.75 hours; 02/02/2015 1 hour; 02/02/2015 1 hour; 03/02/2015 1 hour; 04/02/2015 0.75 hours; 05/02/2015 0.75 hours; 05/02/2015 1.75 hours; 02/03/2015 1 hour; 20/05/2015 2 hours; 21/05/2015 1 hours; 01/08/2018 2 hours: 03/08/2018	27.5 hours	20 minute, 2 hectare bird surveys were extended in time due to relatively low bird activity in most areas and additional species being recorded after or at the end of the typical standard 20 min period. Incidental bird sightings were made throughout surveys activities with species of note being recorded spatially. Birds were identified with the use of 10 X 42 binoculars or from their calls.	All birds	All birds, including Regent Honeyeater	Yes survey guidelines met- Regent Honeyeater – 20 hours over 10 days using area searches.

² See Appendix 8 for further details regarding Commonwealth listed threatened biodiversity



Method	Effort and Timing	Total effort	Details	Target species (NSW)	Target species (Commonwealth)	EPBC species survey guidelines met in relation to Study Area? ²
Reptile survey	20 mins 05/02/2015 45 mins 06/02/2015 25 mins 05/02/2018	90 mins	Random meander turning over surface rocks. Note that such habitat was very restricted and sparse.	Pink-tailed Legless Lizard Striped Legless Lizard Broad-headed Snake Little Whip Snake Rosenberg's Goanna	Pink-tailed Legless Lizard Striped Legless Lizard Broad-headed Snake	Habitat in Study Area limited to non-existent. Survey effort therefore suitable given the lack of habitat present.
Remote Cameras	27 nights x 2 cameras (37,38) 06/02/2015 31 nights x 4 cameras (40,45,39,43) 02/03/2015 27 nights x 3 cameras (41,78,74) 06/02/2015 30 nights x 2 cameras (46,48) 03/02/2015 30 nights x 2 cameras (75,77) 03/02/2015	3,408 hours	Moultrie 990i infrared cameras were deployed. Half of the cameras were baited with a mix of peanut- butter/oats/honey while the other half were baited with sardines. Cameras were placed along animal tracks near water points or other features.	Spotted-tail Quoll, Long- nosed Potoroo, Brush- tail Rock Wallaby, New Holland Mouse.	Spotted-tail Quoll, Brush-tail Rock Wallaby, Long-nosed Potoroo, New Holland Mouse.	Yes – 3.408 hours of trapping is extensive for a range of threatened mammals.
Spotlighti ng	Per ecologist: 30 mins; 03/02/2015 30 mins; 03/02/2015 45 mins; 05/02/2015 30 mins; 03/02/2015 45 mins; 04/02/2015 45 mins; 05/02/2015 2 hours; 02/03/2015 2 hours; 03/03/2015 60 mins 05/02/2018 30 mins 31/08/2018	22.5 hours total	Spotlighting surveys targeting arboreal mammals and nocturnal birds were performed, primarily on foot by two ecologist. Areas near existing access tracks were also surveyed via a slow moving vehicle throughout parts of the Study Area.	Koala, Yellow-bellied Glider, Squirrel Glider, Sooty Owl, Powerful Owl, Masked Owl, Barking Owl, Spotted- tailed Quoll.	Greater Glider, Grey- headed Flying Fox, Koala	Yes – Koala assumed present. No Grey-headed Flying Fox camp site as evident by field inspection. Greater Glider lacks habitat.
Call playback and Owl Listening	3 x 45 minute surveys: 03/02/2015, 05/02/2015 1 x 45 minute survey: 04/2/2015	3 hours	Target species – Powerful Owl, Masked Owl, Sooty Owl, Koala, Yellow-bellied Glider and Sugar Glider. Call- playback sites were established at three locations within the Study Area over the three nights. After an initial listening period of five minutes, calls of the target species were broadcast through a 10 watt megaphone for five minutes followed by a five minute listening period and a period of spotlighting.	Koala, Yellow-bellied Glider, Squirrel Glider, Sooty Owl, Powerful Owl, Masked Owl, Barking Owl.	Koala	Yes – Koala assumed to be present.



Method	Effort and Timing	Total effort	Details	Target species (NSW)	Target species (Commonwealth)	EPBC species survey guidelines met in relation to Study Area? ²
Frog chorus survey and aquatic habitat surveys.	15 mins; 03/02/2015 20 mins; 03/02/2015 30 mins; 05/02/2015 60 mins; 04/02/2015 30 mins; 04/02/2015 3 hours; 02/03/2015 3 hours; 03/03/2015 3 hours; 03/03/2015	11 hours	Frogs were listened for at dams and permanent and ephemeral drainage lines throughout the Study Area. Active searching for frogs using spotlights was also conducted around watercourses. Frog surveys were done outside of the Study area along the Shoalhaven River and its tributaries recognising the potential for indirect impacts through water discharge.	Littlejohn's Tree Frog, Green and Golden Bell Frog, Giant Burrowing Frog.	Littlejohn's Tree Frog, Green and Golden Bell Frog, Giant Burrowing Frog.	Yes – lack of habitat in Study Area.
Stag watching	2 x 30 mins; 03/02/2015 2 x 30 mins; 05/02/2015	2 hours	Trees with hollows or cracks were watched immediately prior to sunset.	Yellow-bellied Glider, Squirrel Glider, Sooty Owl, Powerful Owl, Masked Owl, Barking Owl.		
Koala SAT	3 x surveys; 03/02/2015 1 x survey; 05/02/2015 1 x survey 05/02/2018 1 x survey 02/08/2018	4 hours	SAT (Koala scat) surveys were conducted across the Study Area. In addition to SAT surveys random tree inspections were carried out during traverses of the Study Area at selected feed trees searching for scats and characteristic bark scratches.	Koala	Koala	Yes – Koala assumed to be present.
Opportun istic survey	During all activities	48 hours	Opportunistic observations were made of fauna aided with binoculars and photography as appropriate. Opportunistic survey included searches of habitat such as under logs, rocks or waste piles (where limited areas of such habitat existed) or within heaped leaf litter, casual bird or mammal observations or observations of their calls, including during overnight activities within the Shoalhaven River area, and observations of indirect evidence for certain species such as scats tracks and other traces.	All species	All species	



4.3 Assessment of threatened fauna species and populations

Threatened fauna species predicted or potentially occurring within the IBRA subregion were reviewed. This list was refined post field survey for the development envelope within the BAM Calculator on the basis of the vegetation types, condition and habitat features as well as the results of field survey. The list of predicted and candidate species generated via the BAM Calculator is in Table 8. A status for each species is provided which represents the basis for deciding whether a species was present or absent from the development envelope. No ecosystem credit species were omitted from the BAM Calculator, despite there being very limited or no habitat present within the Site for many of the predicted species.



Table 8: List of predicted and candidate threatened species for the proposed Project

Common Name	Scientific Name	Jan	Feb	Marc	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Status ³
Candidate faun	a species (species cr	edit sp	ecies)											
Regent Honeyeater (Breeding)	Anthochaera phrygia													No – no breeding habitat identified within the Study Area. The species was also not recorded foraging during the survey. The total survey hours exceed the survey guidelines specified in DEWHA (2017). We have also investigation historic records and habitat that aligns to the species as per Bionet
Pink-tailed Legless Lizard	Aprasia parapulchella									Yes	Yes	Yes		No – lack of rocky habitat. Targeted reptile surveys did not record the species.
Gang-gang Cockatoo (Breeding)	Callocephalon fimbriatum	Yes									Yes	Yes	Yes	No – no breeding habitat identified within the Study Area. The species was also not recorded foraging during the survey.
Glossy Black- Cockatoo (Breeding)	Calyptorhynchus Iathami			Yes	Yes	Yes	Yes	Yes	Yes					No – no breeding habitat identified within the Study Area. The species was also not recorded foraging during the survey which was completed during the recommended survey time (November).
Eastern Pygmy- possum	Cercartetus nanus	Yes	Yes	Yes						Yes	Yes	Yes	Yes	No – species not recorded during targeted survey. Unlikely to be present. No previous records within the Study Area. Survey completed during recommended survey time (November).
Large-eared Pied Bat	Chalinolobus dwyeri	Yes	Yes	Yes		Yes – recorded during the field survey.								
Giant Burrowing Frog	Heleioporus australiacus	Yes	Yes	Yes	Yes	Yes				Yes	Yes	Yes	Yes	No – no habitat present within the Study Area (lack of fringing vegetation along the Marulan Creek. No tadpoles recorded in the proposed Marulan Creek Dam Inundation Area to the north of the site. No tadpoles recorded during the targeted amphibian survey.
Little Eagle (Breeding)	Hieraaetus morphnoides								Yes	Yes	Yes			No – no breeding habitat identified within the Study Area. The species was also not recorded foraging during the survey.
Broad- headed Snake (breeding)	Hoplocephalus bungaroides									Yes	Yes			No – lack of preferred habitat present for the species. Reptile surveys completed during recommended survey period (November)

 $^{\rm 3}$ As determined by Bam calculator



Common Name	Scientific Name	Jan	Feb	Marc	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Status ³
Southern Brown Bandicoot (eastern)	Isoodon obesulus obesulus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No – not detected during the field survey which was completed during the recommended survey period (all year). No previous records at the site.
Swift Parrot (Breeding)	Lathamus discolor					Yes	Yes	Yes	Yes					No – no breeding habitat identified within the Study Area. The species was also not recorded foraging during the survey. Surveys completed during the recommended survey time (August).
Booroolong Frog	Litoria booroolongensis											Yes	Yes	No –habitat present within the Study Area is marginal at best for the species. Marulan Creek does not contain fringing native vegetation, lacks flow unless after heavy rain, and lacks rocky outcrops. Tadpoles not recorded during the targeted amphibian survey.
Little Bentwing-bat (Breeding)	Miniopterus australis	Yes	Yes										Yes	No – no breeding habitat identified within the Study Area. The species was also not recorded foraging during the survey.
Eastern Bentwing-bat (Breeding)	Miniopterus schreibersii oceanensis	Yes	Yes									Yes	Yes	No – no breeding habitat identified within the Study Area. The species was also not recorded foraging during the survey.
Stuttering Frog	Mixophyes balbus	Yes	Yes	Yes						Yes	Yes	Yes	Yes	No – No habitat present. No rainforest wet forest or tall open forest present at Marulan Creek.
Barking Owl (Breeding)	Ninox connivens					Yes	No – species not detected during targeted surveys completed during recommended survey period. No evidence at the base of trees of the presence of the Barking Owl. No large hollows recorded in the Study Area.							
Powerful Owl (Breeding)	Ninox strenua					Yes	Yes	Yes	Yes					No – no breeding hollows (Powerful Owls nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old)) were recorded within the Study Area. Species not recorded during targeted surveys.
Squirrel Glider	Petaurus norfolcensis	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No – not detected during survey.
Brush-tailed Rock-wallaby	Petrogale penicillata	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No – not detected during survey. No records within locality. Unlikely to be present.
Pink Robin	Petroica rodinogaster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No – not detected during survey. No records within locality. Unlikely to be present.



Common Name	Scientific Name	Jan	Feb	Marc	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Status ³
Koala	Phascolarctos cinereus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Not recorded during the field survey, however is known to occur within the locality. It may use the habitat features of the Study Area. The Koala is therefore considered further in the impact assessment.
Grey-headed Flying-fox (Breeding)	Pteropus poliocephalus										Yes	Yes	Yes	No – no camp sites present.
Masked Owl (Breeding)	Tyto novaehollandiae					Yes	Yes	Yes	Yes					No – no breeding habitat (Living or dead trees with hollows greater than 20cm diameter) identified within the Study Area. The species was also not recorded foraging during the targeted survey.
Predicted threatened species (ecosystem credit species)														
Regent Honeyeater	Anthochaera phrygia	Spec	ies pre	dicted to	occur,	and the	refore	do not	require	e target	ed surv	vey		Assumed present
Gang-gang Cockatoo	Callocephalon fimbriatum													Assumed present
Glossy Black- Cockatoo	Calyptorhynchus Iathami													Assumed present
Speckled Warbler	Chthonicola sagittata													Assumed present
Brown Treecreeper (eastern subspecies)	Climacteris picumnus victoriae													Assumed present
Varied Sittella	Daphoenositta chrysoptera													Assumed present
Spotted- tailed Quoll	Dasyurus maculatus													Assumed present
Eastern False Pipistrelle	Falsistrellus tasmaniensis													Assumed present
Little Lorikeet	Glossopsitta pusilla													Assumed present



Common Name	Scientific Name	Jan	Feb	Marc	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Status ³
Painted Honeyeater	Grantiella picta													Assumed present
Little Eagle	Hieraaetus morphnoides													Assumed present
Broad- headed Snake	Hoplocephalus bungaroides													Assumed present
Swift Parrot	Lathamus discolor													Assumed present
Hooded Robin (south- eastern form)	Melanodryas cucullata													Assumed present
Black- chinned Honeyeater (eastern subspecies)	Melithreptus gularis gularis													Assumed present
Little Bentwing-bat	Miniopterus australis													Assumed present
Eastern Freetail-bat	Mormopterus norfolkensis													Assumed present
Turquoise Parrot	Neophema pulchella													Assumed present
Barking Owl	Ninox connivens													Assumed present
Powerful Owl	Ninox strenua													Assumed present
Yellow- bellied Glider	Petaurus australis													Assumed present
Scarlet Robin	Petroica boodang													Assumed present
Flame Robin	Petroica phoenicea													Assumed present
Koala	Phascolarctos cinereus													Assumed present



Common Name	Scientific Name	Jan	Feb	Marc	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Status ³
Long-nosed Potoroo	Potorous tridactylus													Assumed present
Grey-headed Flying Fox	Pteropus poliocephalus													Assumed present
Yellow- bellied Sheathtail- bat	Saccolaimus flaviventris													Assumed present
Greater Broad-nosed Bat	Scoteanax rueppellii													Assumed present
Diamond Firetail	Stagonopleura guttata													Assumed present
Little Whip Snake	Suta flagellum													Assumed present
Masked Owl	Tyto novaehollandiae													Assumed present
Rosenberg's Goannna	Varanus rosenbergi													Assumed present



4.4 Fauna habitat

Numerous sources of disturbance operate throughout most of the Study Area, which have impacted upon the condition of fauna habitat. Disturbances include:

- Selective clearing which has occurred throughout all accessible areas of the Study Area, with timber being used historically to fuel furnaces in the Marulan area (pers. comm. Rod Wallace Boral). As a result, all trees were of similar ages, and the understorey had been extensively cleared. Large hollow-bearing logs were very sparse due to the prior clearing events.
- Weed invasion weeds range in their density across the Study Area from moderately sparse in the dry sclerophyll shrubby vegetation types to common throughout the Study Area within grassland habitat. The weed spread is in response to levels of grazing or other disturbance factors. Infestations of Serrated Tussock (*Nassella trichotoma*) were common throughout the entire Study Area, with higher concentrations in the open grass areas. This has greatly contributed to the relatively low site values scores associated with the PCTs.
- Historic cattle grazing as such, the ground cover is a mix of native and introduced pasture species.
- Macropod grazing a high level of macropod grazing was observed in open grass areas. As such, much of the native ground cover within these areas were sparse in composition and species richness.
- Feral animals feral animals were common throughout the entire Study Area. Rabbits and Brown Hares are moderately common throughout most of the Study Area. Feral goats have also been sighted in the Study Area by Niche and known to occupy the Study Area on a regular basis.

The following broad fauna habitat types occur across the Study Area:

- Grassy Woodlands
- Dry Sclerophyll Forests (with a shrubby/grass understorey)
- Aquatic Habitat (creeks and dams).

Grassy Woodlands

Grassy Woodland areas within the proposed emplacement areas are dominated by PCT1334 Yellow Box -Blakely's Red Gum grassy woodland (SR670) (Photo 1). Habitat within these areas is variable in response to previous disturbance. Where there is consistent canopy cover, trees are predominantly young mature trees or advanced regeneration, however large trees occur sporadically.

Acacia thickets are common in areas where there has been recent soil disturbance. The shrub layer is typically limited in density and diversity throughout.

There are occasional tree hollows and logs associated with larger trees however such features are uncommon and hollows are generally limited to small size classes (< 20 cm in diameter, frequently 5 to 10 cm).

Dry Sclerophyll Forests

The Dry Sclerophyll Forests of the Study Area vary in character from the lower elevation slopes and gullies to higher elevation areas (Photo 2). Lower areas primarily support a naturally higher cover of woody shrubs within the understorey and groundcover, and there has been limited to no disturbance from grazing cattle. Such areas have been previously logged however, which has limited the development of large hollow bearing trees and presence of large logs.



Higher areas of Dry Sclerophyll Forests within the Study Area are naturally more open and grassy and have also typically experienced greater levels of disturbance through grazing, diminishing the availability of fauna habitats, particularly shelter for ground-dwelling mammals.

Aquatic Habitat

A number of dams occur within the Study Area, which are typically less than 0.15 hectares in size. The dams differ in their shape and depth and accordingly the quantity and diversity of aquatic macrophyte and shallow benthic habitat. Such habitat is important in determining the diversity and abundance of vertebrate fauna. In general terms the dams are typical of farm dams in the area and include small areas of fringing low diversity aquatic macrophyte assemblages within their shallows. The dams would play a role in water supply for vertebrate fauna and may act as foraging habitat for bats, birds and frogs.

The ephemeral creeks throughout the Study Area do not support permanent pools. Water from the minor ephemeral watercourses within the Study Area is either diverted to small dams or percolates through the underlying bedrock.

Marulan Creek, which occurs within the proposed Marulan Creek Dam Inundation Area, provides an area of semi-permanent pooling (Photo 3). These areas are generally occupied by native water logged species including: *Typha orientalis, Phragmites australis, Cynodon dactylon,* Juncus species, and *Cyperus polystachyos.* These areas provide habitat for common amphibians identified during the field survey including: Beeping Froglet, Common Eastern Toadlet, Clicking Froglet, Spotted Marsh Frog and Striped Marsh Frog.

Targeted amphibians surveys were conducted within Bungonia Creek, Shoalhaven River and Barber's Creek. These areas provided a range of habitat conditions, including larger permanent water bodies along Shoalhaven River, and intermittent flows along Barber's Creek. The survey recorded common amphibians including: Beeping Froglet, Clicking Froglet, Spotted Marsh Frog, and Striped Marsh Frog. The results of the targeted survey further grounded the conclusion that habitat for threatened amphibians – Giant Burrowing Frog, Green and Golden Bell Frog and Littlejohn's Tree Frog, which have the potential to occur within 10 km of the Study Area (based on database searches), were unlikely to be present in the survey area.





Photo 1. Grassy woodland habitat with a mix of *Eucalyptus bosistoana, E. melliodora, E. blakelyi* and *E. eugenioides*.



Photo 2. Gully forest habitat dominated by a mix of *Eucalyptus bosistoana* and Red Gums (*E.tereticornis/E.blakelyi X*)





Photo 3. Marulan Creek and the surrounding paddock grassland which is currently grazed

4.4.1 Condition of habitat

Numerous sources of disturbance operate throughout most of the Study Area, which have impacted upon the condition of fauna habitat. Disturbances include:

- Selective clearing which has occurred throughout all accessible areas of the Study Area, with timber being used historically to fuel furnaces in the Marulan area (pers. comm. Rod Wallace Boral). As a result, all trees were of similar ages, and the understorey had been extensively cleared. Large hollow-bearing logs were very sparse due to the prior clearing events.
- Weed invasion weeds range in their density across the Study Area from moderately sparse in the dry sclerophyll shrubby vegetation types to common throughout the Study Area within grassland habitat. The weed spread is in response to levels of grazing or other disturbance factors. Infestations of Serrated Tussock (*Nassella trichotoma*) were common throughout the entire Study Area, with higher concentrations in the open grassy paddocks.
- Cattle grazing the proposed site of the Western Overburden Emplacement is currently, and historically been used for cattle grazing. As such, the ground cover is a mix of native and introduced pasture species.
- Macropod grazing a high level of macropod grazing was observed in open grassy areas, such as the proposed Northern Overburden Emplacement and Western Overburden Emplacement. As such, much of the native ground cover within these areas were sparse in composition and richness.
- Feral animals feral animals were common throughout the entire Study Area. Rabbits and Brown Hares are moderately common throughout most of the Study Area. Foxes were identified at nine of 12 camera sites where fauna was recorded, indicating their widespread presence throughout the Study Area; whereas a single cat was recorded. Feral goats have also been sighted in the Study Area (pers. comm. Grant Thompson Boral). These introduced predators, coupled with the low abundance of available sheltering habitat (such as hollow logs) may have led to a decreased abundance and diversity of small and medium sized ground dwelling mammals (section 4.5).

4.4.2 Connectivity of fauna habitat

From a regional perspective, the habitats within the Study Area are connected to extensive expanses of vegetation associated with the Shoalhaven gorge to the south and east in Bungonia State Conservation Area and Morton National Park. The land to the west, is predominantly cleared for agriculture. However, scattered patches of native vegetation occur across the tableland areas, some of which is connected to the



Study Area. The Study Area has some capacity to act as a linkage between the vegetated reserve areas and the patchy vegetation of the tablelands.

The Study Area does not form part of any national landscape corridors (SEWPaC, 2012a) and no identified OEH wildlife corridors occur within the vicinity of the Project site.

Vegetation clearing for the Project would contribute to some fragmentation of fauna habitat, in particular though the combination of the Northern Overburden Emplacement and Western Overburden Emplacement reducing the connectivity width to patches of vegetation to the north-west. The amount of contiguous bushland remaining, however, means that most of the surrounding native vegetation cover would remain physically connected.

Connectivity losses would occur for the life of the Mine with connectivity being progressively reinstated during Mine rehabilitation. However, the landforms reinstated during rehabilitation are likely to be a less favourable linkage for some fauna species due to their topography, heterogeneity and reduced quality in some areas. More mobile species, such as birds and bats, without highly specific habitat requirements (at least for certain lifecycle aspects) are likely to be most effective at using reinstated linkages.

Vegetation to be disturbed for the proposed Marulan Creek Dam proposed Marulan Creek Dam Inundation Area is unlikely to result in an increase in loss of connectivity given the relatively narrow linear disturbance, and that the proposed area is predominantly cleared paddocks. No other riparian linkages would be impacted by the Project.



4.5 Fauna recorded during field surveys

Fauna field surveys using the methods described in section 4.1 were undertaken in each of the identified habitats, with the suite of methods employed in each habitat type dependant on the potential presence of subject threatened fauna within that habitat type. Notable opportunistic sightings whilst travelling within the Study Area were also recorded. A complete species list is provided in Appendix 5.

A total of 132 species were recorded during field surveys from the Study Area and surrounds, comprising seven reptile, 34 mammal, two fish, 79 bird and 10 frog species.

A suite of these species were present only outside of the Study Area (for example within Bungonia Gorge) where condition of vegetation there presented a greater availability of fauna microhabitats in comparison to the Study Area. For example, greater log and tree hollow abundance, lack of weeds, older vegetation growth and better connectivity. It is believed that many of these species recorded within the Bungonia Gorge would be unlikely to be found in the Study Area with any regularity due to disturbance factors or lack of habitat availability.

There was a low abundance of native small ground-dwelling and arboreal mammals recorded during infrared camera and spotlighting surveys. It is difficult to make comparisons regarding species richness observed between proposed disturbance areas and nearby areas with better condition vegetation, since survey effort was biased towards disturbance areas in order to detect potentially occurring threatened species that could be impacted by the Project.

Some mobile species recorded would primarily be dependent on the adjacent woodland areas but would take advantage of parts of the Study Area to forage (e.g. common Wallaroo, Large-eared Pied Bat).

A high number of feral species were observed in the Study Area, including goats, rabbits, hares and feral cats. A flock of goats (approximately 35 goats) were recorded at the Northern Overburden Emplacement during the during the July 2018 field survey. According to Grant Thompson (Boral – Environmental officer), the goats have been in the Study Area most days since the start of 2018. It is noted that goats have been present within the current Mine and Study Area for many years. Goat culling within the adjacent national parks to the east and to the suth is a regular activity carried out by the NSW Department of Primary Industries (DPI). Hares and foxes were also frequently recorded in the Study Area during the field surveys.

4.5.1 Threatened fauna

A total of 19 threatened fauna species were recorded during all field surveys in and around the Study Area (Table 9, Figure 15). Seven of these species, including the Large-eared Pied Bat, Greater Broad-nosed Bat (possible recording), Eastern Bent-wing Bat, Yellow-bellied Sheath tail Bat, Eastern Free-tail Bat, Scarlet Robin and Diamond Firetail, were recorded in or immediately adjacent to the proposed disturbance area. The remaining 12 threatened species (Glossy Black Cockatoo, Koala, Southern Myotis, Eastern False Pipestrelle, Rufous Fantail, Grey-headed Flying Fox, Golden-tipped Bat, Powerful Owl, Sooty Owl, Turquoise Parrot, Yellow-bellied Glider and Varied Sittella) were recorded outside of the Study Area, mainly within the habitat features of Bungonia Gorge and the Shoalhaven River.

All threatened species recorded are listed as vulnerable threatened species under the BC Act, and three species (Large-eared Pied Bat, Grey-headed Flying Fox and Koala) are also listed as vulnerable under the EPBC Act. The Rufous Fantail is also listed as Migratory under the EPBC Act.

As provided in Table 9, only the Koala, Large-eared Pied Bat and Southern Myotis are regarded in the BAM as 'species credit' fauna which would require biodiversity offsetting if the habitat features of these species



are present and/or habitat features would be impacted by the Project. The Eastern Cave Bat, Glossy Blackcockatoo, Powerful Owl and Sooty Owl and Grey-headed Flying Fox are regarded as 'dual credit' species' with the species credit component only triggered if breeding habitat is present. The remainder of the species are regarded as 'ecosystem credit' species, which are assumed to have habitat within the vegetation types of the Study Area.

Only the Large-eared Pied Bat was recorded within the Study Area at three locations where anabat and harp traps were established. The Koala and Southern Myotis were recorded outside of the Study Area, within areas containing habitat that was well intact.

The Koala, despite not being recorded in the Study Area, has been considered further in this impact assessment due to the presence of Koala feed trees within the Study Area, and the known Koala population that occurs within Bungonia Gorge (section 4.6.2).

The Southern Myotis was not detected in the anabat and harp traps within the Study Area. This could be attributed to the lack of waterways within the Study Area for which the species uses for foraging habitat. The BioNet Atlas specifies that land within 200 metres of watercourses which contains pools greater than 3 metres in width, should be mapped and be considered further in relation to the Southern Myotis area of habitat. However, within the Study Area, only the site of the proposed Marulan Creek Dam Inundation Area along Marulan South Creek contains a watercourse with sporadic pools. Vegetation within this area is predominately non-native open pasture, and as such, does not provide the surrounding foraging habitat suitable for this species. Furthermore, the creek and pools would still be present following development, as the Project would not result in the drying of the creek and water flow. Given these reason, the species has not been considered further in this impact assessment.

The Eastern Bent-wing Bat has been regarded as an ecosystem credit species for this assessment, as breeding habitat, which triggers the 'species credit' component, was absent from the Study Area. Breeding habitat as listed on the NSW BioNet Atlas includes: caves, tunnels, mines or other structures known or suspected to be used by the species. None of these features would be impacted by the Project, and as such does not trigger the 'species credit' component. Given the Eastern Bent-wing Bat has been nominated in the SEARs for further consideration, further assessment has been provided in section 4.6.3 despite it being an ecosystem credit species.

Similarly, the Grey-headed Flying Fox was not recorded during the field survey, and the 'species credit' component is only triggered where there are breeding camp sites. As no breeding camp sites were located within the Study Area, the species has been regarded as an ecosystem credit species in this assessment.

A number of additional threatened fauna have the potential to occur within the Study Area but were not recorded, most likely due to their potential use of the Study Area or wider locality being limited to sporadic occurrences (e.g. nomadic birds) (Appendix 1).

Scientific Name	Common Name	BC Act	EPBC Act	Location and expected use of Study Area	Species credit or ecosystem credit species
Stagonopleura guttata	Diamond Firetail	v	-	Northern Overburden Emplacement Area and east and west of Study Area. Would likely use parts of the Study Area regularly. Preference for Box Gum Woodland.	Ecosystem
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	v	-	Recorded throughout Study Area and adjacent areas where bat survey was	Dual credit species - Ecosystem/Species credit requirement.

Table 9. Threatened fauna recorded during the survey



Scientific Name	Common Name	BC Act	EPBC Act	Location and expected use of Study Area	Species credit or ecosystem credit species
				conducted. Would likely use the Study Area to forage regularly.	The Species credit component is only triggered if breeding habitat is present. No breeding habitat is present in the Study Area, nor would any be impacted by the Project. As such, the species is regarded as an Ecosystem credit species.
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	v	-	Possible recording from Western Overburden Emplacement. If present may use Study Area with some regularity for foraging but likely in low numbers.	Ecosystem
Scoteanax rueppellii	Greater Broad-nosed Bat	v	-	Single possible recording from Western Overburden Emplacement. If present may use Study Area with some regularity for foraging but likely in low numbers.	Ecosystem
Chalinolobus dwyeri	Large-eared Pied Bat	v	v	Recorded throughout the Study Area and adjacent areas where bat survey was conducted. Would likely use the Study Area to forage regularly.	Species
Petroica boodang	Scarlet Robin	v	-	Recorded between Western Overburden Emplacement and Northern Overburden Emplacement. Expected to occur throughout woodland/forest areas.	Ecosystem
Mormopterus norfolkensis	Eastern Freetail Bat	v	-	Recorded between Western Overburden Emplacement and Northern Overburden Emplacement. Expected to occur throughout woodland/forest areas.	Ecosystem
Threatened fauna recor					
Falsistrellus tasmaniensis?	Eastern False Pipistrelle	v	-	Recorded to the west of the Study Area in Box Gum Woodland. If present would be expected to forage in the Study Area on occasion.	Ecosystem
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Recorded within Bungonia Gorge. Would be expected to forage in the Study Area on occasion.	Ecosystem / dual credit species with species credit component attributed the species being triggered if breeding habitat in living or dead tree with hollows greater than 15cm diameter and greater than 5m above ground occurs. These attributes were absent from the Study Area and therefore the Glossy Black- cockatoo is an ecosystem credit species.
Kerivoula papuensis	Golden-tipped Bat	v	-	Recorded to the south of disturbance areas. If present would be expected to forage in the Study Area, but rarely.	Ecosystem
Myotis macropus	Southern Myotis	v	-	Not recorded within the Study Area. Was recorded within the Bungonia Gorge outside the area to be impacted by the Project.	Species



Scientific Name	Common Name	BC Act	EPBC Act	Location and expected use of Study Area	Species credit or ecosystem credit species
Pteropus poliocephalus	Grey-headed Flying-fox	v	V	Expected to forage in the Study Area.	Species credit requirement (breeding/roost habitat) is absent from Study Area. Therefore is regarded as ecosystem credit species.
Phascolarctos cinereus	Koala	V	V	Previous reliable anecdotal evidence of Koalas from disturbance areas but would have limited use of such areas or comprise a very small number of individuals (e.g. a single Koala).	Species
Tyto tenebricosa	Sooty Owl	V	-	Could potentially forage in the Study Area, but rarely.	Ecosystem / dual credit species with species credit component attributed the species being triggered if breeding habitat in Living or dead trees with hollow greater than 20cm diameter occurs in the Study Area. These attributes were absent from the Study Area and therefore the species is an ecosystem credit species.
Ninox strenua	Powerful Owl	V	-	Could potentially forage in the Study Area.	Ecosystem / dual credit species with species credit component attributed the species being triggered if breeding habitat in Living or dead trees with hollow greater than 20cm diameter occurs in the Study Area. These attributes were absent from the Study Area and therefore the species is an ecosystem credit species.
Rhipidura rufifrons	Rufus Fantail	-	Μ	Recorded adjacent to the Study Area. Has a broad habitat preference and may utilise the site occasionally for foraging.	-
Neophema pulchella	Turquoise Parrot	v	-	Could potentially forage in the Study Area, but rarely.	Ecosystem
Daphoenositta chrysoptera	Varied Sittella	v	-	Recorded and expected to use the Study Area with some regularity given proximity and frequency of records in similar habitat.	Ecosystem
Petaurus australis	Yellow-bellied Glider	v	-	Could potentially forage in disturbance areas, but rarely.	Ecosystem

4.6 Species credit fauna

As discussed in section 4.5.1, the survey resulted in only one species credit fauna being recorded within the Study Area: the Large-eared Pied Bat. The Koala, due to the presence of feed trees and proximity to the Koala population of Bungonia Gorge, has also been considered further as discussed below.



4.6.1 Large-eared Pied Bat habitat in the Study Area

The Large-eared Pied Bat was recorded at all of the anabat survey locations within, and adjacent to the Study Area. As such, portions of native vegetation within the Study Area have been considered foraging habitat for the species.

Not a significant amount of information is known about the Large-eared Pied Bat, however, as indicated on the BioNet Atlas, the species is regarded as a 'species credit' species as it cannot be reliably predicted to occur on a site based on vegetation and other landscape features.

Breeding habitat, which as described on the BioNet Atlas as including PCTs associated with the species within 100m of rocky areas containing caves, overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings. As the site, does not occur within 100 metres of any of these features known to contain the species, breeding habitat is unlikely to be present within the Study Area.

One cave is known to occur within 900m of the Study Area, known as Main Gully Spring (Bauer and Bauer 1998). The cave is located beneath the Mine and in periods of high discharge this cave acts as an overflow. A number of chambers and tunnels are described as occurring in this cave by Baeuer and Bauer (1998) including a chamber 1 m x 2.7 m wide.

Main Gully Spring is a potential bat roosting site. It could not be inspected during the current field survey due to safety and access issues. However, a site inspection by Boral representitives accompanied by an experienced caver was undertaken in August 2017 at the base of the cave, and approximately 10 meteres inside the entrance. During the site inspection, approximately 5 microbats were observed. It was not possible to determine the species from photographs that were provided. As such, it is not possible to state with certainty that a maternal roost could not be established for Large-eared Pied Bat.

Whilst microbats were recorded it is unlikely that long-term maternity roosts would be established in the Main Gully Spring cave due to its limited size and occasional inundation of most, if not all parts of the cave in times of high flow.

Regardless of whether bat roosting or breeding occurs within the cave, it is highly unlikely that the Main Gully Spring Cave would experience any impact associated with the Project. This is due to the distance of the subject cave from the Mine expansion activities that involve mining and blasting which is to occur over 900 metres to the north. There has been an ongoing history of mining within the existing south pit throughout which any roosting bats would have persisted if present. The Project is not forecast to increase noise or vibration to the subject cave or any other known caves in the locality.

The Large-eared Pied Bat is known to forage in a range of vegetation types, including dry and wet sclerophyll forest, grassy woodland, Callitris dominated forest, tall open eucalypt forest with a rainforest sub-canopy, sub-alpine woodland and sandstone outcrop country (Hoye & Dwyer 1995; Pennay 2002; DECC 2007). Foraging habitat on fertile soils (or within fertile valleys) is also considered an important overall requirement for the Large-eared Pied Bat (Pennay 2008), however the species has been recorded extensively within sandstone associated vegetation, indicating that whilst foraging habitat on fertile soils is likely to be important, foraging would by no means be confined to such areas.

As such, the area of foraging habitat within the Study Area includes PCTs with a 'moderate condition' class, and 'Acacia condition' class. PCTs that have been assigned a 'poor' or 'non-EEC water dependant' condition class have been excluded from the foraging habitat given these habitat types are not described in BioNet Atlas nor the Recovery Plan as being areas of important foraging. Approximately 140.3 ha of habitat for the



Large-eared Pied Bat has therefore been mapped within the Study Area. This area has been regarded in this assessment as the Species polygon for the Large-eared Pied Bat, which has been addressed later in the report to generate the species credit required for the Project.

The impacts to foraging habitat for the Large-eared Pied Bat are discussed further in section 6.2.4.

4.6.2 Koala habitat in the Study Area

Surveys and collection of anecdotal evidence of Koala sightings conducted within the Study Area and surrounds as part of this assessment revealed that Koalas have been sighted sporadically within the south of the Project site over the past decade, with a Koala observed every 2-3 years around the Mine (pers. comm. Grant Thompson – Boral).

Scat surveys, spotlighting, call-playback and tree surveys did not identify repeated or on-going use of trees within any of the proposed development areas, however a single Koala was recorded whilst spotlighting to the east of the existing Mine (outside of direct impact area) and multiple Koalas was heard bellowing during aquatic surveys of Bungonia Gorge during November 2014 (Figure 15). Summarily, whilst it is known that Koalas occur within proposed development areas to the west of the existing Mine and that a variety of feed trees exist within them, it is likely that very low densities of Koalas occur, or that Koalas use the areas only whilst moving through the landscape.

There are 137 Koala records from the Bionet Atlas within a 10 km radius of the Study Area (Figure 16). The majority of these records (105) are from the Bungonia National Park and Bungonia State Conservation Area (SCA) which occur approximately 1 - 4 km south of the Project site. The large number of records from the Park can largely be attributed to establishment of a monitoring program based on park visitors and staff reporting Koala sightings. However, the program has not allowed for a reliable estimate of Koala numbers in the area (pers. comm. Audrey Kutzner NSW NPWS). Nonetheless the area where the majority of Koala records occur is considered one of the primary known active sites for a Koala population centred along the Shoalhaven Gorge and extending approximately 40 km to the south of the Study Area towards Nerrigan and approximately 30 km east towards Tallowa Dam (Allen 2002). The population area encompasses large areas of Morton National Park. Within the Shoalhaven Gorge population area, it has been estimated that some 7,500 ha of secondary koala habitat exists (the same habitat status as habitat within the Project site under the classification scheme used within Allen 2002), supporting between 80 and 150 Koalas (Allen 2002). The Shoalhaven Gorge Koala population was described as a low-density population utilising secondary habitat, spread at least in patches and consisting of breeding associations linked by the movements of dispersing young (Allen 2002). Of direct relevance to the Project site, it was noted that west of the gorge human disturbance is greater and that Koala densities may be very low in such areas (Allen 2002).

North and west of the protected areas around the Bungonia and Shoalhaven gorges Koala records within the Bionet Atlas are very limited, with sporadic observations from private land and along roadsides, one being from the Mine and two additional records (including road-kill) each from around the townships of Marulan and Tallong. These areas are more disturbed predominantly private tenure. They generally have been developed traditionally for agriculture. It is clear that Koalas are able to travel through such areas and feed trees, including primary feed trees, are available to them throughout such areas. Targeted Koala survey in these areas (private land on the tablelands) is likely to have been minimal and therefore actual Koala distribution and abundance within such areas is poorly known. Therefore, whilst it is acknowledged that limits exist regarding predictions of Koala distribution and abundance within the locality, given previous disturbance resulting in fragmented vegetation, and the lack of Koala records within the higher elevation areas away from the protected areas around the Bungonia and Shoalhaven gorges, it is



considered unlikely that active Koala areas (with permanent and moderate to high densities of Koalas) such as those within the Bungonia National Park/SCA would extend into the Project site.

Whilst the Koala was not recorded within the Study Area during the targeted surveys, it is recognised given previous sightings throughout the locality, that the Koala may use the habitat features of the Study Area on occasion. In order to determine the area of habitat within the Study Area that the Koala may utilise, the area of occupancy has been determined by considering the density and composition of preferred feed trees listed as primary, secondary and tertiary feed species under the National Recovery Plan for the Koala (DEC 2008). Occupiable habitat was considered as areas where either two or more known feed tree species occurred, or a single feed species occurred and occupied more than 50% of the canopy cover within a 400 m² floristic quadrat. Highly disturbed and substantially cleared areas were excluded as habitat.

The area of habitat has been split into areas deemed poor/unsuitable (very limited use/if any), moderate (contains Koala feed trees however is limited in movement due to steepness of terrain), and good (containing Koala feed trees with relatively limited obstacles in regards to movement). The Koala has therefore been attributed to an area of 132.4 ha of occupiable habitat within the Study Area (Figure 16). This area has been regarded in this assessment as the Species polygon for the Koala, which has been addressed later in the report to generate the species credits required for the Project.

4.6.3 Eastern Bent-wing Bat

The Eastern Bent-wing Bat was identified in the SEARs as a species requiring further consideration.

Eastern Bent-wing Bats were recorded frequently during echolocation surveys within the area surveyed, occurring at all sites where recordings were made (Appendix 5). Nightly Eastern Bent-wing Bat recordings showed consistent arrival and departure times with bats typically recorded from around 8:20 pm in the evening until 5:50 am the following morning during the survey in early February 2015. It is expected that the majority of recorded bats arrived from the Drum Cave roost site where exit times for bats between the 10th and the 12th of February in 2004 were concentrated from 8:00 pm to 8:45 pm with a peak around 8:15 – 8:30 pm (Law and Chidel 2004).

The Study Area is situated approximately 3.7 km north of a major breeding cave and maternity roost for the Eastern Bent-wing-bat known as Drum Cave. Drum cave is one of four known major maternity roosts for the species and is suspected contain between 10,000 and 15,000 individual bats (Law and Chidel 2004). Other caves in the vicinity are known to act as roost habitat for Eastern Bent-wing Bats, however maternity roosts have not been recorded in surrounding caves.

As discussed previously in relation to the Large-eared Pied Bat, Main Gully Spring (Bauer and Bauer 1998) which occurs within 900 m of the Study Area is unlikely to contain long-term roosting due to the water inundation within the cave. It is assumed unlikely that long-term maternity roosts would be established in Main Gully Spring due to its limited size and occasional inundation of most if not all parts of the cave in times of high flow. However, given the lack of previous survey of this cave, it is not possible to state with certainty that a maternal roost could not be established for Eastern Bent-wing bat within Main Gully Spring. Regardless, as is the case with the Large-eared Pied Bat, the cave is located away from the Study Area and would not experience any impact associated with the Project. This is due to the distance of the subject cave from the Mine expansion activities that involve mining and blasting which is to occur over 900 metres to the north.

Foraging habitat for Eastern Bent-wing Bat would be similar to that of the Large-eared Pied Bat, occupying 140.3 ha within the Study Area. Foraging habitat in the locality is considered important for the Eastern



Bent-wing Bat due to the large population dependant on the roost site known from the area (Drum Cave). While foraging habitat of the type to be removed is considered important for both species, such habitat is considered locally common and the quantity of habitat to be removed is not considered critical to the overall species survival or the local occurrence of the species. It is estimated that 33, 837 ha of native vegetation exists within the locality of the Study Area (within a 10 km radius of the Project site). Regardless, the 'species credit' component associated with this species is only triggered with impacts to breeding features (such as caves, tunnels, mines, culverts or other structures known or suspected to be used for breeding). As such, Eastern Bent-wing Bat is regarded as an 'ecosystem credit' species for this assessment.

4.7 EPBC Act listed fauna

A total of 35 EPBC Act listed fauna were considered in the assessment based on the database reviews detailed in section 4.1.

As discussed in section 4.5, during the field survey four threatened fauna listed on the EPBC Act were recorded:

- Koala Recorded outside of the Study Area during general habitat assessment for the Project. The Koala was recorded on a Eucalyptus punctata. Multiple Koalas were also heard bellowing during aquatic and amphibian surveys of Bungonia Gorge during November 2014 (Figure 15).
- Large-eared Pied Bat Recorded throughout the Study Area and adjacent areas where anabat and harp traps were deployed. Given the records at each anabat, it seems likely that the species would use the Study Area to forage regularly.
- Grey-headed Flying Fox Recorded outside of the Study Area during aquatic and amphibian surveys of Bungonia Gorge during November 2014 (Figure 15)
- Rufous Fantail recorded outside of the Study Area near Bungonia Gorge during general habitat surveys (Figure 15).

The field survey and the results of the likelihood of occurrence (Appendix 1) concluded that following Commonwealth threatened fauna may also utilise the Study Area:

- Vulnerable species: Koala, Grey-headed Flying-fox, Large-eared Pied Bat
- Migratory Species (marginal usage): Great Egret, Cattle Egret, Rainbow Bee-eater, Black-faced Monarch, Rufous Fantail.

It should be noted that the Regent Honeyeater was also identified in correspondence by the Department of Environment and Energy (DoEE) as likely to utilise the Study Area. Despite our assessment concluding low likelihood for occurrence, we have conservatively assessed the potential for the species to use the Study Area.

A discussion regarding the usage of the Study Area by the above Commonwealth listed threatened fauna has been provided in Appendix 8.

4.8 EPBC Act – Migratory Species

A total of 16 EPBC Act listed Migratoy species were considered in the assessment based on the database reviews detailed in section 4.1. During the field survey, no migratory species listed under the EPBC Act were recorded within the Study Area, however the Rufous Fantail was recorded to the far south near Bungonia Gorge (immediately outside of the Study Area).



A number of listed migratory species have been recorded from the locality and in some cases have the potential to fly over the Study Area (see Appendix 1). Species that may occasionally forage within the Study Area include: Cattle Egret, Rainbow Bee-eater, Black-faced Monarch, and Rufous Fantail.

A discussion on each of these species in regards to the Commonwealth Assessment Criteria has been provided in Appendix 8.

4.9 State Environment Planning Policy 44 – Koala Habitat

The State Environment Planning Policy 44 – Koala Habitat (SEPP 44) aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline:

(a) by requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat, and

(b) by encouraging the identification of areas of core koala habitat, and

(c) by encouraging the inclusion of areas of core koala habitat in environment protection zones.

SEPP 44 Koala habitat applies to Local Government Areas (LGAs) listed in Schedule 1 of SEPP 44, and where the development has an area of more than 1 hectare.

The Study Area occurs within the Goulburn Mulawaree Local Government Area (LGA) which is not listed in Schedule 1 of SEPP 44. However, the Mulawaree LGA is listed in Schedule 1 which was amalgamated with Goulburn LGA in 2004. As such, the SEPP applies to the Study Area.

Under SEPP 44, potential Koala habitat includes: 'areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component'. Of the Trees listed in Schedule 2, only Eucalyptus tereticornis and E. viminalis applies to the Study Area. However it should be noted that E. tereticornis is likely a hybrid in the Study Area with E. blakelyi X. These trees are scattered throughout the Study Area amongst E. bosistiana, E. melliodora and E. eugeniodes. The trees would meet at least 15% of the total number of trees within the Study Area, and therefore the habitat present is regarded as potential Koala habitat under the SEPP 44.

Core Koala habitat means an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population. Surveys and collection of anecdotal evidence of Koala sightings conducted within the Study Area as part of this assessment revealed that Koalas have been sighted sporadically surrounding the Study Area over the past decade, with Koalas observed every 2- 3 years around the mine (pers. comm. Grant Thompson – Boral).

The Koalas sighted are quite likely to have been from the Bungonia National Park and Bungonia State Conservation Area population (Bungonia population) which is a well-known population which extends along the Shoalhaven Gorge and extending approximately 30 km to the south of the Study Area (e.g. Allen 2002). The Koala population occurs approximately 2 km south of the Study Area with the majority of records within the gorge/valley. This population would undoubtedly be regarded as occurring within core habitat given the number of records, and known breeding population.

The Bungonia population is separated from the Study Area by the Bungonia Gorge, a limestone gorge approximately 350 m deep. The steepness of the gorge would limit connectivity between the main known



breeding area of Koalas in the locality (Bungonia population) and the Study Area, however there are records of the Koala from both sides of the gorge (albeit very limited from the northern side) and connectivity to the Study Area exists indirectly, west of the main gorge area.

North and west of the protected areas around the Bungonia Gorges, Koala records within the NSW Atlas of Wildlife are very limited with sporadic observations from private land and along roadsides, one being from the Marulan South Limestone Mine and two additional records (including road-kill) each from around the townships of Marulan and Tallong. These areas are more disturbed, predominantly private tenure. They generally consist of more fertile areas that have been developed traditionally for agriculture. It is clear that Koalas are able to travel through such areas and feed trees including primary feed trees are available to them throughout such areas.

Despite the limits regarding Koala distribution and abundance, given previous disturbance resulting in fragmented vegetation and the lack of Koala records within the higher elevation areas away from the protected areas around the Bungonia and Shoalhaven gorges, it is considered unlikely that active Koala areas (with permanent and moderate to high densities of Koalas) such as those within the Bungonia population would occur.

Within the Study Area, no Koala observations are known. Scat surveys, spotlighting, call-playback and tree surveys did not identify repeated or on-going use of trees within the Study Area. Therefore, whilst it is known that Koalas can occur on occasion within these areas of potential habitat similar to that of the Study Area near the existing mining operations, it is unlikely that a resident population of Koalas would rely on the habitat features of the Study Area on a regular basis. As such, 'core habitat' within the Study Area is unlikely.



5. Avoidance and site justification

In accordance with the BAM, proponents must demonstrate the measures employed to avoid, mitigate and offset impacts of a Project on biodiversity values. This section of the report outlines how Boral has considered avoidance in Project design.

5.1 Avoidance – Design Process

In order to demonstrate the reason for the Study Area placement, and why the impacts on biodiversity are occurring, it is important that Boral justify the Project through considering alternatives. As detailed in chapter 7 and 28 of the EIS, evaluation of Project alternative site locations, and selecting one is a difficult and important process in planning a new project or a 30-year continuation of mining at the oldest and largest limestone mine in Australia.

As detailed in chapter 7 and 28 of the EIS, evaluating alternatives and arriving at the preferred Project is not a perfect science with a clear set of criteria that can be applied to arrive at the ideal outcome that achieves a harmonious balance between the three pillars of true environmentally sustainable development. Evaluating alternatives is granular, subjective, two steps forward – one step back, influenced by conflicting priorities and objectives of different legislation, stakeholders and even cultures. Evaluating alternatives requires a polycentric decision making approach where the environmental, social and economic impacts of each alternative are considered to lesser or greater degrees based on the potential level of impact and then a value judgement is made on which alternative should be adopted and why certain environmental, social or economic values should receive greater consideration than others. In regards to the Project, there are 17 environmental issues each requiring specialist consideration as detailed in the EIS for the Project.

Chapter 7 and 28 of the EIS details and documents the process of considering Project alternatives which has been informed by Boral and their mine planners expertise and experience in open cut mining, detailed technical studies, cost benefit analysis, and stakeholder engagement.

In summary, in the initial phases of Project design in relation to determining Project constraints (including biodiversity constraints) and determining Project risks (including biodiversity impacts and offsetting) incorporated the following core tasks:

• **Risk, project definition and constraints workshop:** Two all-day risk, project definition and constraints workshops were attended by Boral's mining and planning teams, all technical study leads, the EIS delivery team and an independent 'Challenger' – a mining approvals specialist appointed to challenge the Project team. At the workshops, the Project team of over 30 experts, were introduced to Boral's broad objective of "continuing mining limestone at the site", then they considered key issues associated with 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 workshop approach to defining the Project scope at the commencement of the SSD approval process, allowed the implications of one decision, influenced by a certain issue to be considered by the other 17 technical specialists, the 'Challenger' and Boral's mining and planning teams, in order 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. In regards to biodiversity, vegetation mapping completed by Niche of the Boral landholdings, identified areas of native vegetation, and areas of White Box Yellow Box Blakely's Red Gum Grassy Woodland TEC, and areas of habitat corridors are important considerations.



- Stakeholder and community engagement: Stakeholder and community engagement has been undertaken over a four-year period and has been considered carefully in developing the proposed 30-year mine plan and in deciding which issues should be attributed greater value than others.
- **Ongoing Project team meetings and communication:** Regular project team meetings have been held to update Boral's mine planning and operations team and all technical study leads on outcomes from other technical studies and issues raised through the stakeholder and community consultation process. Through this process, the weighting of the values assigned to each issue identified in the early project constraints and definition phase, and possibly changed due to early stakeholder and community input, is revisited and revaluated and a decision made as to whether further changes should be made.
- Environmental risk assessment: The approach for the environmental impact assessments have considered the hierarchy of avoid, manage, mitigate and offset. Specifically:
 - During preliminary planning, where environmental features with high value and significance were identified that could be avoided, Boral revised the project design to avoid impacts to these areas by relocating infrastructure (such as internal roads, overburden emplacements and ancillary infrastructure); and
 - Where environmental features could not be avoided and would be directly impacted, it was assumed that these areas would be impacted, and the EIS prepared on this basis with a view to identify best practice measures to manage, mitigate or offset the impact.
- **Preliminary environmental risk analysis:** A preliminary environmental risk analysis was undertaken as part of the Preliminary Environmental Assessment (Element, April 2015) to identify the key potential environmental factors or impacts associated with the Project. The preliminary environmental risk analysis was informed by the risk, project definition and constraints workshop, early stakeholder and community engagement, early mine planning and specialist study desktop research and site based investigations. Biodiversity received a high risk given the occurrence of native vegetation and habitat, including the TEC White Box Yellow Box Blakely's Red Gum. A priority matrix was then developed, and ranked each risk, including that of biodiversity, in terms of likelihood of occurrence and for the perceived consequence of effects if left unmanaged. Detailed of this matrix are provided in the EIS.

5.2 Alternatives to the Project

Based on the results of the risk assessment and preliminary studies, alternative designs were considered, however were dismissed largely dictated by the availability of the resource location, Boral owned land, within the development consent boundary, that is not required for other mining operations, and is located as far as possible from constraints such as neighbouring residences. Each of the alternatives are detailed below along with the reason for dismissal, and justification for the current Project design. Biodiversity values of each alternative are discussed where relevant.

5.2.1 Alternative - No longer proceed with development

In terms of avoiding impacts on biodiversity, no longer proceeding with the Project would obviously have a positive benefit to biodiversity as clearing of vegetation and habitat would be avoided. As detailed in the EIS, looking at a larger picture, 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 National Park and the Bungonia Lookdown in perpetuity.

Potential key local positive impacts of ceasing mining operations, rehabilitating disturbed areas and using the site for conservation purposes include:

- avoiding clearing approximately 182.4 ha of native vegetation and associated habitat, including 88.6 ha of White Box Yellow Box Blakely's Red Gum Grassy Woodland TEC, 132.4 ha of Koala habitat and 140.3 ha of Large-eared Pied Bat habitat;
- reduced dust and noise emissions from the site;
- reduced traffic on Marulan South Road, especially heavy vehicles;
- reduced erosion risk and therefore suspended solids in surface water runoff resulting in improved water quality in receiving water;
- avoiding disturbance or loss of Aboriginal heritage sites; and
- avoidance of various historic heritage items associated with previous mining operations.
- Although these may be positive impacts for the site and local area, unless the deficit in limestone based products left by the cessation of mining at Marulan South is met entirely by foreign imports, it is likely that this national limestone deficit would need to be met by starting new greenfield limestone mines elsewhere in NSW and Australia. It is unlikely that establishing a new greenfield limestone mine elsewhere with the same production capacity as the Marulan South Limestone Mine, would be economically viable due to the significant establishment costs in todays terms compared to importing clinker from overseas and would have any less environmental, social and economic impact. For example, starting a new greenfield limestone mine would require disturbing a substantial area to establish the pit, processing plants and associated infrastructure. Whereas these significant disturbances are already established at the mine. Also, the mine was started in 1869 and people moved to the area to work at the mine and established the previous Marulan South village just to service the mine. Therefore, it could be said that the mine is part of the fabric and culture of the Marulan South area.
- Also, importing all limestone or limestone based products from overseas may reduce environmental and social impacts at a local and possibly regional level but are likely to result in far greater environmental and social impacts at a global level as limestone and limestone products would most likely be imported from third world countries where planning, environmental and social regulations are far less onerous than in Australia.

5.2.2 Alternative - Mine Plan 1

The original mine plan (known as MP 1) was developed to target the eastern limestone and some of the Mt Frome limestone. MP 1 was developed on the understanding of the limestone geology extent (vertical and horizontal), configuration (angle of vertical dipping) and quality in 2014/2015 and achieved a limestone to


overburden ratio of 1:>1. Earlier stakeholder consultation, technical studies and EIS preparation was based on MP 1 and the EIS prepared for MP 1 was due for lodgement with DP&E in mid 2016. This mine footprint had a similar impact to biodiversity compared to the current Project, in that a large amount of native vegetation (>120 hectares of native vegetation) would need to be cleared, including that of White Box Yellow Box Blakely's Red Gum Grassy Woodland TEC, habitat for the Koala and Large-eared Pied Bat.

5.2.3 Mine Plan 2 – Preferred Project

Drilling undertaken in 2016 started to show that the extent and configuration of the various limestone bodies were different to the mines previous understanding. The results of the drilling were significant enough for Boral to cease the SSD process, commission further drilling and revisit the mine plan. Further drilling was completed in early 2017 which filled knowledge gaps, especially on the northern extent of the limestone bodies and a revised mine plan (known as MP 2) was developed. MP 2 achieved an overburden to limestone ratio of around 1:0.9 which results in a significant reduction from MP 1 in the amount of overburden that needs to be removed and emplaced to extract the same amount of limestone. MP 2 was therefore adopted as the preferred mine plan and is the Project described in this EIS, the impacts of which are detailed in section 6.

5.2.4 Mine Plan 3

With the far greater understanding of the extent and configuration of the limestone bodies from the extensive drilling program, during development of MP 2, Boral also investigated possibilities of focusing mining in the northern half of the pit and mining the limestone beneath much of the southern processing infrastructure (known as MP 3). This option required the relocation of significant existing infrastructure including the primary crusher, conveyors, transfers and the rail spur. This would also result in the northern edge of the pit being very close to the heart of the processing area and offices which may result in unacceptable blasting and vibration impacts. Preliminary calculations for this northern mine plan option only achieved a limestone to overburden ratio of 1:>1. Due to the significant capital costs of relocating and rebuilding infrastructure and the less than ideal overburden to limestone ratio, this option was not pursued further, and as such a biodiversity impact assessment was not investigated in significant detail. It was initially thought that MP 3 would significantly reduce out-of-pit overburden emplacements as much of the southern part of the pit could be used for in-pit overburden emplacement, however not only would this sterilise significant resource but development of the southern part of the north pit restricted backfilling of the south pit until later in the mine staging, resulting in substantial out-of-pit overburden emplacement, not dissimilar in size to those required under MP 1 and MP 2.

5.3 Alternatives to Project components

Boral considered various other options for pit development, overburden emplacement, mine water supply and reducing the disturbance footprint were considered during the mine planning process. As detailed below, many of these alternatives were ruled out due to economic and viability grounds.

5.3.1 Focus on eastern limestone and mining eastern batters and south pit rim

An option that was considered briefly during the mine planning process but dispelled quickly due to the enormity of its potential social, environmental and/or economic impact, involved focusing mining on the eastern limestone body and mining the eastern batters and southern pit rim. Although this may have achieved a better limestone to overburden ratio and targets the highest grade limestone body, it would require daylighting the pit to Barbers Creek gorge to the east and Bungonia Creek gorge to the south. Biodiversity impacts associated with this design include the following:



- Increased potential for sedimentation into Barbers Creek and Bungonia creek potentially impacting amphibian habitat downstream.
- Impacts to Bungonia Creek gorge, potentially impacting upon roosting habitat for Large-eared Pied Bat and Eastern Bentwing Bat.
- Disturbance would be in close proximity to Main Gully Spring Cave.
- Impacts to relatively benchmark condition vegetation that has not been impacted by historic grazing or clearing.

5.3.2 Establishing overburden emplacements outside of Boral's landholdings

Another option that was also considered during the mine planning process and also dispelled quickly due to the enormity of its potential social, environmental and/or economic impact involved purchasing extensive areas of privately owned land and establishing overburden emplacements outside of Boral's current landholdings. As the plateau lands to the west and far north-west of the mine support areas of native vegetation, Boral would have to approach owners of private land that is cleared of native vegetation. However much of this cleared land supports viable agricultural and other commercial businesses and even if some of these landowners were willing sellers, hauling overburden and creating over-burden emplacements to the west or far north-west would:

- consume substantially more land than the preferred Project as the overburden emplacements would likely have a larger disturbance footprint as they would need to be lower due to increased visibility from sensitive receivers, and buffer lands would also need to be purchased around the emplacements;
- result in significantly greater noise, air quality, visual and traffic impacts; and
- be economically unviable due to the significant land acquisition and overburden haulage costs.

5.3.3 Disposal of overburden off-site

Consideration was given to transporting all overburden from the mine to other disused mines and quarries and/or projects requiring substantial fill off-site. High level evaluation of this alternative estimates annual costs to transport overburden off-site to a void within 200 km of the mine would cost up to \$75 M per annum or over \$2 billion over the Project life. Not only will this render the cost of mining unviable, but off-site disposal of overburden is constrained by:

- The number of train paths allocated to Boral's Marulan South Operations along the Main Southern Railway. Up to six train paths per day are allocated to the mine and are used/reserved entirely for transporting limestone products. It is unlikely that Boral would be able to acquire the number of additional train paths required to also transport overburden from the mine by train;
- Capacity at the mine and on Boral's private rail line. Even if enough train paths could be acquired, there is not enough time each day to load and transport along Boral's private railway line, all the limestone product trains, Peppertree Quarry trains and an additional five overburden trains per day; and
- The availability of void space to backfill. With the number of major infrastructure projects in the Sydney region at the moment, which are forecasted to continue for some time, and the substantial tunnel boring projects forecast in the future that generate significant volumes of surplus material, there is and will continue to be significant competition for any available void space for spoiling overburden/fill material, especially near a railway line.

5.3.4 Mine water supply including Marulan Creek Dam

Boral considered numerous alternatives to meet the mines water demand which included:

- Damming water in the south pit. This was discounted as a viable alternative as:
 - the pit floor is porous and would have to be sealed;
 - the south pit would not be able to be used for overburden emplacement requiring additional out-of-pit emplacements which may result in further areas of biodiversity impact, and exposing



the entire mine pit to views from Bungonia National Park and in particular the Lookdown in perpetuity; and

- \circ The pumping head (vertical height that water would need to be pumped) is extreme.
- Establishing a groundwater extraction well (pumping bore) network to the north of the mine, between the mine and Peppertree Quarry. It was predicted that although it could potentially supplement it, an extraction well network would not produce sufficient water to meet the mine's water demand.
- Establishing an in-stream dam in Marulan Creek to the north of the mine. Constraints to the location of the dam included land ownership, and the steep, incised section of Marulan Creek to the east as it nears Barbers Creek gorge. The proposed Marulan Creek Dam was initially designed in the ideal location from both geotechnical and volume perspectives. However, the Aboriginal heritage assessment and consultation process identified a cultural site immediately below the preferred dam wall location and after consultation with relevant Aboriginal parties, the dam wall was redesigned and moved further upstream to entirely avoid and establish a buffer to the cultural site.

5.3.5 Steeper overburden emplacement batters & higher emplacements

In designing the overburden emplacements, consideration was given to steepening the emplacement batters to increase the height of the emplacements to hold the required volume of overburden while reducing the disturbance footprint. Geotechnical and other advice from soils, erosion and rehabilitation specialists advised against making the batters too steep as this would significantly increase the erosion, sedimentation and water quality risks associated with the Project and would reduce the likelihood of successful rehabilitation and establishing a long term stable vegetated landform.

5.4 Final footprint

Due to the justification provided above, Boral cannot reasonably avoid impacts to native biodiversity and as such need to mitigate the potential indirect impacts associated with the Project, and offset for all residual biodiversity impacts accordingly.

Mitigation measures to be undertaken by Boral have been detailed in section 6.3, and impacts requiring biodiversity offsetting have been detailed in section 6.8.



6. Impact Assessment

6.1 Impact Summary

The Project would affect biodiversity, including threatened biodiversity through both direct and indirect impacts during construction and operation (Figure 9). The majority of impacts on biodiversity would occur during construction from clearing of native vegetation and removal of habitat.

The direct and indirect impacts associated with Project and measures to offset and manage biodiversity in the long term are outlined in the following sections, and specifically discussed in Appendix 8 in relation to EPBC Act listed threatened biodiversity.

6.2 Direct Impacts

The following residual direct impacts would result from the Project:

- Clearing of native vegetation and associated habitat, conservatively estimated to be 182.4 ha.
- The area of clearing includes impacts to 88.6 ha of White Box Yellow Box Blakely's Red Gum Grassy Woodland, which is listed as a TEC under the BC Act, and 80.7 ha under the EPBC Act.
- Clearing of habitat for the following EPBC Act listed threatened species: Koala, Large-eared Pied Bat, Grey-headed Flying Fox, Regent Honeyeater, and migratory species (Rufous Fantail, Great Egret, Cattle Egret, Rainbow Bee-eater, Black-faced Monarch).
- Clearing of species credit fauna habitat for the following:
 - Koala habitat estimated to be 132.4 ha
 - Large-eared Pied Bat estimated to be 140.3 ha.
 - One individual of *Solanum celatum* (species polygon amounts to 0.1 ha)

A discussion of these direct impacts has been provided below, and a specific discussion in regards to EPBC Act listed threatened species provided in Appendix 8.

6.2.1 Direct impact to native vegetation and habitat

The Project would result in the clearing of 182.4 ha of vegetation regarded as 'native vegetation,' as defined in the BAM. The majority of vegetation likely to be affected by the Project has been subject to historic logging, grazing, and other agricultural activities, and is therefore thinned in areas, and dominated in areas by Serrated Tussock. This is evident in all condition classes of PCT1334 Yellow Box - Blakely's Red Gum grassy woodland which has been subjected to grazing and clearing pressures.

Various portions of the site have also been planted with Acacia species and a number of eucalypts including *Eucalyptus tereticornis, E. amplifolia. E. melliodora* and *E. eugeniodes.*

In total, the area attributed in this assessment as a moderate condition class (canopy present) is 132.4 ha, and the area attributed to a poor/planted condition class is 50.0 ha. A further 70 ha is non-native vegetation and includes portions of the existing Mine pit, roads, etc.

6.2.2 Direct impact to White Box Yellow Box Blakely's Red Gum Grassy Woodland (BC Act and EPBC Act)

The Project would result in a direct impact to 88.6 ha of the TEC White Box Yellow Box Blakely's Red Gum Grassy Woodland as listed on the BC Act (Figure 12), and 80.7 ha of the TEC listed on the EPBC Act (Figure 13). As discussed in section 3.2.5, the TEC has been attributed to three different condition classes that make up PCT1334 Yellow Box - Blakely's Red Gum grassy woodland.



The TEC is located within the areas proposed for the Northern Overburden Emplacement and Western Overburden Emplacement on the gentle slopes and relatively flat terrain.

The TEC to be impacted is in a modified state, due to previous land clearing, grazing, feral pest grazing, over abundant herbivore grazing, and due to the abundance and spread of Serrated Tussock. This is a common theme for the TEC, as throughout its range, the TEC has been reduced in area and highly fragmented because of clearance for cropping and grazing and pasture improvement due to the ecological community's occurrence on fertile soils. Very few high quality remnants remain anywhere across its former range. The EPBC Policy Guidelines (DoE 2014) state that over 90% of the original extent of this ecological community has been cleared. This is supported by OEH (2014) who regarded the equivalent Biometric Vegetation Type to be 90% cleared, and Thomas et al. (2000) estimate that within South-Eastern NSW 59,468 ha remain from the pre-1750 extent of 1,012,052 ha (approximately 94% cleared).

The areas of the TEC within the Study Area are already fragmented by access roads, infrastructure and nonnative vegetation (Figure 12;Figure 13). This is a common theme for the TEC which is already highly fragmented in the locality (Tozer et al. 2006 mapping of map unit 24 shown in Figure 9). The Project will lead to increased fragmentation of the ecological community in the local context through the combination of the emplacement areas, however connectivity will be retained within contiguous habitat around the periphery of the Study Area.

As the TEC is regarded as a Serious and Irreversible Impact (SAII) candidate entry under the BAM, further consideration of the impacts on the TEC have been provided in section 6.7.

Futher discussion in regards to the Commonwealth listed White Box Yellow Box Blakely's Red Gum TEC has been provided in Appendix 8, along with a formal Assessment of Significance. The Assessment of Significance concluded that a significant impact was likely, and thus triggering the need to offset the impacts under the EPBC Act (section 7).

6.2.3 Direct impact to Koala habitat

A discussed in section 4.6.2, the Koala is expected to use portions of the Study Area on a limited basis.

Impacts from the Project largely relate to the removal of foraging and dispersal habitat that has been defined as being critical to the survival of the Koala under the EPBC Act (DoE 2014; Appendix 7). Habitat mapped as good and moderate habitat potential, totalling 132.4 ha (Figure **16**), contained either two or more known feed trees (listed as primary, secondary or tertiary species under the species Recovery Plan (DECC 2008)) or a single feed species that occupied more than 50% of a 400 m² floristic quadrat.

Such habitat is recognised as critical habitat due to past impacts on similar habitat limiting the Koalas ability to persist throughout its former distribution. The proposal includes the removal of 132.4 ha of such habitat (good and moderate areas shown on Figure **16**), which through application of the guidelines is considered a significant impact under the EPBC Act (see Appendix 8 MNES Assessments of Significance).

Due to the apparent limited use of the Study Area and its extremely small extent in relation to similar habitat for the Shoalhaven Gorge Koala population (7,500 ha), it is not considered that removal of this habitat alone would significantly adversely impact the relevant Koala population (centred around the Shoalhaven Gorge) such that a decline would occur or that the population is placed at risk of extinction. Active sites for this population are concentrated within protected areas and the Study Area is not thought to provide a link between active areas within the population's distribution or to any other Koala population.



As the Koala is regarded as a SAII candidate entry under the BAM, further consideration of the impacts on the Koala have been provided in section 6.7.

Futher discussion in regards to the Commonwealth significant criteria associated wih the Koala is provided in Appendix 8, including the completion of a formal Assessment of of Significance. The Assessment of Significance concluded that a significant impact to the Koala was likely, and thus triggering the need to offset the impacts under the EPBC Act (section 7).

6.2.4 Direct impact to Large-eared Pied Bat habitat

As detailed in section 4.6.2, 140.3 ha of foraging habitat for the Large-eared Pied Bat would be impacted by the Project. No breeding habitat would be impacted by the Project.

The Large-eared Pied Bat is known to forage in a range of vegetation types, including dry and wet sclerophyll forest, grassy woodland, Callitris dominated forest, tall open eucalypt forest with a rainforest sub-canopy, sub-alpine woodland and sandstone outcrop country (Hoye & Dwyer 1995; Pennay 2002; DECC 2007). Almost all records of the species are within several kilometres of cliff lines or rocky terrain, indicating that foraging habitat is limited to approximately 3 kilometres from clifflines. Foraging habitat is locally common given the species forages on a wide range of vegetation types, and given much of the land to the east of the Study Area which is centred along sandstone outcrops of Bungonia Creek and the Shoalhaven River are protected within Bungonia State Conservation Area, and Morton National Park. These areas provide well connected, intact remnant habitat for the Large-eared Pied Bat along Bungonia Creek and the Shoalhaven River. However it is noted that intact habitat (remnant undisturbed vegetation) within three kilometres of cliff lines and rock outcrops is scattered to the west and north of the Study Area compared to that of the east of Bungonia Creek and south in Bungonia Gorge.

Potential breeding habitat within Main Gully Spring Cave seems unlikely due to the cave being frequently inundated by water to act as a roost site. Regardless, the cave is located away from the Study Area and would not experience any impact associated with the Project. This is due to the distance of the subject cave from the Mine expansion activities that involve mining and blasting which is to occur over 900 m to the north. There has been an ongoing history of mining within the existing south pit throughout which any roosting bats would have persisted if present. The Project is not forecast to increase noise or vibration to the subject cave or any other known caves in the locality.

Foraging habitat is locally common and the quantity of habitat to be removed is not considered critical to the overall species survival or the local occurrence of the species. Within a 10 km radius of the Project site it is estimated that 33, 837 ha of native vegetation exists within the locality of the Study Area.

The removal of the foraging habitat associated the Project is unlikely to be critical to the overall species survival or the local occurrence of the species given the protection of foraging habitat for the Large-eared Pied Bat within Bungonia State Conservation Area and Morton Nation Park that occurs within the locality. The removal of foraging habitat is not likely to reduce the population of the Large-eared Pied Bat given the protected habitat available. Whilst not in the immediate term, it is worth noting that the site would be rehabilitated following decommissioning to a woodland structure, thus providing foraging habitat for the Large-eared Pied Bat.

As the Large-eared Pied Bat is regarded as a SAII candidate entry under the BAM, further consideration of the impacts on the Large-eared Pied Bat have been provided in section 6.7.



Futher discussion in regards to the Commonwealth significant criteria associated wih the Large-eared Pied Bat is provided in Appendix 8, including the completion of a formal Assessment of Significance. The Assessment of Significance concluded that a significant impact to the Large-eared Pied Bat was unlikely to occur. A biodiversity offset under the EPBC Act is therefore not proposed for the impacts toward the Largeeared Pied Bat under the EPBC Act, however the species would be subsequently offset in accordance with the BAM to satisfy the BC Act offsetting requirement (section 7).

6.2.5 Direct impact to foraging habitat for the Eastern Bent-wing Bat

As discussed in section 4.6.3, no breeding habitat for the Eastern Bent-wing Bat occurs within the Study Area and as such, does not need to be considered further in a BDAR Assessment. However, the species was nominated in the SEARs for further consideration, and as such, we have expanded upon our findings toward the species in this section.

Like that of the Large-eared Pied Bat, 140.3 ha of habitat for the Eastern Bentwing Bat will be directly impacted by the Project. Foraging habitat in the locality is considered important for the Eastern Bent-wing Bat due to the large population dependant on the roost site known from the area (Drum Cave). While foraging habitat of the type to be removed is considered important for the species, such habitat is considered locally common and the quantity of habitat to be removed is not considered critical to the overall species survival or the local occurrence of the species. Within a 5 km radius of the Project site it is estimated that 8713 ha of native vegetation exists within the locality of the Study Area. Whilst not a requirement of the BAM, a SAII for the Eastern Bentwing Bat has been completed in order to satisfy the requirement of the SEARs. The SAII has been provided in Appendix 6.

6.2.6 Direct impacts to EPBC Act listed fauna

As discussed above and detailed in Appendix 8, the Project is likely to result in a significant impact to one EPBC Act listed fauna species: the Koala. Significant impacts to the Large-eared Pied Bat are considered unlikely.

As a precautionary and conservative approach, this assessment has also provided Assessments of Significance for impacts to threatened, migratory and relatively mobile EPBC Act listed fauna, which on occasion, may fly over the Study Area, or use it for foraging on an intermittent basis.

Assessments of Significance have been completed in Appendix 8 for the following EPBC Act listed threatened or migratory species: Great Egret, Cattle Egret, Rainbow Bee-eater, Black-faced Monarch, Rufous Fantail and Grey-headed Flying Fox. The Assessments of Significance have concluded that a significant impact to these species is unlikely.

An Assessment of Significance was also completed for the Regent Honeyeater given the DoEE have regarded the site to be important habitat for the species. However the Assessment concluded that a significant impact for the species was unlikely due to the following:

- The species was not detected in the Study Area and surrounds during targeted survey
- The species has only been detected three times in the past 36 years within the Bungonia region that may suggest that the species potential usage of the Study Area is likely to be marginal/low.
- The closest historic records include the following:
 - Approximately 4.8 km south of the Study Area near Lockdown Road, Bungonia. This record was in made in 2005 within a gully environment near Bungonia Creek weir.
 - Approximately 5 km south of the Study Area near the Bungonia State Conservation Area office. This record was made in 1998.



- Approximately 11.9 km south of the Study Area within private property. This record was made in 1983.
- The Project is unlikely to increase fragmentation for any population of the species.
- The species has potential habitat conserved within Morton National Park and Bungonia State Conservation Area, which occurs within the locality of the Project. Therefore the Project would not significantly limit the amount of potential habitat for the species within the immediate locality.

6.2.7 Direct impacts to EPBC Act Migratory Species

As a precautionary and conservative approach, this assessment has also provided Assessments of Significance for impacts to threatened, migratory and relatively mobile EPBC Act listed fauna, which on occasion, may fly over the Study Area, or use it for foraging on an intermittent basis.

Assessments of Significance have been completed in Appendix 8 for the following EPBC Act listed threatened or migratory species: Great Egret, Cattle Egret, Rainbow Bee-eater, Black-faced Monarch, Rufous Fantail and Grey-headed Flying Fox.

Through application of the Assessments of Significance criteria, we have concluded that a significant impact to any migratory species is unlikely (see Appendix 8 for details).

6.3 Managing indirect impacts

Indirect impacts will occur within and adjacent to the subject site (area of direct impact) as a result of Mine construction and operation. Such impacts will largely operate on a short to medium timeframe (i.e. the life of the Mine) and will be minimised through management procedures and processes. A range of indirect impacts are likely to, or could, occur as a result of the Project including:

- increased noise, dust and light from Mine construction and operational activities
- loss of connectivity and fragmentation of habitats at a regional scale through clearing of intact areas of native vegetation within the Study Area
- erosion or sedimentation in areas adjoining construction and operational activities
- increased spreading of weed propagules
- increased edge-effects for surrounding vegetated areas
- changes in vegetation composition and structure as well as available fauna habitats due to altered fire regimes (more or less frequent fire).

The indirect impacts described above are variable in terms of the distance they may extend from the actual subject site, and quantifying the exact distance is not possible.

To account for a quantitative measure of indirect impacts, a 100m buffer has been placed around the subject site (Figure 9). This buffer would likely encapsulate the potential spread of weeds, edge effects in surrounding vegetated areas, erosion, dust, intensive light spill, and sedimentation during construction and operation.

Quantifying the indirect impacts associated with noise, and vibration present difficulties, however, as discussed in Table 10, are unlikely to result in any significant impacts to biodiversity.

The specific indirect impacts and how they relate to the ecology of the Study Area, along with corresponding mitigation measures are discussed in detail in Table 10. The mitigation measures provided would be consistent with industry best practice to ensure that mitigation is effective. Monitoring of the effectiveness of the mitigation measures would be incorporated as part of the management actions associated with the Project.



In addition to this, due to buffer areas that have been incorporated into the subject site, some of the potential indirect impacts would be completely, or partially contained within the subject site detailed in this assessment. Within this assessment, informal buffers were applied to account for a range of geotechnical and logistical constraints, and to provide some flexibility to account for minor changes during Mine design. The general buffer distances adopted when developing the disturbance areas for the Project are detailed in Table 10.

Specific indirect impact and mitigation measures associated with EPBC Act listed threatened biodiversity are detailed in Appendix 8.



Table 10. Indirect impacts and mitigation measures

Indirect impact	Likely impact from the Project	Potential extent of the indirect impact prior to mitigation	Mitigation measure	Expected success of mitigation measure
Edge effects	The establishment of the Project may create a number of new edges along all boundaries of the Study Area, in particular areas where there are no existing buffers (roads, existing emplacements, cleared area) between the disturbance and areas of woodland/native vegetation. Given edge effects are variable in terms of the distance they may extend from the actual subject site, it is difficult to provide a precise area of potential disturbance associated with the potential indirect impacts. This assessment has estimated that the edge effects may occur approximately 50 metres from the Study Area boundary, into woodland/native vegetation immediately adjacent. Areas in particular which may result in exposure to indirect impacts include bushland to the direct south of the in-pit part of the Southern Overburden Emplacement, and bushland to the west of the Western Overburden Emplacement. Isolated parcels of vegetation which occur in between the proposed emplacements and the Mine pit would also be exposed to edge effects. For the most part, these areas are already subject to weed invasion. The new edges could facilitate the establishment and spread of introduced plant species, however this would be managed accordingly.	Varying distance from subject site. Potentially occurring within 50 metres of disturbance area throughout the active life of the Project.	Demarcation fo the boundary of vegetation clearing at the edge of the Study Area where it occurs within 5 metres to native vegetation. Signposting will be used to inform Project personnel and site visitors of areas of conservation value to restrict entry or inform behaviour that will reduce incidental interactions with fauna. Weed management and pest management and monitoring to be implemented in Biodiversity Management Plan. Sedimentation management to be applied in areas that may result in runoff during construction and operation.	Active weed, and pest management are anticipated to be successful at managing edge effects from the Project.
Weeds	Weeds have the opportunity to establish themselves in areas of disturbed vegetation. The greatest establishment of weeds are in areas already disturbed or subject to agricultural land use. All areas exhibited varying condition and weed abundance. The greatest abundance occurs within the Western Overburden Emplacement, northern section of the Northern Overburden Emplacement and the surrounding land. The Project has the potential to increase or lead to the establishment of weed species where they do not currently exist through the operation of machinery during construction and operation. New weed species can potentially be introduced as a result of the movement of construction vehicles and materials into the Study Area. Areas more likely to be exposed to weed increases are areas of native vegetation that occur immediately adjacent to the Study Area, in particular areas to the east of the Study Area.	Variable depending on topography. However, typically would occur within close proximity to disturbance area.	Weed management and monitoring to be implemented in Biodiversity Management Plan. Weed management would be active in preventing the spread of weeds caused by construction and operation of the Project therefore preventing edge effects. At present Boral is undertaking aerial weed spraying to maximise weed control coverage.	Active weed control methods are likely to be successful in managing the spread of weeds within adjacent areas.
Erosion and sedimentation	Erosion of soils during construction and operation of the Project may involve the following:	Variable depending on	Adequate sediment controls applied where appropriate.	Sedimentation control is known to reduce sedimentation spills.



Indirect impact	Likely impact from the Project	Potential extent of the indirect impact prior to mitigation	Mitigation measure	Expected success of mitigation measure
	 Alteration of soil structure beneath infrastructure items, and roads (these have been taken into consideration within the Study Area calculations). The increase of surface water flow from the Study Area during rain events into the woodland areas to the north and south may result in erosion. The deposition of soil particulates in drainage lines and within remnant vegetation as a result of the Project is unlikely to be significant. Mitigation measures will be put in place during the construction and operation to limit the erosion and sedimentation caused by the Project. With the mitigation measures in place, it is likely that the potential for erosion and sedimentation would be contained within the subject site. 	topography and operation.	Procedures for the management of spills throughout the Study Area including the requirements for vehicles to carry spill kits. Surface water flows were designed to follow natural drainage (Advisian 2018), therefore are unlikely to create new gullies/drainage channels. The change to bedrock flows into and out of the alluvium of Shoalhaven River is negligible and is expected to be undetectable (AGEC 2018). Sediment basins proposed to reduce sedimentation and flows. Details provided in the Project's specialist studies. The rehabilitated landforms will be designed to shed water without causing excessive erosion or increasing downstream pollution (LAMAC 2018).	Surface water flows have been designed to follow natural drainage.
Dust	Dust from the Project has been assessed by Todoroski Air Sciences (2018). In summary, the assessment predicts that there is a low potential for dust impacts to occur at the privately-owned residences surrounding the Mine with dispersion modelling predicting no exceedances of the various dust criteria that the assessment utilised. Whilst the assessment did not specifically assess the impacts to biodiversity related criteria, it is unlikely that dust from the Project would be extensively dispersed throughout the locality. It is likely that dust accumulation would occur immediately adjacent to the subject site. Research shows that the impacts of dust on vegetation can have negative impacts, however the impacts of increased levels of dust on animals are unknown (Farmer 1993). Farmer (1993) anticipated that dust may increase the susceptibility of plants and vegetation to secondary stresses, such as drought, insects and pathogens, or allow penetration of toxic metals or phytotoxic gaseous pollutants. Any potential impact from dust is likely to be localised and confined to the immediate vicinity of the subject site.	Variable depending on wind conditions. Potential for dust emissions likely throughout life of Mine.	Boral has a detailed Dust Management Plan for its current operations at Marulan which has been prepared in accordance with the requirements of AS/NZS ISO 14001: 2004 (Boral 2017). This Plan would be updated where relevant to reflect the Project. Current dust suppression activities undertaken at the Mine are extensive. We have summarised some of the relevant mitigation measures that would be applied to the Project: - Dust impacts will be mitigated through the onsite use of water suppression.	Successful implementation of dust control would minimise dust. Current dust suppression mitigation works are on-going at the Mine



Indirect impact	Likely impact from the Project	Potential extent of the indirect impact prior to mitigation	Mitigation measure	Expected success of mitigation measure
			 Enforcement of speed restrictions (to 20km in stockpile areas) Compaction of soil batters to minimise wind pickup Regular use of washdown stations progressive rehabilitation of cleared areas upon decommissioning. Stockpile Management The area containing mine stockpiles and the primary and secondary crushers with associated conveyors is considered to be the largest dust source at the site. The following is undertaken to minimise fugitive dust from stockpile handling: Where possible, consolidation of existing stockpiles to reduce their overall numbers and footprint. Truck speed restriction to 20km/hour in stockpile areas. Compaction of stockpile batters to minimise wind pick up of dust. To keep stockpile surfaces wet in dry weather, consistent application of water sprays for all stockpiles or use of a water cart with pumping facilities if adequate water sprayers cannot be installed. When adverse weather conditions are experienced or predicted, stockpile 	



Indirect impact	Likely impact from the Project	Potential extent of the indirect impact prior to mitigation	Mitigation measure	Expected success of mitigation measure
			 creation and extraction activities stopped until the weather changes. <u>Unsealed Haul Roads</u> During windy conditions and in prolonged dry weather water spraying is carried out repeatedly during the day. Restriction of speed to 40km/hr on unsealed haul roads. Regular use of truck wash station, especially before leaving the site. <u>Crushers and transfers.</u> Dust collection systems upgraded between 2009 – 2015 above all tertiary crushers and screens Dust collection systems in place at secondaries and main transfer points up to tertiary crushers All Dust collection systems on schedule Planned Maintenance program Further, vegetation clearing protocols for the Project will seek to minimise exposed areas with the potential to generate dust by completing progressive vegetation clearing as close to mining as practical.	
Noise	Noise impacts have been occurring from the current operations since the Mine began. Such historic impacts have subjected fauna immediately surrounding the existing Mine to noise levels which may have deterred them from occupying areas immediately adjacent to the existing Mine footprint. Literature supports that noise can have impacts on fauna. For example, research has found that traffic noise can mask the important contact calls of the budgerigar, canary, and Zebra Finch, (Lohr et al. 1998). Parris and Schneider (2008) found that it was increased volumes of noise and not	Variable depending on wind conditions. Potential for noise impacts likely throughout life of Mine.	 The Project would reduce noise by the following: A Noise Management Plan be developed and implemented throughout the life of the Project which will serve to further reduce the noise exposure at surrounding 	Details explored in Wilkinson and Murray (2018).

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Environment	and Heritage

Indirect impact	Likely impact from the Project	Potential extent of the indirect impact prior to mitigation	Mitigation measure	Expected success of mitigation measure
	 increased volumes of traffic that were important. Various studies have indicated that changes in bird calls in response to traffic noise are twofold, either the birds change the characteristics of their call to avoid interaction of the sound of the call with the created sounds or they limit calling to periods when the levels of noise are reduced. In terms of the Project, noise likely to be generated was assessed by Wilkinson and Murray (2018). Whilst the noise assessment did not address the impact of the Project noise upon fauna, the conclusions from the assessment were based on a comparison to human noise criteria. Conclusions include that the Project would not result in exceedance of noise criteria to humans during operation; no exceedance of relevant noise criteria for off-site traffic noise would occur. Given fauna have historically been exposed to noise impacts immediately surrounding the Study Area for many years (since 1929 – see EIS main document) due to the ongoing mining operations at the site, the Project is unlikely to result in any significant decline or edge effects toward fauna and their habitats within the locality. 		 residences and to fauna occupying surrounding bushland. It is proposed that future operation of the Mine would incorporate an ongoing attended noise monitoring program, as required, throughout its operational life. 	
Vibration	 Vibration from the blasting associated with the Project is unlikely to result in any impacts to the fauna habitat including the Karst systems and caves known to occur within the Locality, particularly in Bungonia Conservation Reserve and Bungonia National Park based on the following: Blasting is currently conducted within the existing Mine which occurs closer to the National Parks than where the proposed blasting would take place. No reported impacts from the current blasting are known to occur within the Karst systems or known caves. It is considered unlikely that microbat roosting habitat within Main Gully Cave (detailed in section 4.6) would be impacted by the Project due to the distance of the subject cave from the Mine expansion activities that involve mining and blasting, which is to occur approximately 600 m north of the southern tip of the existing south pit (approximately 900 m from the identified cave). There has been an ongoing history of mining within the existing south pit throughout which any roosting bats would have persisted if present. The Project is not forecast to increase noise 	Unlikely to occur outside of disturbance area, or immediately surrounding the area of the blast.	The Mine currently monitors its blasts. The Project would require this monitoring to continue. In the unlikely event that blasting impacts result in reported damage to Karst systems of caves within the Locality, such impacts should be reviewed.	Currently not an issue.



Indirect impact	Likely impact from the Project	Potential extent of the indirect impact prior to mitigation	Mitigation measure	Expected success of mitigation measure
	or vibration to the subject cave or any other known caves in the locality.			
Increased artificial lighting	As detailed in Richard Lamb & Associates (RLA 2018) three types of lighting are currently operating at the Mine: general and security lighting, lighting for safe mining activities and vehicle guidance lighting and headlights. Each of these lighting types would be required for the Project. The light from the existing Mine would continue with the Project resulting in localised effect of illuminating features adjacent to the vehicles particularly as they move (e.g. trees or rock faces), constant low intensity lighting as a result of security lighting around the existing facilities, and luminance as a result of the mining activities. Lighting may also be reflected off surfaces causing the illumination of secondary features such as fauna habitat. As detailed in RLA (2015), much of these impacts would be minimised through lighting design and directional lighting. Research and anecdotal evidence indicate potential for artificial lighting to influence the behaviour of both nocturnal and diurnal species. Influences of artificial night lighting on behaviour and community ecology are less well-recognised (Longcore and Rich 2004). The potential impacts of artificial lighting on any particular species and the severity will vary depending on the ecology of the species, the predator – prey relations, the distance of the core population from the source of light and the reaction of that species to light disturbance. In general, artificial lighting impacts on birds include the disruption of nesting sites or the altered choice of nesting sites, disruption of roosting, the altered timing of a dawn chorus and general disturbance. The impact of artificially lit nocturnal migratory birds is well documented (Longcore et al. 2008; Poot et al. 2008). Birds are known to become disoriented and entrapped by artificial lights. The disorientation of nocturnally migrating birds by lights results in either direct mortality or depletion of energy reserves (Poot et al. 2008). The lighting impacts has been occurring from the existing operations f	Variable depending on the type of light source (e.g. vehicles, construction guidance lighting etc.). Details provided in RLA (2018).	RLA (2018) recommend that during the course of the Project a strategy relating to lighting be introduced to reduce lighting to the lowest level possible that also maintains an appropriate standard of safety and security and to minimise obtrusive lighting. Type 2 mobile lighting used for in-pit works would employ lamps that produce light in the red or yellow areas of the spectrum rather than the blue or white and be shrouded as much as possible to reduce lateral spread of the light and excess reflection of light, as well as being directed downward. A strategy is also required for control of the potential visibility of type 3 lighting associated with night time use of vehicles in the Project, specifically the potential for headlight or directional lighting during development or contouring of overburden emplacements at night, if that occurs. It is therefore recommended that for each new lift on the western and south-western edges of the Western Overburden Emplacement, or the northern margins of the Northern Overburden Emplacement, should begin at the margins of the lift relative to potential view directions and then progress in rows behind the margin, providing a light barrier to vehicle headlights.	Mitigation measures likely to be successful at reducing light spill.



Indirect impact	Likely impact from the Project	Potential extent of the indirect impact prior to mitigation	Mitigation measure	Expected success of mitigation measure
	current Mine operation. Whilst it is indicated by research that potential impacts may arise from artificial light, given the history of lighting impacts in the Study Area, it is unlikely that the Project would result in any significant decline or edge effects toward fauna and their habitats within the locality.		Overburden emplacement work will also be carried out at night in the South Pit, where light spill will be increasingly controlled by the work being generally below view lines and also shielded by walls of the Pit. Some light will be visible at times, however because of the use of these areas being largely confined to daylight hours, it is considered that the above strategy would be successful in mitigating light spill of type 3 light from vehicles.	
Fire	Historically, arid zone bushfires tend to be associated with a proficient growth of native grasses following large rain events. During summer, following rain events, dry swards of grasses pose a bushfire hazard when placed near a source of ignition. Vehicles driven through long grass and hot exhaust may attribute to fire ignition. This may occur during construction and operation of the Project particularly during the hotter months.	Potential to be widespread in locality, though unlikely.	The Bushfire Management Plan will incorporate bushfire management protocols to prevent and deal with the potential for bushfire.	Given the existing Mine operations have not resulted in any significant fires, the implementation of the Bushfire Management Plan would likely assist in fire prevention.



6.4 Biodiversity Management Plan

A Biodiversity Management Plan (BMP) would be prepared to inform and manage various activities throughout the life of the Project in order to protect and manage important biodiversity values. Key commitments to be covered by the BMP include threatened species management, pest and weed management, native vegetation clearing protocols, fauna handling and site hygiene practices.

The BMP will include specific protocols dealing with any potential interaction between the Project activities and threatened flora or fauna species during the life of the Project. The BMP will include directions for survey, monitoring and management of key threatened species known or considered to be potentially impacted by the Project and protocols for reporting and managing any unforeseen threatened species occurrences within the Project site. Measures designed to mitigate impacts on threatened species would be monitored for success.

Impacts arising from activities associated with the 30 year Mine plan will primarily relate to vegetation clearing. Boral proposes to undertake the following mitigation and management actions during development of the 30 year Mine plan.

Key components of the BMP would include details in relation to the following:

Fencing and signposting

Fencing and/or the use of highly visible rope or tape boundaries or alternative effective markings e.g. 2m high timber posts with brightly coloured tops will be used to delineate the boundary of vegetation clearing at the edge of the Study Area where mining activities occur within 5 metres of native vegetation.

Signposting will be used to inform Project personnel and site visitors of areas of conservation value to restrict entry or inform behaviour that will reduce incidental interactions with threatened species - e.g. speed limits along access roads to reduce potential for fauna vehicle strikes.

Employee Education and General Environmental Controls

Employees and contractors would be educated on and required to implement the following controls, to avoid or at least minimise potential environmental impacts associated with the construction of the Project:

- minimise dust generation by minimising the extent and time that bare soil is exposed and by appropriate dust suppression
- procedures for the management of hydrocarbon and/or chemical spills throughout the Study Area including the requirements for vehicles to carry spill kits
- ensuring vehicles remain on designated roads and tracks and abide by site speed limits, through use of signposting and driver education during the induction process and in on-going Project discussions
- management and removal of all rubbish from the Study Area.

Vegetation Clearance Protocol

A vegetation clearing protocol would be provided in the BMP. The vegetation clearing protocol would include the following:

- Prior to clearing of grassland, a survey will be conducted for ground dwelling fauna and to remove any fauna/fauna habitats to adjacent areas that would not be further disturbed.
- Prior to clearing of remnant hollow-bearing trees, suitably qualified personnel are to be engaged to supervise felling. All hollow-bearing trees that are accessible safely from the ground are to be checked



and identified fauna relocated. Hollows higher up and not accessible from the ground are to be identified and trees felled gently by an excavator or dozer and left overnight to allow fauna to relocate.

- Any fauna displaced during clearing are to be captured where possible and relocated to pre-planned areas (fauna to be captured and handled only by personnel trained to do so).
- In an event that fauna are injured during clearing, the NSW Wildlife Information, Rescue and Education Service (WIRES) will be contacted to handle and collect fauna for appropriate care and rehabilitation.

Pest and weed management

The BMP would include a section relating to pest and weed management activities of the Project and will include:

- Management protocols for feral animals such as foxes, goats, rabbits and cats within the rehabilitation areas.
- Management protocols for the identification of noxious or important environmental weeds within areas to be cleared (in order to avoid transporting weeds to rehabilitation areas or other parts of the site).

6.4.1 Rehabilitation

The disturbance area would be progressively rehabilitated in accordance with a Rehabilitation Management Plan which will be developed following approval. The rehabilition will create a stable landform that does not result in sediment laden runoff or fugitive dust emissions, blends well with the adjacent natural landscapes of the Morton National Park and Bungonia State Conservation area and re-establishes a native bushland dominated by White Box Yellow Box Blakely's Red Gum Grassy Woodland species, which outcompetes invasive weed species.

The Rehabilitation Management Plan will need to include biodiversity management measures associated with the Project in order to protect and manage important biodiversity values. Currently, the Marulan South Limestone Mine Continued Operations Project – Soil, Land Resources and Rehabilitation Assessment (LAMAC 2018) discusses key commitments relating to threatened species management, pest and weed management, fire management and site hygiene practices.

6.4.2 Fire management

Boral currently have a Bushfire Management Plan (Boral 2015) which is part of the Mine emergency procedures for their Mine Operations. Fire prevention and suppression are detailed within the Plan including emergency protocols should a fire occur. This Plan would be updated to reflect the Project following approval.

6.5 Cumulative impacts

Cumulative impacts are the successive, incremental and combined impacts (both positive and negative) of an activity on the environment (Franks et al., 2010). They can arise from the compounding activities of a single operation given the interaction of that operation with past, current and future activities that may or may not be related to the existing development. Cumulative impacts may also arise through the interaction of one development with other types of activities and industries, such as grazing and broad scale agriculture.

In relation to the Project, the cumulative impacts are considered to be the total impact on the environment that would result from the Project plus any additional impacts likely to occur due to subsequent projects that are of a similar nature or that are partly or wholly contingent on the Project. Identifiable cumulative



impacts to be considered in the locality include current and future operations by Holcim Lynwood Quarry approximately 10 km to the north, and Gunlake Quarry approximately 15km to the north of the Mine.

At a regional scale, the Project site occurs within the Tablelands landscape of the Southern Rivers Bioregion of which approximately 44 % is occupied by the Goulburn Mulwaree LGA (ELA 2007). Agriculture is the main land use within the LGA which makes up 56% of the total area. Clearing has occurred predominately in the more fertile lands and along riparian zones. This is consistent with the Project with grazing land occurring along the proposed Marulan Creek Dam proposed Marulan Creek Dam Inundation Area and Western Overburden Emplacement. Only a small portion of the LGA (8%) is part of formal reserves and the remaining native vegetation represents only a small proportion of the pre-European vegetation. The main threat to remaining vegetation and to important ecosystem functions carried out by riparian zones and wetlands has been attributed to further clearing associated with agricultural practises and rural residential development in agricultural areas (ELA 2007), rather than Mine associated clearing or impacts.

Whilst the Project will result in degradation to native vegetation within the Southern Rivers Bioregion, the Project will also involve an offset that will contribute to in-perpetuity managed conservation areas within the Bioregion. This will contribute to objectives within the CMA's catchment action plan (Southern Rivers CMA 2013); within the Southern Rivers Bioregion it is proposed that an increase of 11,000 hectares to at least 41,000 hectares of land managed for conservation is to be achieved.

6.6 National Parks and Conservation Areas within the Locality

6.6.1 Bungonia National Park and State Conservation Reserve

Bungonia National Park (770 ha) occurs approximately 250 m to the south of the Study area, and the Bungonia State Conservation Reserve (3,285 ha) extends from the National Park's southern and western boundaries (Figure 1). Collectively, the reserves cover an area from the gorges of Jerrara and Bungonia Creeks southwards along the western side of the Shoalhaven River gorge to Paradise Creek. The State Conservation Area lies adjacent to the very large natural area of Morton National Park. These conservation areas are important as they contain a wide range of karst features including dolines, blind valleys, springs, tufa deposits, solution forms, a slot canyon and over 175 cave entrances. A variety of speleothems (cave formations) occur in the caves including stalactites, stalagmites, helictites, flowstone, pool formations and cave coral. The reserves also support a variety of threatened species including an active Koala population.

Potential issues raised in DECCW (2010) Guidelines for developments adjoining land and water managed by the Department of Environment, Climate Change and Water, in relation to Bungonia National Park and Bungonia State Conservation Reserve have been addressed in Table 11. In summary, the Project is unlikely to result in any impacts to the conservation areas due to the following:

- No vegetation clearing will take place within the Bungonia National Park or State Conservation Area as a result of the Project. The nearest vegetation clearing would occur approximately 300 m north of the National Park boundary, which is separated from the conservation areas by a gorge, and bushland. Given the distance from the Study Area, edge effects associated with vegetation clearing as documented in section 6.2.1 are not expected to affect the National Park or State Conservation Reserve.
- It is also unlikely that the Project would increase vibrations or noise to the extent that the Karst features of the conservation areas (including known and potential bat roosts) would be impacted. The proposed Study Area is further away from such features than where existing blasting currently takes place within the southern end of the South Pit. No known damages have been reported from the existing activity toward karst systems within the National Park. Significant impacts to groundwater quality are not expected and are not anticipated to impact karst systems.



- The Project's surface water flows would eventually flow into Bungonia Creek which occurs directly to the north of the conservation areas. The Advisian (2018) Surface Water Assessment for the Project predicts no change in the catchment areas draining to Bungonia Creek as this area currently drains into the pit void. As such, no significant impacts to fauna habitat along the proposed route into Bungonia Creek are likely to occur.
- Similarly, Advisian (2018) predicts that post-mining the flow regime in Main Gully is predicted to be comparable to pre-mining conditions, and to be improved significantly from current conditions in which a large proportion of the catchment drains to the South Pit.
- Advisian (2018) also predicts changes in flow regime as a result of the Project are not expected to have a significant adverse impact on Tangarang Creek or the tributaries that receive runoff from the overburden emplacements.
- The Koala population known to occur within the Bungonia National Park and State Conservation Area are unlikely to be impacted by the proposed removal of potential habitat within the Study Area, given the availability of habitat with the conservation areas and surrounding environment.

6.6.2 Morton National Park

Morton National Park is located 750 m - 2 km east of the Mine on the eastern side of Barbers Creek. The current reserved area is 199,690 ha. The National Park is known to contain a variety of threatened biodiversity; of particular relevance to this assessment are *Solanum celatum, Pomaderris cotoneaster* and the Koala.

As per the above assessment for Bungonia National and the Bungonia State Conservation Area, the potential issues raised in DECCW (2010) Guidelines for developments adjoining land and water managed by the Department of Environment, Climate Change and Water, in relation to Morton National Park have been addressed in Table 11. The conclusions were similar to those listed above, with the Project unlikely to result in any impacts to the conservation areas due to the following:

- No vegetation clearing will take place within Morton National Park. The nearest vegetation clearing would be approximately 750 m west of the National Park boundary, which is separated from the subject site by Barber's Creek and bushland. Given the distance from the Study area, edge effects associated with vegetation clearing as documented in section 6.2.1 are not expected to affect the National Park.
- The Project's surface water flows would eventually flow into Bungonia Creek which occurs directly to the north of the conservation areas. The Advisian (2018) Surface Water Assessment for the Project predicts no change in the catchment areas draining to Bungonia Creek as this area currently drains into the pit void. As such, no significant impacts to fauna habitat along the proposed route into Bungonia Creek are likely to occur. As such, no corresponding impact to fauna habitat which adjoin the National Park is anticipated.
- Similarly, Advisian (2018) predicts that post-mining the flow regime in Main Gully is predicted to be comparable to pre-mining conditions, and to be improved significantly from current conditions in which a large proportion of the catchment drains to the South Pit.
- Advisian (2018) also predicts changes in flow regime as a result of the Project are not expected to have a significant adverse impact on Tangarang Creek or the tributaries that receive runoff from the overburden emplacements.
- The Koala population known to occur within the Morton National Park is unlikely to be impacted by the proposed removal of potential habitat within the Study Area, given the availability of habitat within the National Park and surrounding environment.
- The populations of *Solanum celatum* and *Pomaderris cotoneaster* known to occur within the National Park would not be impacted by the Project.



Table 11. Issues raised in DECCW (2010) in relation to Bungonia National Park and State Conservation Reserve and Morton National Park

Issue	Risk identified in DECCW (2010)	Potential impact from Project on Bungonia National Park, State Conservation Reserve and Morton National Park?
Erosion and sediment control	 Removal of vegetation and disturbance of groundcover from construction activities will expose the soil and increase the risk of erosion. Eroded sediments, including those from soil stockpiles, may be transported downstream or down slope and deposited on vegetation and in creeks, rivers, wetlands and other aquatic habitats. Changes to the hydrology of streams outside the reserve system, including from activities on land that may not immediately adjoin reserves, can impact on land managed by OEH by: increasing the intensity and frequency of flows as a result of clearing vegetation increasing the area of impermeable surfaces. 	 Unlikely due to the following: The stormwater management and sediment and erosion control system has been designed to relevant standards to prevent erosion or sedimentation within the National Parks and Conservation Reserve as a result of the Project. These erosion and sedimentation control measures would be implemented prior to works commencing and maintained for the duration of mining related activities, and until the site has been rehabilitated. Surface water flows would follow the natural flow regime to prevent the formation of unnatural gullies and drainage channels. Areas of vegetation to be retained would be demarcated as no-go zones during Mine development and operation to prevent unauthorised access. Disturbed areas would be rehabilitated and appropriately stabilised as soon as possible.
Stormwater runoff – Nutrient levels are minimised, and stormwater flow regimes and patterns mimic natural levels before reaching OEH land.	 The discharge of stormwater to OEH land poses a threat to the values of land and downstream environments by: dispersing litter and pest species (especially weeds) altering nutrient composition and pollutant levels, which can damage native vegetation and aquatic ecosystems, reduce water recreation safety and promote weed growth causing potential erosion and sedimentation in watercourses, particularly where new developments have led to an increased volume and concentration of flow. 	 Unlikely due to the following: The stormwater management and sediment and erosion control system has been designed to relevant standards to trap sediment and other pollutants, preventing the discharge of poor quality water from the site that could impact negatively on water quality of receiving waters. Waste generated by the site operations will be appropriately managed in accordance with industry standards and a protocols provided in the BMP to prevent litter being dispersed off site through stormwater runoff and wind. All hazardous substances e.g. hydraulic oils, fuels and chemicals (including herbicides) will be stored in accordance with relevant industry standards to prevent contamination of soils and surface water runoff. The Project's surface water flows would eventually flow into Bungonia Creek which occurs directly to the north of the conservation areas. The Advisian (2018) Surface Water

	Envi	ronment and Heritage
		 Assessment for the Project predicts no change in the catchment areas draining to Bungonia Creek as this area currently drains into the pit void. As such, no significant impacts to fauna habitat along the proposed route into Bungonia Creek are likely to occur. Similarly, Advisian (2018) predicts that post-mining the flow regime in Main Gully is predicted to be comparable to pre-mining conditions, and to be improved significantly from current conditions in which a large proportion of the catchment drains to the South Pit. Advisian (2018) also predicts changes in flow regime as a result of the Project are not expected to have a significant adverse impact on Tangarang Creek or the tributaries that receive runoff from the overburden emplacements. Given the proposed surface water flows follow the natural hydrology of the landscape and the increase in flow would only result in a localised change to the current state of the drainage line, no significant impacts to fauna habitat along the existing creeks are likely to occur. As such, no corresponding impact to fauna habitat which adjoin the conservation areas are anticipated.
Wastewater/sewage	Not relevant to assessment	Effluent from the office and workshop facilities is treated by a licenced on- site wastewater treatment system. Treated effluent is disposed of by irrigation onto a designated effluent irrigation area. 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 serviced by adsorption trenches. No new on-site wastewater management systems are proposed as part of the Project.
Management implications relating to pests, weeds and edge effects	 Development adjoining OEH land has the potential to significantly affect the operation or management of OEH land, resulting in damage to conservation values and cost implications for future management. Development may result in: increased informal and inappropriate access (such as by trailbike riders) increase in invasive species and decline in biodiversity and ecosystem health (such as dieback) 	 Unlikely due to the following: Site layout is proposed within the existing Mine site. Most of the development occurs to the west of the Mine and thus away from the National Parks and Conservation Areas. Pest management protocols would be included in the BMP and would be implemented as part of the Project. A buffer of over 350 m at the closest point occurs between the proposed vegetation clearing and the Bungonia National park and State Conservation Reserve

niche

	 impacts on areas of particular environmental sensitivity, including Aboriginal and historic heritage sites, watercourses and threatened species habitat disturbance and predation by domestic pets or stock animals. Clearing of vegetation (including aquatic vegetation) along or near the boundary of OEH land can lead to edge effects such as: increased drying of soils and consequent changes to vegetation at the land boundary decline in fauna that are sensitive to changes in vegetation along newly created edges increased predation in the vicinity of the OEH land boundary associated with aggressive species in open situations (such as nest predation by ravens and currawongs). 	 A buffer of over 750 m at the closest point occurs between the proposed vegetation clearing and the Morton National Park. Weed management protocols would be included in the BMP. Buffer currently exists between the Study Area and the conservation areas. Unlikely to result in a decline in fauna within the conservation areas as a result of the Project.
Fire and the location of asset protection zones All asset protection measures are within the development area, and there is no expectation for OEH to change its fire management regime for the land it manages.	OEH recognises fire as a natural and recurring factor which shapes the environment. However, it also acknowledges that altered fire regimes may pose a significant threat to life, property and other values including biodiversity, cultural heritage and tourism, and that the onset of climate change may exacerbate these risks. Fire management is one of the most important tasks in managing protected areas.	Unlikely. The Mine has a Bushfire Management Plan in place which will be revised if necessary on approval of the Project. All mining activities associated with the proposed continuation of operations at the stie for the next 30 years do not involve activities closer to the Bungonia State Conservatuon area or the Mornton National Park. Thefore, the continued operations at the Mine will not require a change to the bushfire management approach implemented by OEH in the neighbouring conservation lands. The Bushfire Management Plan would provide a strategy to manage bushfires within the confines of Boral Landholdings and not rely on the management actions of OEH within the conservation areas.
Boundary encroachments and access through OEH land. No pre-construction, construction or post- construction activity occurs on land managed by OEH.	 OEH land is not to be used: to access development sites to store materials, equipment, workers' vehicles or machinery for maintenance access after development. Unauthorised access to OEH land can have direct physical impacts on the conservation values of parks, such as those due to the removal of vegetation, erosion and soil disturbance. If such access continues or other encroachments occur (such as the construction of buildings, carparks or roads), this can have long-term implications affecting park	 No impacts likely based on the following: No access for construction is required to occur within the National Parks or Conservation Reserve. Any access for environmental monitoring (e.g. water quality sampling in Bungonia Creek, Barbers Creek and the Shoalhaven River) would be arranged with relevant OEH and NPWS officers. No construction would take place within the Reserves. The Project would not lead to an increase in encroachment and unauthorised access through the National Park or conservation reserve.

Heritage



	planning, park management (for example fire protection) and public use and enjoyment.	
Visual, odour, noise, vibration, air quality and amenity impacts.	These impacts may particularly affect native fauna (for example, noise, vibration and lighting may disrupt foraging and breeding habits).	A Biodiversity Management Plan would be developed detailing measures that would be taken to minimise indirect impacts, including mitigation measures discussed in section 6.3.
Threats to ecological connectivity	The above issue may result in a decrease in connectivity within the OEH land.	The Study Area does not directly adjoin the National Parks and Conservation Reserve. The impacted areas would be rehabilitated post works, so connectivity values would be re-established.



6.7 Serious and irreversible impacts

As detailed in section 10.2 of the BAM, the determination of serious and irreversible impacts (SAII) on biodiversity values is to be made by the consent authority in accordance with the principles set out in the BC Regulation. To assist the consent authority, the guidance document titled 'Guidance to assist a decision-maker to determine a serious and irreversible impact' includes criteria that enable the application of the four principles set out in clause 6.7 of the BC Regulation to identify the species and ecological communities that are likely to be the subject of serious and irreversible impacts. All potential SAII entities that would be impacted by the proposed development need to address the SAII criteria which would assist the consent authority with the review of impact to SAII.

Threatened species which have potential to experience a SAII as a result of the Project include impacts to:

- White Box Yellow Box Blakely's Red Gum Woodland TEC
- Koala habitat and
- Large-eared Pied Bat habitat.

SAII assessment criteria have also been completed for the Eastern Bentwing Bat, given the species was nominated in the SEARs as requiring further consideration.

The SAII assessment criteria in relation to White Box Yellow Box Blakely's Red Gum Woodland TEC, Koala habitat, Large-eared Pied Bat habitat and Eastern Bentwing Bat habitat has been provided in Appendix 6.

6.8 Quantifying offset requirements

The BAM identifies the BAM Calculator as the appropriate tool for quantifying the offsets required in both Ecosystem Credit and Species Credit terms. A calculation of the nature and extent of offset credits required due to biodiversity impacts associated with the Project has been undertaken using the BAM Calculator.

6.8.1 Summary of ecosystem credits required

The ecosystem credits to be retired for the Project, as determined by the Biodiversity Credit Calculator, are shown in Table 12. The Biodiversity Credit Calculator outputs have been provided in Appendix 7.

Vegetation zone no.	Plant Community Type (PCT)	Vegetation formation	Vegetation class	Condition identifier input used in calculator	Vegetation Integrity Loss	Total (ha)	Credits required	Total credits required
1	PCT 1334 Yellow Box		Southern Tableland Grassy Woodlands	Medium	40.4	48.8	985	
2	 Blakely's Red Gum grassy woodland on 	Grassv		Poor	23.7	31.9	378	
3	the tablelands, South Eastern Highlands (SR670)	Woodlands		Acacia	26.1	7.9	103	1466
4	PCT 778 Coast Grey Box – stringybark dry woodland on	Dry Sclerophyll	Central Gorge Dry Sclerophyll Forests	Medium	45.6	57.9	990	
5	slopes of the Shoalhaven Gorges - Southern Sydney Basin (SR534)	(Shrub/grass subformation)		Poor	18.3	7.5	52	1042
6	PCT 1150 - Silvertop Ash - Blue-leaved Stringybark shrubby	Dry Sclerophyll Forests		Medium	454	13.7	233	260

Table 12 : Ecosystem credit requirements



Vegetation zone no.	Plant Community Type (PCT)	Vegetation formation	Vegetation class	Condition identifier input used in calculator	Vegetation Integrity Loss	Total (ha)	Credits required	Total credits required
7	open forest on ridges, north east South Eastern Highlands Bioregion (SR624)	(Shrubby sub- formation)	South East Dry Sclerophyll Forests	Poor	27.2	2.6	27	
8	731 - Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion (SR524)	Grassy Woodlands	Southern Tableland Grassy Woodlands	Medium	540	12.0	325	325
9	PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670) – Best fit equivalent based on surrounding land use and previous Tozer et al. (2006) mapping	Grassy Woodlands	Southern Tableland Grassy Woodlands	Non EEC_water dependent	0	0.1	0	0
10	Non-native	-	-			70.0	0	0
	Total					252.4	3,093	3,093

6.8.2 Summary of species credits required

Offsets required for species credit species are shown in Table 13. Species credits are required for the *Solanum celatum,* Koala and Large-eared Pied Bat.

Table 13	: Species	credit specie	es requirements
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Species Credit Species	Cleared habitat area (ha)	Area of impact	Required credits	Total
Solanum celatum	778_Medium	45.6	2	2
	731_medium	54.1	325	
Koala - (Phascolarctos cinereus)	778_medium	45.6	1320	2941
	1150_medium	45.4	311	
	1334_medium	40.4	985	
Large-eared Pied Bat - (Chalinolobus dwyeri)	731_Medium	54.1	12	4567
	778_Medium	45.6	57.9	



Species Credit Species	Cleared habitat area (ha)	Area of impact	Required credits	Total
	1150_Medium	45.4	13.7	
	1334_Acacia	26.1	7.9	
	1334_Medium	40.4	48.8	

6.8.3 Revised Marulan South Credit Offset in relation to Peppertree Modification 5

As per discussion with DPIE and BCD, the Peppertree Modification 5 Project has been subject to a separate approval and biodiversity offset requirements as detailed in the *Niche (2019) Pepertree Modification 5 Biodiversity Development Assessment Report*. A total of 39.7 ha of native vegetation and habitat associated with the Peppertree Modification 5 disturbance area is contained within the area assessed and offset as part of this BDAR. As such, the Projects biodiversity credit amounts presented in Table 12 and Table 13 need to be reduced to reflect the credits that would be required for Peppertree Modification 5.

The revised biodiversity credits associated with the Project are details in Table 14.

Offset liability	Marulan South Project credits as detailed in this BDAR	Peppertree Modification Project Biodiversity credit requirement	Revised Marulan South Project Biodiversity Credit
PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670)	1,466	428	1,038
PCT 778 Coast Grey Box – stringybark dry woodland on slopes of the Shoalhaven Gorges -Southern Sydney Basin (SR534)	1,042	157	885
PCT 1150 - Silvertop Ash - Blue-leaved Stringybark shrubby open forest on ridges, north east South Eastern Highlands Bioregion (SR624)	260	0	260
731 - Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion (SR524)	325	0	325
Solanum celatum	2	0	2
Koala	2,941	487	2,454
Large-eared Pied Bat	4,567	731	3,836

Table 14. Revised offset liability for the Marulan South Project



7. Offset strategy

Under the BAM, an offset strategy is not required to be submitted with the BDAR, as the credits are to be formally retired with the establishment of a Biodiversity Stewardship Site, or payment into the Biodiversity Conservation Trust (BCT) Fund. However, as noted in the DoEE Supplementary SEARs, a biodiversity offset strategy is required to be included in the Biodiversity Assessment.

7.1 One offset package to satisfy the NSW and EPBC Offset Requirements

Under the BAM, the biodiversity offsets must provide benefits to biodiversity to compensate for the adverse impacts of an action. Biodiversity offsets assist in achieving long-term conservation outcomes while providing development proponents with the ability to undertake actions that have unavoidable impacts on biodiversity.

Unavoidable impacts to biodiversity are those impacts that are residual (i.e. impacts that remain after impact avoidance, management and mitigation measures are employed to reduce the type or magnitude of biodiversity impacts). Section 5.1 of this report outlines the design changes that Boral has implemented through the feasibility and pre-feasibility stages of the Project. Section 6.3 to Section 6.4.2 of this report outline the management and mitigation actions that Boral will employ to further reduce direct and indirect impacts to biodiversity values as a result of this Project.

This section of the report describes the approach to biodiversity offsetting proposed for the Project in accordance with the BAM and Commonwealth offsetting requirements.

Based on the results of the MNES Assessments of Significance contained in this report, the Project would result in a significant impact to White Box Yellow Box Blakely's Red Gum Grassy Woodland and the Koala. As such, the biodiversity offset proposed would satisfy both the State and Commonwealth offsetting requirement for both threatened entities.

7.2 Proposed offset strategy

Boral propose to offset the Project using two properties, which would be established as Stewardship Sites under the BAM to provide in-perpetuity protection and management of biodiversity values. The properties are listed in Table 15 and detailed below.



Table 15. Offset liability properties

		Credits ea of detailed pact in this BDAR	Revised Biodiversity	Stewardship Sites		Percentage of offset		
Offset liability	Area of impact		credits required (see Table 14)	Property 1 – Boral owned (BCT Case No. 0001191)	Property 2 – Private owned (BCT Case No. 00011444, 00011437, 00011449, 00011453)	NSW offset liability	Commonwealth liability	BCT Payment fund – option for State offset requirement
PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670) – associated TEC as listed under the BC Act and EPBC Act.	88.6	1466	1,038	-	>1500 credits	100%	100%	Not proposed however is an option for State offset liability, however cannot be used for Commonwealth.
PCT 778 Coast Grey Box – stringybark dry woodland on slopes of the Shoalhaven Gorges -Southern Sydney Basin (SR534)	65.4	1042	885	>2000 credits	-	100%	N/A	Not proposed however is an option for State offset liability
PCT 1150 - Silvertop Ash - Blue-leaved Stringybark shrubby open forest on ridges, north east South Eastern Highlands Bioregion (SR624)	16.3	260	260	>300 credits	-	100%	N/A	Not proposed however is an option for State offset liability
731 - Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion (SR524)	12.0	325	325	-	-	100%	N/A	Yes – option for State offset liability.
Solanum celatum	0.1	2	2	-	-	100%	N/A	Yes – option for State offset liability.
Koala	132.4	2941	2,454	936 ha habitat Approx 2000 credits	-	68%	100% - as the area of habitat exceeds that required per EPBC Act policy calculator	Yes – payment into the fund proposed for remaining 32% credits



	Area of impact	Credits detailed in this BDAR	Revised Biodiversity credits required (see Table 14)	Stewardship Sites	Percentage of offse		liability met		
Offset liability				Property 1 – Boral owned (BCT Case No. 0001191)	Property 2 – Private owned (BCT Case No. 00011444, 00011437, 00011449, 00011453)	NSW offset liability	Commonwealth liability	BCT Payment fund – option for State offset requirement	
Large-eared Pied Bat	140.3	4567	3,836	936 ha habitat Approx 2500 credits	-	55%	100% - as the area of habitat exceeds that required per EPBC Act policy calculator	Yes – payment into the fund proposed remain 45% credits	



7.2.1 Property 1 (Boral owned) - Biodiversity Credit Case No. 0001191

Boral has purchased a 1,000 hectare property within the Bungonia subregion for the purposes of offsetting for the current Project. The details of the property have been withheld from this assessment for confidentiality reasons, however can be provided in a separate report to the Departments should it be required.

To date, Niche have completed field surveys on the property in accordance with the BAM, and fauna surveys (spotlighting and anabat recording) to determine the presence of Koala and Large-eared Pied Bat.

The field surveys confirmed the presence of a Koala population on the site (four individuals recorded), and Large-eared Pied Bat foraging habitat (captured using anabat devices located in all habitat types of the property).

The area of both Koala and Large-eared Pied Bat habitat available on the site that would be managed in perpetuity is approximately 936 hectares. In particular, management would focus on feral animal control given the presence of feral dogs throughout the area.

The Biodiversity values at the site would satisfy the following biodiversity offset liabilities:

- PCT 778 Coast Grey Box stringybark dry woodland on slopes of the Shoalhaven Gorges -Southern Sydney Basin (SR534)
- The EPBC Act offset requirement for the Koala and Large-eared Pied Bat as 936 hectares of habitat would be retained which meets that of the EPBC Act Policty Calculator.
- Partial offset for the State credits offset liability for the Koala and Large-eared Pied Bat, with residual credit requirements to be paid into the BCT Fund or market.

To date, reporting and Biodiversity credit calculations have been completed, which will be submitted to the BCT for review.

7.2.2 Property 2 (private owned) - Biodiversity Credit Case No. 00011444, 00011437, 00011449, 00011453

In order to satisfy the offset liability for PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670) and subsequent EPBC listed White Box Yellow Box Blakely's Red Gum Grassy Woodland, Boral have negotiated the security of credits within a 360 hectare property containing the TEC. The property would contain four separate stewardship sites given the subdivision of the land. Four Biodiversity Stewardship Site applications has been submitted to the BCT for this site (Case no. 00011444, 00011437, 00011449, 00011453) which is currently being reviewed by the BCT.

Through the retirement of credits at the site, the offset liability for the Project would be met for both the State and Commonwealth TEC requirement as the site meets 100% of the Commonwealth offset liability using the EPBC Act Policy Calculator.

7.2.3 BCT Payment Fund

Boral may consider payment into the BCT Payment Fund for any residual State offsetting requirements associated with the Koala and Large-eared Pied Bat that are not generated at the Boral owned offset site. Boral may also pay into the BCT Payment Fund for impacts to non-threatened PCTs.



8. Conclusion

This report provides a BDAR in accordance with the BAM in order to address the potential impacts associated with the Project.

The Project will result in the disturbance of 182.4 ha of native vegetation, of which all has been historically cleared for logging, or grazed. Indirect impacts may include dust, noise, erosion and sedimentation which will be mitigated by measures provided in section 5.1 of this report.

During the field survey one TEC - White Box Yellow Box Blakely's Red Gum Woodland was found to occur within the Study Area. Three condition classes were attributed to the TEC to assist with offsetting the impacts. The Project will result in disturbance to approximately 88.6 ha of the TEC listed under the BC Act and EPBC Act of with the majority of the vegetation comprised of highly degraded condition classes and assisted regeneration areas comprising of planted tubestock among native pasture. An offset for the impact on this TEC has been proposed as per the requirements of the BAM. This TEC would be offset according to the requirements of the BAM.

A further 93.8 ha of native vegetation would also be offset in accordance with the BAM.

One threatened flora – *Solanum celatum* was recorded within the Study Area and would be removed by the Project. No other threatened flora are likely to be present given the lack of habitat and absence of threatened flora during the field survey.

Twenty-six threatened and migratory fauna are considered to be affected by the Project. Most of these species are likely to utilise the foraging habitat of the Study Area on an intermittent basis. No further assessment of impact is required for the ecosystem credit species based on the requirements of the BAM and the offsetting of the associated PCTs Ecosystem Credit Species under the BAM which do not require further assessment of impact as they would be offset with their associated PCTs.

The Koala and Large-eared Pied Bat are the only listed Species Credit Species which require an offset for the Project given their detection within, or adjacent to the Study Area.

Those threatened fauna species which are listed under the EPBC Act that were attributed a moderate to high likelihood of occurrence within the Study Area include: Cattle Egret, Rainbow Bee-eater, Black-faced Monarch, Rufous Fantail, Large-eared Pied Bat, and Grey-headed Flying Fox. An EPBC Act Assessment of Significance for each of these species has been completed and concluded that a significant impact to the Koala was possible. A significant impact on the remaining EPBC Act listed threatened fauna was determined to be unlikely.

Mitigation measures associated with indirect impacts have been proposed, will be included in various management plans that will be prepared and/or updated on approval of the Project and will be implemented on site during construction and operations associated with the continuation of mining over the next 30 years.

The BAM identifies the Biodiversity Credit Calculator as the appropriate tool for quantifying the precise nature of the offsets required in both ecosystem and species credit terms.

As detailed in our assessment, the revised total of ecosystem credits required to offset the Project (taking into consideration the reduction in credits due to the Peppertree Modification 5 Project) equate to the following:



- Total of 1,038 credits for PCT 1334 Yellow Box Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670)
- Total of 885 credits for PCT 778 Coast Grey Box stringybark dry woodland on slopes of the Shoalhaven Gorges Southern Sydney Basin (SR534)
- Total of 260 credits for PCT 1150 Silvertop Ash Blue-leaved Stringybark shrubby open forest on ridges, north east South Eastern Highlands Bioregion (SR624)
- Total of 325 credits for PCT 731 Broad-leaved Peppermint Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion (SR524).

The species credits required for the Project include:

- A total of 2,454 credits for the impact to Koala habitat
- A total of 3,836 credits for the impact to Large-eared Pied Bat habitat
- A total of 2 credits for the removal Solanum celatum.

An offset strategy has been discussed in section 6. Boral propose to offset the Project using a range of offsetting mechanisms.



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Regional context



Project boundary

Project Manager:

Drawn by: PR



Regional context

Marulan South Limestone Mine Continued Operations

FIGURE 1



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Local context



MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION ENVIRONMENTAL IMPACT STATEMENT



Project Manager:

Drawn by: PR

Local context

Marulan South Limestone Mine Continued Operations

FIGURE 2



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Figure The Project



MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION ENVIRONMENTAL IMPACT STATEMENT



Project Manager:

Drawn by: PR

The Project

Marulan South Limestone Mine Continued Operations

FIGURE 3



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The Project - Disturbance footprint

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION ENVIRONMENTAL IMPACT STATEMENT





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The Project Disturbance Footprint Marulan South Limestone Mine Continued Operations

FIGURE 4

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Marulan Creek Dam - Disturbance footprint

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION ENVIRONMENTAL IMPACT STATEMENT



Drawn by: PR



Marulan Creek Dam - Disturbance footprint

Marulan South Limestone Mine Continued Operations

FIGURE 5



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Marulan South Limestone Mine Continued Operations Site Map of Marulan South Project



Marulan South Limestone Mine Continued Operations Location Map

Figure 7



Environment and Heritage

Niche PM: Luke Baker Niche Proj. #: 2155 Client: Boral Cement Limited







Marulan South Limestone Mine Continued Operations Location Map with 1,500m buffer

Niche PM: Luke Baker Niche Proj. #: 2155 Client: Boral Cement Limited







Marulan South Limestone Mine Continued Operations Direct Impact and Indirect Impact extent without Migitation Measures







Marulan South Limestone Mine Continued Operations Existing Vegetation Mapping (Tozer et al 2006)







Marulan South Limestone Mine Continued Operations Validated Vegetation Mapping

Niche PM: Luke Baker Niche Proj. #: 2155 Client: Boral Cement Limited



Threatened Ecological Community (BC Act)

White Box Yellow Box Blakelys Red Gum Grassy Woodland, Medium (site integrity 40.1)White Box Yellow Box Blakelys Red Gum Grassy Woodland, Acacia (site integrity 26.1)White Box Yellow Box Blakelys Red Gum Grassy Woodland, Poor (site integrity 23.7)





Marulan South Limestone Mine Continued Operatations Threatened Ecological Communities listed under the BC Act

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Marulan South Limestone Mine Continued Operatations Threatened Ecological Communities listed under the EPBC Act

Niche PM: Luke Baker Niche Proj. #: 2155 Client: Boral Cement Limited

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GDA 1994 MGA Zone 56

Environment and Heritage

Figure 13

Imagery: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Environment and Heritage



Niche PM: Luke Baker Niche Proj. #: 2155 Client: Boral Cement Limited

Marulan South Limestone Mine Continued Operations Fauna Survey Effort rrawn by: File: Ti\SpatialWorkingia2155\BDAR Figures\BDAR 2020\2155_Figure_13_fauna survey effort.mkd Last updated: 5/5/2020 3:18:46 F







Marulan South Limestone Mine Continued Operations Threatened Flora and Fauna Recorded







Marulan South Limestone Mine Continued Operations Koala Habitat within Locality







Marulan South Limestone Mine Continued Operations Large-eared Pied Bat Habitat within Locality







Marulan South Limestone Mine Continued Operations Grey-headed Flying Fox Habitat within Locality

Figure 18

Imagery: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community







Figure 19

Marulan South Limestone Mine Continued Operations

Potential Regent Honeyeater Habitat within Locality



Appendix 1. Likelihood of occurrence

Threatened flora likelihood of occurrence

Scientific Name	Common Name	BC Act	EPBC Act	Habitat ⁴	Likelihood of Occurrence
Acacia bynoeana	Bynoe's Wattle	V	V	<i>A. bynoeana</i> occurs mainly in heath and dry sclerophyll forest (Morrison & Davies 1991). The substrate is typically sand and sandy clay, often with ironstone gravels and is usually very infertile and well-drained. The species seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds.	Low – habitat not suitable within Study Area and unlikely to remain undetected during survey if present.
Acacia flocktoniae	Flockton Wattle	V	V	This species grows in dry sclerophyll forest on low nutrient soils derived from sandstone. Associated species include <i>Acacia stricta</i> and <i>Podolobium ilicifolium</i> . Altitude is 500-1000 m asl, average annual rainfall is 800-1200 mm (Benson & McDougall 1996). This species has isolated occurrences from Mt Wilson and Little Hartley south to Yerranderie and Picton, in the Cental Tablelands of NSW Specific cited locations include: Little Hartley, Megalong Valley, Mt Victoria, Kiaramba Ridge, Byrnes Gap (near Yerranderie), Scotts Main Range, Nepean R. and Yerranderie (Benson & McDougall 1996; Orchard & Wilson 2001).	Low – habitat not suitable within Study Area based on the absence of associated species. The species is relatively conspicuous and unlikely to remain undetected during survey if present.
Caladenia tessellata	Thick- lipped Spider- orchid	E	V	Found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. Known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. Known to favour low, dry sclerophyll woodland (for example open Kunzea woodland) with a heathy or sometimes grassy understorey on clay loams or sandy soils. The population at Braidwood occurs in dry, low Brittle Gum (<i>Eucalyptus mannifera</i>), Inland Scribbly Gum (<i>E. rossii</i>) and <i>Allocasuarina</i> spp. woodland with a sparse understorey and stony soil.	Low – no records within 10km of subject site. There is some marginal habitat on subject site, however given the species was not detected during survey, the species is unlikely to be present.
Commersonia prostate	Dwarf Kerrawang	E	E	Occurs on sandy, sometimes peaty soils in a wide variety of habitats: Snow Gum (Eucalyptus pauciflora) Woodland and Ephemeral Wetland floor at Rowes Lagoon; Blue leaved Stringybark (E. agglomerata) Open Forest at Tallong; and in Brittle Gum (E. mannifera) Low Open Woodland at Penrose; Scribbly Gum (E. haemostoma)/ Swamp Mahogany (E. robusta) Ecotonal Forest at Tomago. Associated native species may include Imperata cylindrica, Empodisma minus and Leptospermum continentale. Not recorded during our targeted survey. It relatively conspicuous and unlikely to remain undetected. Has not been recorded previously at the Mine or immediate surrounds.	Low – no records within 10km of subject site. There is some marginal habitat on subject site, however given the species was not detected during survey, the species is unlikely to be present.

⁴ As described in OEH Threatened Species Profiles (2018). Threatened Species Profiles <u>http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx</u>, unless otherwise stated.



Scientific Name	Common Name	BC Act	EPBC Act	Habitat ⁴	Likelihood of Occurrence
Cryptostylis hunteriana	Leafless Tongue- orchid	V	V	Grows in swamp-heath on sandy soils, chiefly in coastal districts, south from the Gibraltar Range. The Leafless Tongue-orchid has been reported to occur in a wide variety of habitats including heathlands, heathy woodlands, sedgelands, Xanthorrheoa spp. plains, dry sclerophyll forests (shrub/grass sub-formation and shrubby sub-formation), forested wetlands, freshwater wetlands, grasslands, grassy woodlands, rainforests and wet sclerophyll forests (grassy sub-formation). Soils are generally considered to be moist and sandy, however, this species is also known to grow in dry or peaty soils.	Low – occurs within a variety of habitats however it was not detected during field survey and no records occur within 10 km of subject site.
Diuris aquilis	Buttercup Doubletail	E	v	The species is known from fewer than 20 small and fragmented populations between Braidwood and the Blue Mountains in the central and southern tablelands of NSW. The species previously occurred in the Liverpool area of western Sydney but has not been located there in over 100 years. Only three populations, containing a total of less than 50 individuals, occur within a conservation reserve, Kanangra-Boyd National Park. The remaining populations are restricted to remnant vegetation along roadsides and within agricultural lands. Buttercup Doubletail favours montane eucalypt forest and low open woodland with a grassy heathy understory, and secondary grassland, growing in gravelly clay-loam, often on gentle slopes	Low – no records within the locality. Only known from 20 fragmented populations, none of which occur near the Study Area. The species can occur within Box Gum Woodland habitat, however was not detected during the field survey which was completed during the known flowering time for the species.
Diuris tricolor		V	-	Sporadically distributed on the western slopes of NSW, extending from south of Narrandera all the way to the north of NSW. Localities in the south include Red Hill north of Narrandera, Coolamon, and several sites west of Wagga Wagga. Condobolin-Nymagee road, Wattamondara towards Cowra, Eugowra, Girilambone, Dubbo and Cooyal, in the Central West. Pilliga SCA, Pilliga National Park and Bibblewindi State Forest in the north and Muswellbrook in the east. Associated species include Callitris glaucophylla, Eucalyptus populnea, Eucalyptus intertexta, Ironbark and Acacia shrubland. The understorey is often grassy with herbaceous plants such as Bulbine species.	Low – no records within the locality. No habitat within the Study Area. The species was not detected during the field survey which was completed during the known flowering time for the species.
Eucalyptus aggregata	Black Gum	V	-	Found in the NSW Central and Southern Tablelands, with small isolated populations in Victoria and the ACT. Has a moderately narrow distribution, occurring mainly in the wetter, cooler and higher parts of the tablelands in the lowest parts of the landscape, on alluvial soils, on cold, poorly-drained flats and hollows adjacent to creeks and small rivers. Also occurs as isolated paddock trees in modified native or exotic pastures. Often grows with other cold-adapted eucalypts, such as Snow Gum or White Sallee (<i>Eucalyptus pauciflora</i>), Manna or Ribbon Gum (<i>E. viminalis</i>), Candlebark (<i>E. rubida</i>), Black Sallee (<i>E. stellulata</i>) and Swamp Gum (<i>E. ovata</i>). Black Gum usually occurs in an open woodland formation with a grassy groundlayer dominated either by River Tussock (<i>Poa labillardierei</i>) or Kangaroo Grass (<i>Themeda australis</i>), but with few shrubs.	Low – Recorded over 2 km to the north-east of the subject site within Conservation Area. Relatively conspicuous species and unlikely to remain undetected during field survey.
Eucalyptus aquatica		V	V	Found primarily in the Penrose area near Goulburn where all records are either from State forest or private property. There is also one record from within Morton National Park. Occurs as scattered plants on open, swampy flats.	Low – habitat not suitable within Study Area and unlikely to remain undetected during survey if present.



Scientific Name	Common Name	BC Act	EPBC Act	Habitat ⁴	Likelihood of Occurrence
Eucalyptus macarthurii	Paddys RiverBox	V	-	A moderately restricted distribution, recorded from the Moss Vale District to Kanangra Boyd National Park. In the Southern Highlands it occurs mainly on private land, often as isolated individuals in, or on the edges of paddocks. Isolated stands occur in the north west part of the range on the Boyd Plateau. The only known record in the conservation estate is within Kanangra Boyd National Park. Occurs on grassy woodland on relatively fertile soils on broad cold flats.	Low – recorded over 5 km to the west. Relatively conspicuous species which is unlikely to remain undetected during survey.
Genoplesium baueri	Yellow Gnat- orchid	-	E	The species has been recorded from locations between Ulladulla and Port Stephens. About half the records were made before 1960 with most of the older records being from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahroonga. No collections have been made from those sites in recent years. Currently the species is known from just over 200 plants across 13 sites. The species has been recorded at locations now likely to be within the following conservation reserves: Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments. Grows in dry sclerophyll forest and moss gardens over sandstone.	None – no suitable habitat. No records. Not detected during field survey.
Genoplesium plumosum	Tallong Midge Orchid	CE	E	Occurs exclusively in heathland, generally dominated by common fringe-mytre and parrot- peas. Grows on very shallow soils or within mosses on sandstone conglomerate shelves. Plants exist only as a dormant tuber for much of the year, with leaves or fruiting stems dying back in winter. Reproduces by seed and has no mechanism for vegetative reproduction.	Low – the disturbed area is not along sandstone shelves.
Genoplesium superbum	Superb Midge Orchid	E	-	The Superb Midge Orchid is restricted to the Central and Southern Tablelands of NSW where it has been recorded from 2 locations near Nerriga, c. 20 km apart, and north of Wallerawang. Some plants occur in Morton National Park. The Superb Midge Orchid occurs predominantly in wet heathland on shallow soils above a sandstone cap but has also been found in open woodland interspersed with heath and dry open shrubby woodland.	No – no habitat present at site. No records within the locality. The species is restricted to the Central and Southern Tablelands of NSW where it has been recorded from 2 locations near Nerriga, c. 20 km apart, and north of Wallerawang. Surveys completed during the recommended survey period (February). Not recorded during field survey.
Grevillea molyneuxii	Wingello Grevillea	V	E	This species has only been recorded in low heathland on sandstone, where it grows in skeletal soil on flat, wet sandstone shelves above dissected valleys.	None – no suitable habitat.
Haloragis exalata subsp. exalata	Square Raspwart	v	V	Occurs in 4 widely scattered localities in eastern NSW. It is disjunctly distributed in the central coast, south coast and north-western slopes botanical subdivisions of NSW. The species appears to require protected and shaded damp situations in riparian habitats.	Low – not detected during field survey. Habitat marginal within disturbance area.
Kunzea cambagei	Cambage Kunzea	V	V	Restricted to damp, sandy soils in wet heath or mallee open scrub at higher altitudes on sandstone outcrops or Silurian group sediments.	None – no potential habitat.



Scientific Name	Common Name	BC Act	EPBC Act	Habitat ⁴	Likelihood of Occurrence
Lepidium hyssopifolium	Aromatic Peppercre SS	E	E	Currently, the species is known from near Bathurst and Bungendore, in the South Eastern Highlands Bioregion Historically, the Aromatic Peppercress has been recorded from the Northern and Central Tablelands, with an atypical specimen from Cooma on the Southern Tablelands (Harden 2000). The Central Tablelands records are from the Bathurst area; the Northern Tablelands collections are from Gostwyck, near Armidale, and there was an 1884 record from 'near Maryland', though this record may have been from either NSW or Queensland, as the Maryland Station once extended over the border. Most other records have been found to be misidentifications. Generally, the Basalt Pepper-cress is known to establish on open, bare ground with limited competition from other plants. The Basalt Pepper-cress was previously recorded from Eucalypt woodland with a grassy ground cover, low open Casuarina woodland with a grassy ground cover and tussock grassland. Recently recorded localities have predominantly been in weed-infested areas of heavy modification, high degradation and high soil disturbance such as road and rail verges, on the fringes of developed agricultural land or within small reserves in agricultural land. Many populations are now generally found amongst exotic pasture grasses and beneath exotic trees such as the Radiata Pine (<i>Pinus radiata</i>) and Monterey Cypress (<i>Cupressus macrocarpus</i>), often associated with other species of Lepidium. The lack of competition from other shade-tolerant species allows the Basalt Pepper-cress to persist.	Low – despite having marginal habitat present, there are no records within 10 km. Unlikely to be present.
Leucochrysum albicans var. tricolor	Hoary Sunray	-	E	Occurs in a wide variety of grassland, woodland and forest habitats, generally on relatively heavy soils. The Hoary Sunray occurs at relatively high elevations in woodland and open forest communities, in an area roughly bounded by Goulburn, Albury and Bega. The species has been recorded in the Yass Valley, Tumut, Upper Lachlan, Snowy River and Galong. The species is known from the South Eastern Highlands, Australian Alps and Sydney Basin bioregions. Herbarium records indicate that the taxa once occurred more widely in inland NSW, near Cobar, Dubbo, Lithgow, Moss Vale and Delegate.	Low – grassland areas are highly disturbed. No records within 10 km of subject site.
<i>Pelargonium</i> sp. Striatellum	Omeo's Stork's-bill	E	E	Flowering occurs from October to March. Occurs in habitat usually located just above the high water level of irregularly inundated or ephemeral lakes. During dry periods, the species is known to colonise exposed lake beds. The species is known to form clonal colonies by rhizomatous propagation. Known from only three locations in NSW, with two on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst. A population at a fourth known site on the Monaro has not been seen in recent years. The only other known population is at Lake Omeo, Victoria. It occurs at altitudes between 680 to 1030 m. It is known to occur in the local government areas of Goulburn-Mulwaree, Cooma-Monaro, and Snowy River, but	None – no known records. No habitat present.



Scientific Name	Common Name	BC Act	EPBC Act	Habitat ⁴	Likelihood of Occurrence
				may occur in other areas with suitable habitat; these may include Bombala, Eurobodalla, Palerang, Tumbarumba, Tumut, Upper Lachlan, and Yass Valley local government areas.	
Persicaria elatior	Tall Knotweed	V	V	Tall Knotweed has been recorded in south-eastern NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance. The species has only marginal habitat in the proposed Inundation area to the north of the Study Area. It is relatively conspicuous and likely to be detected during our field survey if presented	Low – no know records in locality. Habitat marginal at best. Likely to be detected if it were present.
Phyllota humifusa		V	V	Occurs in dry sclerophyll forest, sometimes near swamps, in deep sandy soils or gravely loams over a sandstone substrate. Accompanying trees are often Brittle Gum <i>Eucalyptus mannifera</i> , Narrow-leafed Peppermint <i>E. radiata</i> or Sydney Peppermint <i>E. piperita</i> .	Low – closest record over 6 km to the north-east. Lack of sandstone present. Habitat very marginal.
Pimelea axiflora subsp. pubescens	Bungonia Rice- flower	E	-	Endemic to NSW and currently only known to occur in the Bungonia State Conservation Area, south east of Goulburn. Occurs in a single population which is estimated to contain a total of 50 to 500 plants within an area of less than 4 square kilometres. Occurs on limestone cliff edges and outcrops.	Low - This species was not recorded within the Study Area during the field surveys or in any previous survey of the Study Area. The species is currently only known to occur in the Bungonia State Conservation Area, south-east of Goulburn, in a single population which is estimated to contain a total of 50 to 500 plants within an area of less than four square kilometres. The species occurs along limestone cliff edges and outcrops. Within the Study Area such habitat features are limited and occur sparsely to the far east of the existing Mine. These features will not be impacted by the Project as they do not occur within the Study Area. As such, given the species was not recorded during the current or previous survey, and potential habitat is unlikely to be disturbed as a result of the Project, the species has not been considered further in this assessment.



Scientific Name	Common Name	BC Act	EPBC Act	Habitat ⁴	Likelihood of Occurrence
Pomaderris cotoneaster	Cotoneast er Pomaderri s	E	E	Cotoneaster Pomaderris has been recorded in a range of habitats in predominantly forested country. The habitats include forest with deep, friable soil, amongst rock beside a creek, on rocky forested slopes and in steep gullies between sandstone cliffs. Habitat notes from specimens include: 'base of cliff, tall open forest (<i>E. fastigata</i>)'; 'alluvial terrace with tall open forest (<i>E. cypellocarpa</i>)'; 'alluvial terrace with tall open forest (<i>E. muelleriana</i>)'; 'rocky riparian site amongst tall open eucalypt forest (<i>E. viminalis</i>)'; 'rocky river bed'; 'Growing on dry south-westerly facing slope above river. Associated with <i>Westringia</i> sp. aff. Longifolia, <i>Grevillea lanigera, Prostanthera</i> sp. nov., <i>Eucalyptus radiata, Olearia sp., Kunzea ericoides</i> and <i>Acacia pravissima</i> '; 'Growing in shrubby woodland of <i>Eucalyptus maidenii</i> & <i>E. elata</i> . South-facing slope with loamy soil on metasiltstone'	Low - This species was not recorded within the Study Area during the field surveys or in any previous survey of the Study Area. The closest record is within 1 kilometre to the south in Bungonia gorge. The species has been recorded from five reserves: South East Forests National Park (three populations); Morton National Park (two populations); Kosciuszko National Park (one population), Bungonia State Conservation Area (two populations); Coopracambra National Park (one population). The species has been recorded in a range of habitats in predominantly forested country. The habitats include forest with deep, friable soil, amongst rock beside a creek, on rocky forested slopes and in steep gullies between sandstone cliffs. The species was given a moderate likelihood of occurrence given it can occur within a wide variety of habitat. However, the species was not recorded during targeted survey. Furthermore, the records of <i>Pomaderris cotoneaster</i> in Bungonia State Conservation Area has been associated with the following species: <i>Eucalyptus dives</i> and <i>E. macrorhyncha, E. agglomerata / E. punctata</i> forest. These species were only occasionally recorded during the survey, however were recorded outside of the Study Area.
Pomaderris delicata	Delicate Pomaderri s	CE	CE	Delicate Pomaderris is known from only two sites; between Goulburn and Bungonia and south of Windellama (Cullula). At both known sites the Delicate Pomaderris grows in dry open forest dominated by <i>Eucalyptus sieberi</i> with a dense she-oak understorey. Soils are shallow and derived from sandstone and siltstone. Nothing is known about the response of the species to fire and other disturbance.	Low – Not detected during the field survey. Associate species Eucalyptus seiberi is present, however after traverses throughout the Study Area



Scientific Name	Common Name	BC Act	EPBC Act	Habitat ⁴	Likelihood of Occurrence
					is unlikley to remain undetected given it is a relatively conspicuous species.
Pomaderris pallida	Pale Pomaderri S	V	V	This species usually grows in shrub communities surrounded by Brittle Gum (<i>Eucalyptus mannifera</i>) and Red Stringybark (<i>E. macrorhyncha</i>) or Callitris spp. woodland. The Pale Pomaderris is found at numerous small sites along the plateau edge and very steep upper slopes and cliffs of river valleys at 480-600 m above sea level. The ACT sites are only on the eastern banks of the rivers, with an aspect ranging from north-westerly through westerly to southerly. The soils are shallow, pale brown sandy loams over granite rock and large, exposed granite boulders may be present. The species grows in near-monospecific stands in shrubland, surrounded by Eucalyptus or Callitris woodland, or in open forest. The shrubland is commonly dominated by <i>Bursaria spinosa</i> (Blackthorn/Boxthorn), <i>Grevillea juniperina</i> (Juniper Grevillea), <i>Acacia rubida</i> (Red-stemmed Wattle) and <i>Kunzea ericoides</i> (formerly <i>Leptospermum phylicoides</i>).	Low - This species was not recorded within the Study Area during the field surveys or in any previous survey of the Study area. The species is found at numerous small sites along the plateau edge and very steep upper slopes and cliffs of river valleys. Within the Study Area the species has potential habitat toward the east as this area contains steeper slopes. However, there is a low potential for this species to occur within the Study Area given the Study Area is located approximately 100 metres away from the plateau edges. As such, the species is unlikely to be disturbed and has not been considered further in this assessment.
Pultenaea pedunculata	Matted Bush-pea	E	-	The Matted Bush-pea occurs in a range of habitats. NSW populations are generally among woodland vegetation but plants have also been found on road batters and coastal cliffs. It is largely confined to loamy soils in dry gullies in populations in the Windellama area. The ability of stems to creep and root from the nodes has made this species a very good coloniser of bare ground in many parts of its range. Matted Bush-pea is widespread in Victoria, Tasmania, and south-eastern South Australia. In NSW however, it is represented by just three disjunct populations, in the Cumberland Plain in Sydney, the coast between Tathra and Bermagui and the Windellama area south of Goulburn (where it is locally abundant). The Cumberland Plain occurrences were more widespread (Yennora, Canley Vale and Cabramatta were lost to development) and is now found at Villawood and Prestons, and north-west of Appin between the Nepean River and Devines Tunnel number 2 (Upper Sydney Water Supply Canal).	Low – out of known range. Unlikely to be present.
Rulingia prostrata	Dwarf Kerrawang	E	E	Occurs on sandy, sometimes peaty soils in a wide variety of habitats: snow gum woodland at Rose Lagoon; blue leaved stringybark open forest at Tallong; and in brittle gum low open woodland at Penrose; scribbly gum – swamp mahogany ecotonal forest at Tomago.	Low – habitat not suitable within disturbance area and unlikely to remain undetected during survey if present.



Scientific Name	Common Name	BC Act	EPBC Act	Habitat ⁴	Likelihood of Occurrence
Rutidosis heterogama	Buttone Wrinkewar t	v	v	Recorded from near Cessnock to Kurri Kurri with an outlying occurrence at Howes Valley. On the Central Coast it is located north from Wyong to Newcastle. There are north coast populations between Wooli and Evans Head in Yuraygir and Bundjalung National Parks. It also occurs on the New England Tablelands from Torrington and Ashford south to Wandsworth south-west of Glen Innes. Grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides	Low – habitat not suitable within Study Area and unlikely to remain undetected during survey if present.
Rutidosis Ieptorrhynchoide s	Button Wrinklewo rt	E	E	In the ACT and NSW, Button Wrinklewort occurs in box-gum woodland, secondary grassland derived from box-gum woodland or in natural temperate grassland; and often in the ecotone between the two communities.	Low – habitat not suitable within Study Area and unlikely to remain undetected during survey if present.
Solanum celatum		E	-	Grows on hills and slopes in eucalypt woodland; commonly found after fire or disturbance. Restricted to an area from Wollongong to a little south of Nowra and west to Bungonia Nature Reserve.	Known – recorded during current survey. Many records within the locality.
Swainsona sericea	Silky Swainson- pea	v	-	Silky Swainson-pea has been recorded from the Northern Tablelands to the Southern Tablelands and further inland on the slopes and plains. There is one isolated record from the far north-west of NSW. Its stronghold is on the Monaro. Also found in South Australia, Victoria and Queensland. Found in Natural Temperate Grassland and Snow Gum <i>Eucalyptus pauciflora</i> Woodland on the Monaro. Found in Box-Gum Woodland in the Southern Tablelands and South West Slopes.	Low – not detected during targeted flora survey which was completed during the recommended flowering period (November). Unlikely to remain undetected during the survey.
Thelymitra kangiloonica	Kangaloon Sun Orchid	CE	CE	Only known to occur on the southern tablelands of NSW in the Moss Vale – Kangaloon – Fitzroy Falls area at 550-700 m above sea level. It is known to occur at three swamps that are above the Kangaloon Aquifer. It is found in swamps in sedgelands over grey silty grey loam soils	None – no habitat present.
Thesium australe	Austral Toadflax	v	v	Grows in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland or grassy woodland. Grows on kangaroo grass tussocks but has also been recorded within the exotic bullrush grass.	No records within 10 km of subject site. Habitat not suitable.



Threatened fauna likelihood of occurrence

Scientific Name	Common Name	BC Act	EPBC Act	Preferred habitat/previous records and habitat within impact area	Likelihood of Occurrence	Potential fo Impacts	r Species Credit or Ecosystem Species and whether predicted
Amphibians							
Heleioporus australiacus	Giant Burrowing Frog	V	V	The Giant Burrowing Frog has been recorded breeding in a range of water bodies associated with more sandy environments of the coast and adjacent ranges from the Sydney Basin south the eastern Victoria. It breeds in hanging swamps, perennial non-flooding creeks and occasionally permanent pools, but permanent water must be present to allow its large tadpoles time to reach metamorphosis. Some potential habitat is present within the gullies to the south and east of the emplacement areas, however the species has not been previously recorded within the locality, and were not detected during amphibian surveys within more ideal habitat within the Shoalhaven Gorge. Based on the habitat requirement, non-detection during surveys, coupled with the absence of records within the locality, the species is likely to be absent from the Study Area and therefore have not been considered further.	Low	Unlikely	Species – excluded from further assessment
Litoria aurea	Green and Golden Bell Frog	E	V	Inhabits a very wide range of water bodies including marshes, dams and streams, particularly those containing emergent vegetation such as bulrushes or spikerushes. It also inhabits numerous types of man-made water bodies including quarries and sand extraction sites. Optimum habitat includes water-bodies that are un-shaded, free of predatory fish such as Plague Minnow, have a grassy area nearby and diurnal sheltering sites available. A single record exists from the locality and region from 40 years ago. Some potential habitat is present within the gullies to the south and east of the emplacement areas, however the species has not been previously recorded within the locality, and were not detected during amphibian surveys within more ideal habitat within the Shoalhaven Gorge. Based on the habitat requirement, non-detection during surveys, coupled with the absence of records within the locality, the species is likely to be absent from the Study Area and therefore have not been considered further.	Low	Unlikely	Species – excluded from further assessment
Litoria littlejohni	Littlejohn's Tree Frog	V	v	Occurs in wet and dry sclerophyll forests and heathland associated with sandstone outcrops between 280 and 1000 m on the eastern slopes of the Great Dividing Range from the Central Coast down into Victoria. Individuals have been collected from a wide range of water bodies that includes semi-permanent dams, permanent ponds, temporary pools and permanent streams, with calling occurring from fringing vegetation or on the banks. Individuals have been observed sheltering under rocks on high exposed ridges during summer and within deep leaf litter adjacent to the breeding site. Calling occurs in all months of the year, often in association with heavy rains. The tadpoles are distinctive, being large and very dark in colouration.	Low	Unlikely	Species – excluded from further assessment



Scientific Name	Common Name	BC Act	EPBC Act	Preferred habitat/previous records and habitat within impact area	Likelihood of Occurrence	Potential for Impacts	Species Credit or Ecosystem Species and whether predicted
				Some potential habitat is present within the gullies to the south and east of the emplacement areas, however the species has not been previously recorded within the locality, and were not detected during amphibian surveys within more ideal habitat within the Shoalhaven Gorge. Based on the habitat requirement, non-detection during surveys, coupled with the absence of records within the locality, the species is likely to be absent from the Study Area and therefore have not been considered further.			
Birds							
Actitis hypoleucos	Common Sandpiper		M, MA	Utilises a wide range of coastal wetlands and some inland wetlands, mostly found around muddy margins or rocky shores. Forages in shallow water and on soft mud, roosts on rocks or vegetation such as mangroves. Northern hemisphere breeding. Unlikely to utilise the Study Area given the absence of inland wetlands.	Low – transient visitor only.	Unlikely – negligible impacts.	N/A
Anthochaera phrygia	Regent Honeyeater	CE	E,M	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. This species has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests. Three records from the locality centred around the Bungonia National Park area to the south. As the species is migratory it may occur as a transient visitor to the site, including to forage, but would use the site rarely. No breeding habitat present. Not recorded during targeted bird survey.	Low/Modera te	Unlikely – negligible impacts.	Species – excluded from further assessment – not detected during survey.
Apus pacificus	Fork-tailed Swift	-	м	In Australia, they mostly occur over inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over settled areas, including towns, urban areas and cities. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes. They forage aerially, up to hundreds of metres above ground, but also less then 1 m above open areas or over water. They are common in NSW from October–March and common in the ACT from December–March with flocks occurring three to four times a year within this time period.	Low – transient visitor only.	Unlikely – negligible impacts. May fly over site.	N/A



Scientific Name	Common Name	BC Act	EPBC Act	Preferred habitat/previous records and habitat within impact area	Likelihood of Occurrence	Potential for Impacts	Species Credit or Ecosystem Species and whether predicted
				The species may fly over the Study area, or may foraging above the canopy tree line on occassinon. Highly unlikely to utilise the Study Area on a regular basis.			
Ardea alba	Great Egret	-	М	Great Egrets are widespread in Australia. Great Egrets has been reported in a wide range of wetland habitats (for example inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial). These include swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs. Given the wide habitat preferences, the species may occur intermittently within the Study area, particularly during flood around Marulan Creek, however unlikely to the use the Study Area on a permanent basis.	Low/ Moderate	Potential – with minimal impacts.	N/A
Ardea ibis	Cattle Egret	-	М	The Cattle Egret is widespread and common according to migration movements and breeding localities surveys. It is commonly associated with the habitats of farm animals, particularly cattle, but also pigs, sheep, horses and deer. The Cattle Egret is known to follow earth-moving machinery and has been located at rubbish tips. It uses predominately shallow, open and fresh wetlands including meadows and swamps with low emergent vegetation and abundant aquatic flora. The Cattle Egret is found in grasslands, woodlands and wetlands, and is not common in arid areas. It also uses pastures and croplands, especially where drainage is poor. May occur intermittently within the Study area – species is relatively common in distribution and may occupy range of habitat types, such as open paddock vegetation.	Low/Modera te	Unlikely	N/A
Botaurus poiciloptilus	Australasian Bittern	E	E	The Australasian Bittern is widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes and spikerushes.Single record from Bungonia State Conservation Reserve. Potential habitat is very limited within the proposed disturbance areas with permanent wetlands very limited in extent.	Low	Unlikely	Species - excluded from further assessment
Calidris acuminata	Sharp-tailed Sandpiper	-	М	Prefers muddy edges of shallow or brackish wetlands, with inundated or emergent sedges, saltmarsh or other low vegetation. Also found foraging in sewage ponds and flooded paddocks. Northern hemisphere breeding. Given the absence of wetlands, and saltmarsh it is unlikely that the species would utilise the Study Area.	Low – transient visitor only.	Unlikely – negligible impacts.	N/A



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Calidris ferruginea	Curlew Sandpiper	E	CE,M	It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes the inland. Northern hemisphere breeding. Given the absence of wetlands, and lagoons it is unlikely that the species would utilise the Study Area.	Low – transient visitor only.	Unlikely – negligible impacts.	Ecosystem
Calidris melanotos —	Pectoral Sandpiper	-	м	In Australasia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. In New South Wales (NSW), the Pectoral Sandpiper is widespread, but scattered. Records exist east of the Great Divide, from Casino and Ballina, south to Ulladulla. Given the widespread habitat of the species in NSW, any waterbody would therefore be determined hatbiat to an extent. The Study Area is likely to have very marginal habitat where there are farm dams, and within the area mapped as Innundation Area. Such habitat is available throughout the locality within farm dams, lower seepage areas, and riparian areas. There is no limiting habitat for the species within the Study Area contain any important limiting foraging habitat.	Low – transient visitor only.	Unlikely – negligible impacts.	N/A
Callocephalon fimbriatum	Gang-gang Cockatoo	v	-	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine snow gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed. The species has been recorded to the south and north of the Study Area and is expected to use the site on occasion to forage. The species was not detected during survey however there is very limited breeding habitat.	Moderate. Recorded on Peppertree Quarry by ERM (2006)	Potential – with minimal impacts.	Ecosystem
Calyptorhynchu s lathami	Glossy Black- Cockatoo	v	-	Inhabits forest with low nutrients, characteristically with key Allocasuarina spp. Tends to prefer drier forest types with a middle stratum of Allocasuarina below Eucalyptus or Angophora. Often confined to remnant patches in hills and gullies. Breed in hollows stumps or limbs, either living or dead. Endangered population in the Riverina. The species has been recorded to the south and north of the Study Area and is expected to use the site on occasion to forage. The species was not detected during survey however there is very limited breeding habitat.	Moderate	Potential – with minimal impacts.	Ecosystem



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Chthonicola sagittata	Speckled Warbler	v	-	The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. This species has been recorded from the locality within grassy woodland areas to the west of the Study Area. While the species was not recorded during field survey there is potential habitat that may be used. Three records exist for Speckled Warbler from the locality west of the Study Area. The species was not recorded during field survey.	Moderate	Potential – with minimal impacts.	Ecosystem
Climacteris picumnus victoriae	Brown Treecreeper	v	-	Found in eucalypt woodlands (including White Box Yellow Box Blakely's Red Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (<i>Eucalyptus camaldulensis</i>) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains. Whilst this species has been recorded within the locality, there is limited potential habitat within the Study Area as mature trees with hollows and large logs are rare. Conspicuous species not recorded during field survey.	Low	Unlikely	Ecosystem
Daphoenositta chrysoptera	Varied Sittella	V	-	Inhabits wide variety of dry eucalypt forests and woodlands, usually with either shrubby under storey or grassy ground cover or both, in all climatic zones of Australia. Usually in areas with rough-barked trees, such as stringybarks or ironbarks, but also in paperbarks or mature Eucalypts with hollows. Four records exist from the locality to the west of the Study Area. A single observation of this species was made during the feasibility assessment from Grassy Woodland.	Known	Likely – non- significant impacts	Ecosystem
Gallinago hardwickii	Latham's Snipe	-	М	Latham's Snipe is a non-breeding migrant to the south east of Australia including Tasmania, passing through the north and New Guinea on passage. Latham's Snipe breed in Japan and on the east Asian mainland. Seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration. No records from locality and not recorded during field survey. The general habitat for the species is near the coast.	Low	Unlikely	N/A
Glossopsitta pusilla	Little Lorikeet	V	-	Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2	Low	Unlikely	Ecosystem



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				m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes.			
				Most records from the region are from lower elevation near coastal areas. Not recorded during survey.			
Grantiella picta	Painted Honeyeater	v	v	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits boree, brigalow and box-gum woodlands and box-ironbark forests.	Low	Unlikely	Ecosystem
Haliaeetus leucogaster	White-bellied Sea-Eagle	v	Μ	Inhabits coastal and near coastal areas, building large stick nests, and feeding mostly on marine and estuarine fish and aquatic fauna. No nests were recorded within the Study Area during the field survey, nor was the species recorded flying over head during the field surveys.	Low	Unlikely	Ecosystem
Hieraaetus morphnoides	Little Eagle	v	-	Most abundant in lightly timbered areas with open areas nearby. Often recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. May nest in farmland, woodland and forest in tall trees. Wide ranging species, not recorded during field surveys. One record exists from the north of the locality. Two records from Marulan area. No individuals or breeding nests were observed during field surveys.	Low/Modera te –may fly over	Unlikely	Ecosystem
Hirundapus caudacutus	White-throated Needletail	-	М	An aerial species found in feeding concentrations over cities, hilltops and timbered ranges. Potential overfly habitat only.	Low – transient visitor only.	Unlikely	N/A
Lathamus discolor	Swift Parrot	E	E	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability. No records within the locality and not recorded from surveys. Closest record is approximately 50 km east and most records in the region are coastal. As the species is migratory it may occur as a transient visitor to the site, including to forage, but would use the site rarely given the lack of records from the region.	Low	Unlikely	Ecosystem
Melanodryas cucullata cucullata	Hooded Robin	V	-	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. One recent and one dated record from locality to	Low	Unlikely	Ecosystem


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				west of Study Area. Conspicuous bird that is primarily sedentary and was not recorded during survey.			
Melithreptus gularis gularis	Black-chinned Honeyeater	V	-	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (<i>Eucalyptus sideroxylon</i>), White Box (E. <i>albens</i>), Inland Grey Box (<i>E. microcarpa</i>), Yellow Box (<i>E. melliodora</i>), Blakely's Red Gum (<i>E. blakelyi</i>) and Forest Red Gum (<i>E. tereticornis</i>). Two records from 30 years ago exist for this species from near Marulan and towards Goulburn. No other records occur from the region and the species was not recorded during field survey.	Low	Unlikely	Ecosystem
Merops ornatus	Rainbow Bee- eater	-	М	Found throughout mainland Australia most often in open forests, woodlands and shrublands, and cleared areas, usually near water. It will be found on farmland with remnant vegetation and in orchards and vineyards. It will use disturbed sites such as quarries, cuttings and mines to build its nesting tunnels. Widespread migratory species with wide habitat preference, and as such, may move through Study Area occasionally.	Low/Modera te	Potential – with minimal impacts.	N/A
Monarcha melanopsis	Black-faced Monarch	-	М	In New South Wales and the Australian Capital Territory, the species occurs around the eastern slopes and tablelands of the Great Divide, inland to Coutts Crossing, Armidale, Widden Valley, Wollemi National Park, Wombeyan Caves and Canberra. Found along the coast of eastern Australia, becoming less common further south. Inhabits rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating. Predominant habitat within Study Area is in lower areas away from proposed impact areas. May move through other parts of the Study Area.	Low/Modera te	Potential – with minimal impacts.	N/A
Myiagra cyanoleuca	Satin Flycatcher	-	Μ	The Satin Flycatcher is found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. Found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests. Habitat types which the species prefers do not occur within the Study Area.	Low	Unlikely	N/A
Motacilla flava	Yellow Wagtail	-	М	Breeds in temperate Europe and Asia. The Yellow Wagtail is a regular wet season visitor to northern Australia. Increasing records in NSW suggest this species is an occasional but regular summer visitor to the Hunter River region. The species is considered a vagrant to Victoria, South Australia and southern Western Australia. Habitat requirements for the Yellow Wagtail are highly variable, but typically include open grassy flats near water. Habitats include open areas with low vegetation such as grasslands, airstrips, pastures, sports fields; damp open areas such as muddy or grassy edges of wetlands, rivers, irrigated	Low	Unlikely	Ecosystem



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				farmland, dams, waterholes; sewage farms, sometimes utilise tidal mudflats and edges of mangroves.			
Neophema pulchella	Turquoise Parrot	V	-	The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Nests in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust. Recorded within Shoalhaven Gorge, within Casuarina gully forest, possibly moving to the area to drink. There are no records from the locality and records from the region are very sparse. The species was recorded outside of the Study Area during the field survey and there are limited hollow resources available for breeding within the Study Area.	Recorded during field survey outside of the Study Area.	Unlikely	Ecosystem
Ninox strenua	Powerful Owl	v	-	Occupies wet and dry eucalypt forests and rainforests. Can occupy both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. It is most commonly recorded within red turpentine in tall open forests and black she-oak within open forests. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm.	Moderate. Recorded outside of the Study Area.	Potential – with minimal impacts.	Dual credit. Species Credit component (breeding habitat) not present in Study Area and therefore listed as an Ecosystem credit.
Numenius madagascarien sis	Eastern Curlew	-	CE, MA, M	A primarily coastal distribution. Found in all states, particularly the north, east, and south- east regions including Tasmania. Rarely recorded inland. Mainly forages on soft sheltered intertidal sand flats or mudflats, open and without vegetation or cover. Breeds in the northern hemisphere.	Low	Unlikely	Ecosystem
Pandion cristatus	Eastern Osprey	v	М	Eastern Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging. They frequent a variety of wetland habitats including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes. They exhibit a preference for coastal cliffs and elevated islands in some parts of their range, but may also occur on low sandy, muddy or rocky shores and over coral cays. They may occur over atypical habitats such as heath, woodland or forest when travelling to and from foraging sites.	None	None	Ecosystem



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Petroica boodang	Scarlet Robin	V	-	The Scarlet Robin is found from SE Queensland to SE South Australia and also in Tasmania and SW Western Australia. In NSW, it occurs from the coast to the inland slopes. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs	Known	Likely – with minimal impacts.	Ecosystem
Petroica phoenicea	Flame Robin	v	-	 Flame Robins are found in a broad coastal band from southern Queensland to just west of the South Australian border. The species is also found in Tasmania. The preferred habitat in summer includes eucalyptus forests and woodland, whilst in winter prefers open woodlands and farmlands. It is considered migratory. The Flame Robin breeds from about August to January. Two records from the locality around Marulan, however not recorded during survey. As the species is somewhat migratory it may visit the site, particularly grassy woodlands during winter. 	Moderate	Potential – with minimal impacts.	Ecosystem
Rhipidura rufifrons	Rufous Fantail	-	Μ	Mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (<i>Eucalyptus microcorys</i>), Mountain Grey Gum (<i>E. cypellocarpa</i>), Narrow-leaved Peppermint (<i>E. radiata</i>), Mountain Ash (<i>E. regnans</i>), Alpine Ash (<i>E. delegatensis</i>), Blackbutt (<i>E. pilularis</i>) or Red Mahogany (<i>E. resinifera</i>); usually with a dense shrubby understorey often including ferns.	High – recorded outside of the Study Area	Likely – with minimal impacts	N/A
Rostratula australis	Australian Painted Snipe	E	E, M	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.	Low	Unlikely	Ecosystem
Sminthopsis leucopus	White-footed Dunnart	v	-	The White-footed Dunnart occurs in Tasmania and along the Victorian and southern NSW coast. The Shoalhaven area is the species' northern-most limit. It has not been recorded west of the coastal escarpment with the western-most record being from Coolangubra State Forest, approximately 10 km south-east of Bombala. The White-footed Dunnart is found in a range of different habitats across its distribution, including coastal dune vegetation, coastal forest, tussock grassland and sedgeland, heathland, woodland and forest. In NSW, the species seems to favour vegetation communities with an open understorey structure (contrasting with populations in Victoria which apparently prefer dense shrub and ground layers). It is patchily distributed across these habitats and, where present, typically occurs at low densities.	Low	Unlikely	Species
Stagonopleura guttata	Diamond Firetail	V	-	Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). Found in grassy eucalypt woodlands, including White Box Yellow Box Blakely's Red Gum Woodlands and snow gum	Known	Likely – with minimal impacts	Ecosystem



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				woodlands. Also occurs in open forest, mallee, natural temperate grassland, and in secondary grassland derived from other communities.			
Tringa nebularia	Common Greenshank	-	М	The species has been recorded in most coastal regions. It is widespread west of the Great Dividing Range, especially between the Lachlan and Murray Rivers and the Darling River drainage basin, including the Macquarie Marshes, and north-west regions. The Common Greenshank is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms. The species uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats. It will also use artificial wetlands, including sewage farms and saltworks dams, inundated rice crops and bores. Given the widespread habitat of the species in NSW, any waterbody would therefore be determined habitat to an extent. The Study Area is likely to have marginal habitat where there are farm dams, and within the area mapped as Innundation Area. Such habitat is available throughout the locality within farm dams, lower seepage areas, and riparian areas. There is no limiting habitat for the species within the Study Area. No breeding habitat for the species occurs. Nor does the Study Area contain any important limiting foraging habitat.	Low – transient visitor only.	Unlikely – negligible impacts.	N/A
Tyto novaehollandia e	Masked Owl	V	-	Inhabits a diverse range of wooded habitat that provide tall or dense mature trees with hollows suitable for nesting and roosting. Mostly recorded in open forest and woodlands adjacent to cleared lands. Nest in hollows, in trunks and in near vertical spouts or large trees, usually living but sometimes dead. Nest hollows are usually located within dense forests or woodlands. Masked owls prey upon hollow-dependent arboreal marsupials, but terrestrial mammals make up the largest proportion of the diet.	Moderate	Potential – with minimal impacts	Dual credit. Species Credit component (breeding habitat) not present in Study Area and therefore listed as an Ecosystem credit.
Tyto tenebricosa	Sooty Owl	V	-	Often found in tall old-growth forests, including temperate and subtropical rainforests. In NSW mostly found on escarpments with a mean altitude less than 500 metres. Nests and roosts in hollows of tall emergent trees, mainly eucalypts often located in gullies. Nests have been located in trees 125 to 161 centimetres in diameter. No local records. Nearest regional record near Bundanoon. Recorded during current surveys within the Bungonia gorge.	Moderate – recorded outside of Study Area in Bunongia Gorge	Potential — with minimal impacts	Dual credit. Species Credit component (breeding habitat) not present in Study Area and therefore listed as an



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							Ecosystem credit.
Fish							
Macquaria australasica	Macquarie Perch	E (FM Act)	E	 Macquarie perch are found in the Murray-Darling Basin (particularly upstream reaches) of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW, including the Hawkesbury and Shoalhaven catchments. The conservation status of the different populations is not well known, but there have been long-term declines in their abundance. Macquarie Perch are found in both river and lake habitats; especially the upper reaches of rivers and their tributaries. They are quiet, furtive fish that feed on aquatic insects, crustaceans and molluscs. Sexual maturity occurs at two years for males and three years for females. Macquarie perch spawn in spring or summer in shallow upland streams or flowing parts of rivers and females produce around 50,000-100,000 eggs which settle among stones and gravel of the stream or river bed. Populations from the eastward-flowing Shoalhaven and Hawkesbury rivers are genetically distinct and may represent an undescribed species (Allen et al., 2002). Potential habitat exists in the upper reaches and tributaries of Shoalhaven River where one specimen has been recorded in 2007 (3km upstream of Bungonia confluence. However such habitat is not present within Bungonia or Barbers Creek. 	Low – there is no preferred habitat in Bungonia Creek or Barbers Creek and no records from extensive surveys in these systems.	Unlikely	N/A
Prototroctes maraena	Australian Grayling	-	V	Historically, this species occurred in coastal streams from the Grose River Valley, southwards through NSW, Vic. and Tas, With occurrences in the Shoalhaven catchment below Tallowa Dam. It also occasionally occurred high upstream in the Snowy R. A single juvenile specimen was collected from Lake Macquarie in 1974. This species spends only part of its lifecycle in freshwater. The Tambo River population inhabits a clear, gravel-bottomed stream with alternating pools and riffles, and granite outcrops. It has also been associated with clear, gravel-bottomed habitats in the Mitchell & Wonnangatta Rivers but was present in a muddy-bottomed, heavily silted habitat in the Tarwin River.	None —no records up stream of Tallowa Dam.	Unlikely	N/A
Mammals							
Chalinolobus dwyeri	Large-eared Pied Bat	v	V	Located in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. Can also be found on the edges of rainforests and in wet sclerophyll forests. This species roosts in caves and mines in groups of between 3 and 37 individuals.	Known	Likely – with minimal impacts.	Species



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				Recorded at all locations where bat recorders were placed within the Study area including south of the proposed disturbance areas and within both the Western Overburden Emplacement area and the Northern Overburden emplacement area.			
				Spotted-tailed Quoll are found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Only in Tasmania is it still considered common. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.			
Dasyurus maculatus	Spotted-tailed Quoll	Spotted-tailed V Quoll	ootted-tailed V E uoll	One regional record only. Not recorded during field survey. Low abundance of preferred prey items (ground dwelling fauna), no denning habitat and widespread presence of foxes which is likely to prevent establishment of a population in the area. Quolls may occur on the site (more likely dispersing males) given proximity of conservation areas but are unlikely to use site with any frequency and there is limited value in regard to prey density.	Low	Unlikely	Ecosystem
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Inhabit sclerophyll forests, preferring wet habitats where trees are more than 20 m high. Two observations have been made of roosts in stem holes of living eucalypts. There is debate about whether or not this species moves to lower altitudes during winter, or whether they remain sedentary but enter torpor. This species also appears to be highly mobile and records showing movements of up to 12 km between roosting and foraging sites. Three records from locality to the west of the Study area near Marulan. One possible call from current survey. Not recorded at Marulan South during echolocation surveys.	Moderate – recorded outside of the Study Area	Potential – with low level impacts.	Ecosystem
Kerivoula papuensis	Golden-tipped Bat	V	-	Distributed along the east coast of Australia in scattered locations from Cape York Peninsula in Queensland to Bega in southern NSW. Found in rainforest and adjacent sclerophyll forest. Roost in abandoned hanging Yellow-throated Scrubwren and Brown Gerygone nests located in rainforest gullies on small first- and second-order streams. No Atlas records in locality or region. May occur within proposed disturbance areas but is likely to rarely use such areas being confined mainly to gullies.	Moderate – recorded outside of the Study Area	Potential – with low level impacts.	Ecosystem
Miniopterus schreibersii oceanensis	Eastern Bent- wing-bat	V	-	Eastern Bent-wing bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Known maternity caves within Bungonia Gorge. Recorded at one harp trap location and from all sites where echolocation recording was performed.	Known	Likely – with minimal impacts.	Ecosystem and species. Species Credit component (breeding habitat) excluded from assessment



Scientific Name	Common Name	BC Act	EPBC Act	Preferred habitat/previous records and habitat within impact area	Likelihood of Occurrence	Potential for Impacts	Species Credit or Ecosystem Species and whether predicted
Mormopterus norfolkensis	Eastern Freetail- bat	v	-	Most records are from dry eucalypt forests and woodlands to the east of the Great Dividing Range. Appears to roost in trees, but little is known of this species' habits. One record from locality from Hume Highway near Marulan. Not recorded during field survey. Hollows/required breeding habitat is rare within the areas to be impacted by clearing.	Known	Unlikely	Ecosystem
Petaurus australis	Yellow-bellied Glider	V	-	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. Recorded from Bungonia Gorge during current surveys. Not recorded during surveys of the disturbance areas and no obvious glider incisions found. Not recorded outside of protected area complex on tableland areas.	Low – recored in Bungonia Gorge	Unlikely	Ecosystem
Myotis macropus	Southern Myotis	V	-	Found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Generally roost in groups of 10 - 15 close to water in caves, Mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Has been recorded from locality near Bungonia gorge on three occasions. Three possible recordings during current survey. Limited water resources and roost habitat (e.g. hollow trees, bridges and culverts) within disturbance areas.	Moderate – recored outside of the Study Area in Bungonia Gorge.	Unlikely	Species
Petauroides volans	Greater Glider	EP	V	The Greater Glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria. It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows.	Low	Unlikely	No listed
Petaurus norfolcensis	Squirrel Glider	٧	-	Generally occurs in dry sclerophyll forests and woodlands but is absent from dense coastal ranges in the southern part of its range. Requires abundant hollow bearing trees and a mix of eucalypts, banksias and acacias. There is only limited information available on den tree use by Squirrel gliders, but it has been observed using both living and dead trees as well as hollow stumps. Within a suitable vegetation community at least one species should flower heavily in winter and one species of eucalypt should be smooth barked. Endangered population in the Wagga Wagga LGA. Not recorded during survey. No records from locality or region (one Atlas record from Marulan area with accuracy of 100 km).	Low	Unlikely	Species – Excluded from further assessment



Scientific Name	Common Name	BC Act	EPBC Act	Preferred habitat/previous records and habitat within impact area	Likelihood of Occurrence	Potential for Impacts	Species Credit or Ecosystem Species and whether predicted
Petrogale penicillata	Brush-tailed Rock-wallaby	E	v	Found in rocky areas in a wide variety of habitats including rainforest gullies, wet and dry sclerophyll forest, open woodland and rocky outcrops in semi-arid country. Commonly sites have a northerly aspect with numerous ledges, caves and crevices. No potential habitat within the disturbance areas and no habitat to be impacted indirectly. Not recorded during field survey.	Low	Unlikely	Species – excluded from further assessment
Phascolarctos cinereus	Koala	v	v	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall. Seen within forest on the east edge of existing Mine area.	High	Likely – significant impact under EPBC Act	Species
Potorous tridactylus tridactylus	Long-nosed Potoroo	v	v	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature. No records locally or regionally and not recorded during survey.	Low	Unlikely	Ecosystem
Pseudomys novaehollandia e	New Holland Mouse	-	v	The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes. No local records. Single record regionally. Habitat on site is not preferred habitat.	Low	Unlikely	Ecosystem
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Bats commute daily to foraging areas, usually within 15 km of the day roost although some individuals may travel up to 70 km. Recorded from Bungonia Gorge during field survey and expected to occur throughout area.	High – recorded outside of the Study Area	Likely – non significant impacts.	Ecosystem and species. Species Credit component (breeding habitat) excluded from further assessment.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. No Bionet Atlas records in locality or within the wider region.	Known	Potential	Ecosystem



Scientific Name	Common Name	BC Act	EPBC Act	Preferred habitat/previous records and habitat within impact area	Likelihood of Occurrence	Potential for Impacts	Species Credit or Ecosystem Species and whether predicted
Scoteanax rueppellii	Greater Broad- nosed Bat	V	-	Prefer moist gullies in mature coastal forests and rainforests, between the Great Dividing Range and the coast. They are only found at low altitudes below 500 m. In dense environments they utilise natural and human-made opening in the forest for flight paths. Creeks and small rivers are favoured foraging habitat. This species roosts in hollow tree trunks and branches. Two records from the region with the nearest being approximately 12 km to the north of the Study Area. Recorded as possible within disturbance areas and probable outside.	Known – possible recording	Potential	Ecosystem
Invertebrates							
Synemon plana	Golden Sun Moth	E	CE	The Golden Sun Moth's NSW populations are found in the area between Queanbeyan, Gunning, Young and Tumut. The species' historical distribution extended from Bathurst (central NSW) through the NSW Southern Tablelands, through to central and western Victoria, to Bordertown in eastern South Australia. Known sites in NSW include areas - Binalong, Blackburn, Coolalie, Davis, Derringullen, Eady's, Glenothian, Gocup, Gounyan, Grace's Flat, Harry's Creek, Jeir Ck, Lagoon, Lambs, Merryville, Nanima, Rye Park, Silverdale, Tarengo, Wargeila, Warroo, Washpen and Wolverhampton. Suitable habitat for the Golden Sun Moth includes native temperate grassland and open grassy woodlands dominated by wallaby grass (DEC 2007). No records for the species occurs within 10 km of the Study Area. It is highly unlikely the species would occur within the Study area given the lack of records within the locality, the Study Area does not occur within the known range of the species, and the Study Area generally lacks suitable habitat being native grassland that is dominated by wallaby grass.	Low	Low	Species
Reptiles							
Aprasia parapulchella	Pink-tailed Legless Lizard	V	v	Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by kangaroo grass. Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. No records locally or regionally. Preferred habitat not present.	Low	Unlikely	Species - excluded from further assessment
Delma impar	Striped Legless Lizard	v	V	Found mainly in natural temperate grassland but has also been captured in grasslands that have a high exotic component. Also found in secondary grassland near natural temperate grassland and occasionally in open White Box Yellow Box Blakely's Red Gum Woodland. Sometimes found in grasslands with significant amounts of surface rocks, which are used for shelter. No records locally, single record from Goulburn area regionally. Not recorded during survey and preferred sheltering habitat not present.	Low	Unlikely	Species – excluded from further assessment



Scientific Name	Common Name	BC Act	EPBC Act	Preferred habitat/previous records and habitat within impact area	Likelihood of Occurrence	Potential for Impacts	Species Credit or Ecosystem Species and whether predicted
Hoplocephalus bungaroides	Broad-headed Snake	E	v	Occurs almost exclusively in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they spend most of the year sheltering in and under rock crevices and exfoliating rock. However, some individuals will migrate to tree hollows to find shelter during hotter parts of summer. Required habitat not present.	Low	Unlikely	Species – excluded from further assessment
Suta flagellum	Little Whip Snake	V	-	The Little Whip Snake is found within an area bounded by Crookwell in the north, Bombala in the south, Tumbarumba to the west and Braidwood to the east. Occurs in natural temperate grasslands and grassy woodlands, including those dominated by snow gum or yellow box. Also occurs in secondary grasslands derived from clearing of woodlands. It is commonly found under rocks in more open areas of habitat. Outside of known distribution with nearest records from ACT area – 50 – 100 km away. Limited habitat within Study Area.	Low	Unlikely	Ecosystem
Varanus rosenbergi	Rosenberg's Goanna	v	-	This species is a Hawkesbury-Narrabeen sandstone outcrop specialist. Occurs in coastal heaths, humid woodlands and both wet and dry sclerophyll forests. No local records. No termite mounds in Study Area, not recorded during survey and preferred habitat not present in areas to be impacted.	Low	Unlikely	Species – excluded from further assessment



Threatened Ecological Community (TEC) Likelihood of occurrence

Threatened Ecological Community	Description	BC Act Status	EPBC Act Status	Likelihood of occurrence within Study Area
Illawarra and South Coast Lowland Forest and Woodland	This community comprises vegetation types that occupy the Illawarra coastal plain and escarpment foothills. Characteristic tree species include Forest Red Gum <i>Eucalyptus tereticornis</i> , Thin-leaved Stringybark <i>Eucalyptus eugenioides</i> , Woollybutt <i>Eucalyptus longifolia</i> , Coast Grey Box <i>Eucalyptus bosistoana</i> and White Feather Honey-myrtle <i>Melaleuca decora</i> . The understorey is not necessarily grassy as moist forest vegetation types are also included within this broad community. Common shrub species include <i>Acacia mearnsii</i> and <i>Dodonaea viscosa</i> subsp. <i>angustifolia</i> . Floodplain vegetation dominated by Casuarina species or rainforests on latite soils are not part of this community.	Endangered	Critically Endangered	None – occurs more toward the coast. Was not recorded during the vegetation survey.
Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions	Montane Peatlands and Swamps comprises a dense, open or sparse layer of shrubs with soft-leaved sedges, grasses and forbs. It is the only type of wetland that may contain more than trace amounts of Sphagnum spp., the hummock peat-forming mosses. Small trees may be present as scattered emergents or absent. The community typically has an open to very sparse layer of shrubs, 1-5 m tall, (eg. <i>Baeckea gunniana, B. utilis, Callistemon pityoides, Leptospermum juniperinum, L. lanigerum, L. myrtifolium, L. obovatum, L. polygalifolium)</i> . Species of <i>Epacris</i> (eg. <i>E. breviflora, E. microphylla, E. paludosa</i>) and <i>Hakea microcarpa</i> are also common shrubs. In some peatlands and swamps, particularly those with a history of disturbance to vegetation, soils or hydrology, the shrub layer comprises dense thickets of Leptospermum species. In other peatlands and swamps with a history of grazing by domestic livestock, the shrub layer may be very sparse or absent.	Endangered	Endangered	None – not recorded during vegetation survey, Project Area out of known range and not previously mapped within the Project Area.
Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory	In the Southern Tablelands of NSW and the ACT, dominant grasses include Kangaroo Grass <i>Themeda triandra</i> , wallaby grasses <i>Austrodanthonia</i> spp., spear grasses <i>Austrostipa</i> spp., Red Grass <i>Bothriochloa macra</i> and tussock grasses <i>Poa</i> spp <i>Themeda triandra</i> and Snow Grass <i>Poa sieberiana</i> are co-dominant in a variety of landscape positions and soil types. In wetter areas, such as moist flats, <i>Themeda</i> dominates the grassland with Pinrush <i>Juncus filicaulis</i> , while River Tussock <i>Poa labillardieri</i> is dominant along drainage lines, seepage areas, creeks and river flats. <i>Poa sieberiana</i> is dominant on the undulating basalt plains of the Monaro. The upper slopes, hill crests and ridges with well drained soils are generally dominated by Corkscrew <i>Austrostipa scabra</i> subsp. <i>falcata</i> and Tall Speargrass <i>A. bigeniculata</i> , while species of <i>Austrodanthonia</i> and <i>Bothriochloa macra</i> dominate gentle slopes, ridges and flats with well drained, shallow to skeletal soils. Present grass species dominance is thought to have changed significantly since European settlement because of past land uses. Other grasses such as Common Wheat Grass <i>Elymus scaber</i> and Nineawn Grass <i>Enneapogon nigricans</i> may also be present frequently, in the inter-tussock spaces.	Endangered	Endangered	None – out of range. Not recorded during field survey.



Threatened Ecological Community	Description	BC Act Status	EPBC Act Status	Likelihood of occurrence within Study Area
Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions	Tableland Basalt Forest is dominated by an open eucalypt canopy of variable composition. <i>Eucalyptus viminalis, E. radiata, E. dalrympleana subsp. dalrympleana</i> and <i>E. pauciflora</i> may occur in the community in pure stands or in varying combinations. The community typically has an open canopy of eucalypts with sparse mid-story shrubs (e.g. <i>Acacia melanoxylon</i> and <i>A. dealbata</i>) and understory shrubs (e.g. <i>Rubus parvifolius</i>) and a dense groundcover of herbs and grasses, although disturbed stands may lack either or both of the woody strata. The structure of the community varies depending on past and current disturbances, particularly fire history, clearing and grazing. Contemporary tree-dominated stands of the community are largely relics or regrowth of originally taller forests and woodlands, which are likely to have had scattered shrubs and a largely continuous grassy groundcover. At some sites, mature trees may exceed 30 m tall, although regrowth stands may be shorter than 10 m tall. Tableland Basalt Forest is currently found in the Eastern Highlands and Southern and Central Tablelands, covering the local government areas of Bathurst Regional, Goulburn Mulwaree, Oberon, Palerang, Shoalhaven, Upper Lachlan and Wingecarribee. The community, however, may be found elsewhere within the designated bioregions.	Endangered	-	Low – not recorded during vegetation survey, or previously mapped by Tozer et al. (2006) within the Project Area.
Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions	This community, commonly referred to as Tablelands Snow Gum Grassy Woodland, occurs as an open-forest, woodland or open woodland. This community may also occur as a secondary grassland where the trees have been removed, but the groundlayer remains. The main tree species are <i>Eucalyptus pauciflora</i> (Snow Gum), <i>E. rubida</i> (Candlebark), <i>E. stellulata</i> (Back Sallee) and <i>E. viminalis</i> (Ribbon Gum), either alone or in various combinations. Other eucalypt species may occur. A shrub layer may be present and sub-shrubs are common. The most common shrubs include Melicytus sp. 'Snowfileds' (Gruggly-bush) and <i>Melichrus urceolatus</i> (Urn Heath). The ground layer is grassy, with the most common species including <i>Themeda australis</i> (Kangaroo Grass), Poa spp. (snow-grasses), Austrostipa spp. (spear-grasses) and Rytidosperma spp. (wallaby-grasses). Sites in high condition have a range of forb (wildlfower) species, including <i>Leptorhynchos squamatus</i> (Scaly-buttons), <i>Chrysocephalum apiculatum</i> (Common Everlastings) and <i>Asperula conferta</i> (Native Woodlruff). Many threatened flora and fauna species have been recorded in this community.	Endangered	Critically Endangered	None – out of distribution range for this community.
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	The ecological community typically occurs as an open to tall open forest with a sparse to dense layer of shrubs and vines, and a diverse understorey of native grasses, forbs, twiners and ferns. However, the structure of the ecological community may vary from tall open forest with trees up to and above 30 m tall with a projected foliage cover of 30–70% (e.g. <i>Eucalyptus fastigata</i> forest on basalt near Sassafras in and around Morton National Park) to woodland with trees 10–30 m tall, with a projected foliage cover of 10–30% (e.g. exposed woodland on rocky microsyenite at Mt Jellore) depending on aspect, slope, soil conditions, soil depth, and previous clearing and disturbance.	Endangered	Endangered	Low – not recorded during vegetation survey, or previously mapped by Tozer et al. (2006) within the Project Area.



Threatened Ecological Community	Description	BC Act Status	EPBC Act Status	Likelihood of occurrence within Study Area
White Box, Yellow Box, Blakely's Red Gum Derived Native Grassland	 White Box Yellow Box Blakely's Red Gum Woodland (commonly referred to as Box-Gum Woodland) is an open woodland community (sometimes occurring as a forest formation), in which the most obvious species are one or more of the following: White Box <i>Eucalyptus albens</i>, Yellow Box <i>E. melliodora</i> and Blakely's Red Gum <i>E. blakelyi</i>. Intact sites contain a high diversity of plant species, including the main tree species, additional tree species, some shrub species, several climbing plant species, many grasses and a very high diversity of herbs. The community also includes a range of mammal, bird, reptile, frog and invertebrate fauna species. Intact stands that contain diverse upper and mid-storeys and groundlayers are rare. Modified sites include the following: Areas where the main tree species are present ranging from an open woodland formation to a forest structure, and the groundlayer is predominantly composed of exotic species; and Sites where the trees have been removed and only the grassy groundlayer and some herbs remain. The Australian Government listing of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland is slightly different to the NSW listing. Areas that are part of the Australian Government listed ecological community must have either: An intact tree layer and predominately native ground layer; or An intact tree layer and predominately native ground layer; or 	Endangered	Critically Endangered	Yes – recorded within the Study Area and will be impacted by the Project.



Appendix 2. Plant Community Type Descriptions

PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670)

Habitat: PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland occupies the flat terrain and gentle slopes located to the north of the Study Area.

Structure/Characteristics: three different condition classes of the community were recorded in the Study Area. Typically, the best condition of the community consisted of a tree layer ranging in height from 15 - 25 m consisting of *Eucalyptus blakelyi*, and *Eucalyptus melliodora* with the occasional *E. eugenioides* and *E. bosistoana*. A midstorey contained *Acacia mearnsii*, was sparse. The sparse shrub layer consisted of *Cassinia aculeata, Lissanthe strigosa* and *Olearia viscidula*. The ground layer consisted of *Einadia hastata Austrodanthonia racemosa, Microlaena stipoides, Bothriochloa macra, Acaena novae-zelandiae, Lomandra filiform*is subsp. coriacea, Thysanotus patersonii, Anisopogon avenaceus, Poa sieberiana, Austrostipa scabra, and *Aristida ramosa*.

Nassella trichotoma (Serrated Tussock) was in relatively high cover and abundance throughout portions of this PCT within the Study Area.

Condition classes:

Three condition classes were assigned to 1334 Yellow Box - Blakely's Red Gum grassy woodland within the Study Area:

- Moderate condition: this condition class was the best condition within the Study Area. It consisting
 of clumps of scattered trees (mainly *E. melliodora* with *E. blakelyiX*) with a mix of native and
 introduced ground cover. The native ground cover generally comprised of native grasses, including *Bothriochloa macra, Austrodanthonia racemosa, Dichelachne micrantha.* Forbs and shrubs were
 relatively sparse. Cover of Nassella trichotoma (Serrated Tussock) was relatively high across much
 of the vegetation zone. The zone had a vegetation integrity score of 40.4
- 2. Poor condition: consisting of very few scattered *Eucalyptus melliodora, E. bosistoana,* and *E. blakelyi*. Canopy cover was low when compared to benchmark. Acacia parramattensis was scattered in clumps throughout the vegetation zone. Forbs and shrubs were relatively sparse and typically were concentrated under the canopy. Much of this condition class has been used historically for grazing. Portions toward the west at the site of the Western Overburden Emplacement are still grazed. Cover of Nassella trichotoma (Serrated Tussock) was relatively high across much of the vegetation zone. The zone had a vegetation integrity score of 23.7.
- 3. Acacia/assisted regeneration: consisting of planted and regenerating Acacias and occasional eucalypts (not a CEEC under the EPBC Act). This vegetation zone had a ground cover similar to that of the 'poor condition' class, however tubestock has been planted in areas. The zone had a vegetation integrity score of 26.1.

Conservation Status: This vegetation community in a moderate and poor condition class aligns to the NSW BC Act - White Box Yellow Box Blakely's Red Gum Woodland TEC (EEC) due to the following listing criteria (Scientific Committee 2002) being satisfied within the Study Area:

- Characterised by the presence or prior occurrence of Yellow Box and/or Blakely's Red Gum
- The understorey in intact sites is characterised by native grasses and a high diversity of herbs
- Shrubs are generally sparse or absent, though they may be locally common



- Characteristic species are present as identified in the Scientific Committee (2012)
- Occurs within the known range of the TEC.

In regards to the EPBC Act listing, an analysis of the Determination and Flow Chart Diagram within the EPBC Act Policy Statement (DoE undated) was undertaken. The two different condition classes occurring in the Study Area meet the criteria in different ways. The alignment of each condition class to the CEEC criteria is provided in Table 16.

Resilience and ability to regenerate:

The historic clearing coupled with the existing and historic grazing within the Study Area has resulted in most of the Study Area having a low to moderate resilience. Serrated tussock was a dominant grass within much of the Study Area. It is likely that this species would continue to expand throughout the patches and would outcompete native groundcover. Extensive weed management would need to be undertaken in order to assist natural regeneration.

Condition	Description	Comparison to the TSC Act Determination	Comparison EPBC Act Determination
Moderate	 The presence of diagnostic mature trees including <i>Eucalyptus blakelyi, E. melliodora</i> and <i>E. eugenioides</i> in an open woodland formation. Presence of diagnostic groundcover plant species including some important species (excluding grasses). Presence of regenerating overstorey species. Moderate occurrence of exotic plant species. The patch has a high resilience. 	 Characterised by the presence or prior occurrence of <i>Eucalyptus albens, E. melliodora</i> and/or <i>E. blakelyi</i>. The understorey is characterised by native grasses and a high diversity of herbs. Shrubs are generally sparse or absent, though they may be locally common. Characteristic species are present as identified in the Scientific Determination. Occurs within the known range of the TEC. 	 Diagnostic species present. Predominantly native understorey. Whilst the plots undertaken did not contain greater than 12 native understorey species (excluding grasses), the size of the patch when adjacent grassland areas are included is greater than 2 ha. Mature trees and natural regeneration of eucalypts is present.
Poor	 Reduced diversity of characteristic canopy dominants in the overstorey stratum with diagnostic tree species confined to <i>Eucalyptus blakelyi</i> and <i>E. melliodora</i>. Low to very low diversity of White Box Yellow Box Blakely's Red Gum Woodland CEEC groundcover plant species (excluding grasses). Rare occurrences of important species of which there were 0 to 2 of in floristic plots conducted within the degraded condition class. Regenerating over storey species. Moderate to high occurrence of exotic plant species. A long history of grazing. 	 Characterised by the presence or prior occurrence of White Box, Yellow Box and/or Blakely's Red Gum. The understorey in intact sites is characterised by native grasses and some diversity of herbs. Shrubs are generally sparse or absent. Characteristic species are present as identified in the Scientific Determination. Occurs within the known range of the TEC. 	 Whilst in a disturbed condition, diagnostic species such as overstorey eucalypts are present. Whilst the plots undertaken did not contain greater than 12 native understorey species (excluding grasses), the size of the patch when adjacent grassland areas are included is greater than 2 ha. Mature trees and natural regeneration of eucalypts are present.
Acacia	 Reduced diversity of characteristic canopy dominants in the overstorey stratum with diagnostic tree species confined to <i>Eucalyptus blakelyi</i> and <i>E. melliodora</i>. Low to very low diversity of White Box Yellow Box Blakely's Red Gum Woodland CEEC groundcover plant species 	 Characterised by the presence or prior occurrence of White Box, Yellow Box and/or Blakely's Red Gum. The understorey in intact sites is characterised by native grasses and some diversity of herbs. Shrubs are generally sparse or absent. 	 The plots did not contain greater than 12 native understorey species. The plots did not contain on average greater than 20 mature eucalypts or natural regeneration amongst mature eucalypts.

Table 16. Alignment to TEC determinations



Condition	Description	Comparison to the TSC Act Determination	Comparison EPBC Act Determination
	 (excluding grasses). Rare occurrences of important species of which there were 0 to 2 of in floristic plots conducted within the degraded condition class. High occurrence of exotic plant species. A long history of grazing. Assisted regeneration dominated by the planting on Acacia tubestock (mainly Acacia 	 Characteristic species are present as identified in the Scientific Determination. Occurs within the known range of the TEC. 	

parramattensis)



Photo 4. PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands moderate condition



Photo 5. PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands poor condition





Photo 6. PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands Acacia regrowth



PCT 778 Coast Grey Box – stringybark dry woodland on slopes of the Shoalhaven Gorges -Southern Sydney Basin

Habitat: PCT 778 Coast Grey Box – stringybark dry woodland on slopes of the Shoalhaven Gorges -Southern Sydney Basin is equivalent to Tozer et al (2006) mapping unit p.27 Bungonia Slates Woodland. The PCT is found in the study are on the slopes where it comprise of a woodland to forest formation particularly toward the south-east of the Study Area. The vegetation community transitions into PCT 1334 on the gentle slopes and flat terrain. A degree of difficulty in determining the transition zone between the two communities was attributed due to the presence of Eucalyptus bosistoana which intergraded with E. melliodora. As discussed with OEH botanist John Briggs whilst on-site on the 16th June 2015, landscape position plays an important part in separating PCT 778 from PCT 778. As such, the steeper slopes have been attributed to the PCT 778 community.

Structure/Characteristics: Two different condition classes of the community were recorded in the Study Area. The best condition of the community consisted of a tree layer ranging in height from 15 - 25 m consisting of *Eucalyptus bosistiana*, and *E. blakelyi/E. tereticornis* with *E. eugenioides*. The sparse shrub layer consisted of *Cassinia aculeata*, *Lissanthe strigosa* and *Olearia viscidula*. The ground layer consisted of *Austrodanthonia racemosa*, *Microlaena stipoides*, *Bothriochloa macra*, *Acaena novae-zelandiae*, *Lomandra filiform*is subsp. coriacea, Anisopogon avenaceus, Poa sieberiana and *Aristida ramosa*.

Like that of PCT 1334, *Nassella trichotoma* (Serrated Tussock) was in relatively high cover and abundance throughout portions of this PCT within the Study Area.

Condition classes:

Two condition classes were assigned to PCT1334 within the Study Area:

Moderate: Consisting of a canopy dominated by *Eucalyptus bosistoana* and E. blakelyi/E.tereticornis with a mixture of native and introduced ground cover.

Poor: Typically lacked a canopy and shrub layer. Consisted predominantly of a native and introduced ground cover. This condition class typically occurred within the transmission line easement on steep slopes.

Conservation Status: This PCT does not align to a TEC under State or Commonwealth legislation.





Photo 7. PCT 778 Coast Grey Box – stringybark dry woodland on slopes of the Shoalhaven Gorges -Southern Sydney Basin – Moderate Condition



Photo 8. PCT 778 Coast Grey Box – stringybark dry woodland on slopes of the Shoalhaven Gorges -Southern Sydney Basin – Poor Condition



PCT 1150 - Silvertop Ash - Blue-leaved Stringybark shrubby open forest on ridges, north east South Eastern Highlands Bioregion

Habitat: PCT 1150 - Silvertop Ash - Blue-leaved Stringybark shrubby open forest on ridges, north east South Eastern Highlands Bioregion is equivalent to Tozer et al (2006) mapping unit P10. Eastern Tablelands Dry Forest.

The PCT is found in the study are on the upper slopes where it is of a forest formation with an open understorey of sclerophyll shrubs, sedges and forbs. It occurs only as relatively small patches toward the south and middle of the Study Area.

Structure/Characteristics: Two different condition classes of the community were recorded in the Study Area:

The best condition of the community consisted of a tree layer ranging in height from 10 - 25 m consisting of *Eucalyptus seiberi*, E. agglomerata and E. eugeniodes. The sparse shrub layer consisted of Persoonia linearis, Allocasuarina littoralis, Hibbertia obtusifolia, Stypandra glauca. *Cassinia aculeata, Lissanthe strigosa* and *Olearia viscidula*. The ground layer consisted of *Lepidosperma laterale, Lomandra filiform*is, and Austrodanthonia spp..

Condition classes:

Two condition classes were assigned to PCT 1150 - Silvertop Ash - Blue-leaved Stringybark shrubby open forest within the Study Area:

Moderate: Consisting of a canopy dominated by *Eucalyptus seiberi*, E. agglomerata and E. eugeniodes with a mixture of native and introduced ground cover.

Poor: this condition class lacked a canopy and shrub layer leaving only a native and introduced ground cover.

Conservation Status: This PCT does not align to a TEC under State or Commonwealth legislation.



Photo 9. PCT 1150 - Silvertop Ash - Blue-leaved Stringybark shrubby open forest on ridges, north east South Eastern Highlands Bioregion – Moderate Condition





Photo 10. PCT 1150 - Silvertop Ash - Blue-leaved Stringybark shrubby open forest on ridges, north east South Eastern Highlands Bioregion – Poor Condition



PCT 731 - Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion

Habitat: PCT 731 - Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion is equivalent to Tozer et al (2006) mapping unit P23. Tableland Hills Grassy Woodland. The PCT is found in the study are on the slopes where it comprise of a woodland to forest formation particularly toward the south-east of the Study Area. The vegetation community transitions into PCT 1334 on the gentle slopes and flat terrain. A degree of difficulty in determining the transition zone between the two communities was attributed due to the presence of similar overstorey species. However, the presence of Eucalyptus goniocalyx is listed as an associate species with P23. Tableland Hills Grassy Woodland and not P24.Tableland Grassy Box-Gum Woodland.

Structure/Characteristics: One condition class was assigned to PCT 731 - Broad-leaved Peppermint - Red Stringybark grassy open forest within the Study Area: Moderate condition which consisting of a canopy dominated by *Eucalyptus goniocalyx, E. bosistoana E. eugenoides, E. cinerea, E. dives* and E. blakelyi/E.tereticornis with a mixture of native and introduced ground cover. The sparse shrub layer consisted of *Cassinia aculeata, Lissanthe strigosa* and *Olearia viscidula*. The ground layer consisted of *Austrodanthonia racemosa, Microlaena stipoides, Bothriochloa macra, Acaena novae-zelandiae, Lomandra filiform*is subsp. coriacea, T Anisopogon avenaceus, Poa sieberiana and *Aristida ramosa*.

Like that of PCT 1334, *Nassella trichotoma* (Serrated Tussock) was in relatively high cover and abundance throughout portions of this PCT within the Study Area.

Conservation Status: This PCT does not align to a TEC under State or Commonwealth legislation.



Photo 11. PCT 731 - Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion



PCT 778 Coast Grey Box – stringybark dry woodland on slopes of the Shoalhaven Gorges -Southern Sydney Basin – BEST FIT

Habitat: occurs as small intermittent strips of native sedges and rushes along Marulan Creek generally in areas which receive semi-permanent pooling.

Structure/Characteristics: Cleared vegetation comprising of introduced pasture on the banks and within the proposed Marulan Creek Dam Inundation Area a mix of exotic grasses and native water dependent species.

No PCT matches the description of the vegetation observed on-site. Given the highly degraded condition the native vegetation integrity score was 8.9. This is below the amount required (>17 score) that triggers the requirement to offset.

Distribution within Project site: Occurs sporadically along Marulan Creek where there are patches of permanent to semi-permanent pools. Occurs at the northern end of the Project site within the proposed Marulan Creek Dam Inundation Area.

Condition and Presence of Weeds: the vegetation has been cleared and grazed. As a result, no trees occur along the banks. Exotic pasture grasses surround the proposed Marulan Creek Dam proposed Marulan Creek Dam Inundation Area and occur within the areas that receive less water. In the deeper channel of the proposed Marulan Creek Dam proposed Marulan Creek Dam Inundation Area where water holds for a long period, native species occur including: *Plantago lanceolata, Anagallis arvensis, Juncus usitatus,* and *Paspalum dilatumdilatatum*.



Conservation Status: This PCT does not align to a TEC under State or Commonwealth legislation.

Photo 12. Water-dependent native vegetation along portions of Marulan Creek.

Non-native vegetation

Portions of the Study Area have been extensively cleared, and have a soil profile which offers very little resilience to regenerate to a native vegetation community. These areas have been attributed to non-native



vegetation type given the historic disturbance. These areas are dominated by introduced grasses and herbaceous weeds, including: *Plantago lanceolata, Hypochaeris radicata, Pennisetum clandestina, Setaria gracilis, Nassella trichotoma and Paspalum dilatatum.*



Photo 13. Example of Non-native vegetation



Appendix 3. Floristic plot data

Plot Data extracted from Fulcrum digital data collection – Evidence of the raw Fulcrum data files can be provided upon request as handwritten datasheets are no longer used. The below species lists can be provided in excel format upon request.



Appendix 4. Plot transect scores

Location det	ails								Compositio	n					Structure						Function										
plot	pct	are a	patchsiz e	conditionclass	zon e	easting	northing	bearin g	compTre e	compShru b	compGra ss	compFor bs	compFer ns	compOth er	strucTre e	strucShru b	strucGra ss	strucFor bs	strucFer ns	strucOth er	funLargeTre es	funHollowtre es	funLitterCov er	funLenFallenLo gs	funTreeStem5to 10	funTreeStem10to 20	funTreeStem20to 30	funTreeStem30to 50	funTreeStem50to 80	funTreeRege	funHighThreatExo tic
2155s01	115 0	2.6	2000	Poor	56	227478	6148587. 0	15	1	2	6	2	0	0	1.0	1.0	35.0	0.2	0.0	0.0	0	0	66.0	0.0	1	0	0	1	0	1	45.0
2155lb088	731	12. 0	2000	Medium	56	227097. 7	6147556. 9	10	3	3	4	6	0	3	20.0	12.0	40.0	1.3	0.0	0.5	0	0	64.0	30.0	1	1	1	0	0	1	30.0
2155lb14	731	12.	2000	Medium	56	227241	6147585.	187	2	3	4	7	0	2	15.0	13.0	35.0	1.0	0.0	0.4	0	0	75	58.0		1	1	0	0		40.0
2155lb16	731	12.	2000	Medium	56	227134.	6147615.	170	2	2	4	5	0	4	15.0	11.0	21.0	0.7	0.0	0.7	0	0	18.0	21.0	1	1	1	1	1		35.0
2155i1429	778	57.	2000	Medium	56	227727.	6147161. 7	160	4	3	5	5	0	1	31.0	22.0	8.2	0.5	0.0	0.2	0	0	78.0	36.0	1	1	1	1	0		10.0
2155 1432	770	57.	2000	Modium	50	227382.	6147088.	200		5			0	1	20.0	22.0	4.2	1.4	0.0	0.1	1		76.0	42.0	1	1	1	1	1		2.0
2155/602	778	57.	2000	Medium	50		6146929.	120	2	5			0	1	20.0	11.2	4.2	1.4	0.0	0.5		1	54.0	42.0	1	1	1	1	1		3.0
249811410	778	57.	2000	Medium	50	228004.	6148656.	120			5	4	0		30.0	20.0	3.2	0.4	0.0	0.1	0	1	54.0	35.0	1	1	1	1	0		0.0
2498 1412	778	57.	2000	Medium	50	228045.	6148768.	340	4	1		4	0	1	31.0	20.0	7.6	0.9	0.0	0.1	1	0	74.0	25.0		1		1			2.0
D	778	9	2000	Medium	56	/	6148828.	0	3	3	4	/	0	0	8.0	10.5	20.0	1.1	0.0	0.0	1	1	62.0	30.0	0	1	1	1	1		/0.0
28	//8	7.5	2000	Poor	56	227725	6148957.	56	0	1	4	2	0	2	0.0	0.5	16.0	0.1	0.0	0.2	0	0	55.0	0.0	0	0	0	0	0	l	45.0
31	778	7.5	2000	Poor	56	227935	0 6148787.	88	0	2	6	2	0	3	0.0	1.5	12.0	0.5	0.0	0.6	0	0	65.0	0.0	0	0	0	0	0		55.0
2155c01	778	7.5	2000	Poor Waterdepende	56	227744	0 6151693.	270	1	2	4	1	0	0	1.0	1.0	20.0	0.1	0.0	0.0	0	0	55.0	0.0	1	0	0	1	0	1	40.0
2155a1	778 133	0.1	2000	nt	56	227504 226668.	0 6148325.	47	0	0	2	2	0	4	0.0	0.0	5.0	0.6	0.0	40.0	0	0	40.0	0.0	0	0	0	0	0		25.0
2155lb04	4	7.9	2000	Acacia	56	7 226623.	3 6148301.	230	3	3	2	0	0	0	6.5	46.0	1.2	0.0	0.0	0.0	0	0	56.0	0.0	1	1	0	0	0	C	1.0
2155lb05	4	7.9	2000	Acacia	56	3 226896.	7 6147721.	210	5	2	4	3	0	0	28.0	2.1	0.5	0.3	0.0	0.0	0	0	67.0	5.0	1	1	1	1	0	1	0.0
2155lb09	4	7.9	2000	Acacia	56	1 226732.	6 6147692.	120	0	3	3	3	0	0	0.0	30.1	21.0	0.3	0.0	0.0	0	0	34.0	0.0	1	1	0	0	0	1	40.0
2155lb10	4	7.9	2000	Acacia	56	6 226842.	2 6148155.	46	1	1	2	5	0	0	0.1	15.0	6.0	0.5	0.0	0.0	0	0	31.0	20.0	1	1	0	0	0	1	40.0
2155lb07	4	7.9	2000	Acacia	56	5 226695.	8 6148084.	220	0	2	1	2	0	0	0.0	20.0	35.0	0.6	0.0	0.0	0	0	11.0	0.0	0	1	1	0	0		10.0
2155lb08 2498l1415	4	7.9 48.	2000	Acacia	56	1 228141.	0 6149141.	190	1	6	3	5	0	0	20.0	44.1	5.2	0.5	0.0	0.0	0	0	45.0	0.0	1	1	1	0	0	1	5.0
b 2498 1416	4	8 48.	2000	Medium	56	2 228077.	8 6149315.	40	3	1	3	6	0	1	15.0	0.5	15.5	2.4	0.0	0.1	0	0	44.0	20.0	0	1	1	1	0	1	20.1
b	4	8	2000	Medium	56	6 227783.	9 6149329.	195	2	1	2	5	0	0	14.0	15.0	13.0	3.5	0.0	0.0	2	1	40.0	24.0	0	0	1	1	1	C	40.0
2498lb01 2155l1139	4	8	2000	Medium	56	4 226917.	4 6147894.	130	1	1	3	3	0	0	10.0	15.0	25.1	0.8	0.0	0.0	1	0	54.0	0.0	0	0	0	1	1	1	55.0
b 2155/1143	4	8	2000	Medium	56	2	6	60	1	3	1	5	1	0	10.0	53.2	20.0	0.5	0.1	0.0	0	0	48.0	0.0	1	1	0	0	0	1	0.1
b 2155/1144	133	48	2000	Medium	56	227029	6147661	210	1	3	3	5	0	0	10.0	21.0	20.2	0.5	0.0	0.0	0	0	62.0	10.0	1	1	1	1	0	1	40.0
b 2155/1380	133	40.	2000	Medium	56	1	5	200	2	4	4	3	0	0	30.0	11.6	10.4	0.4	0.0	0.0	0	0	66.0	15.0	1	1	1	0	0	1	30.0
b	100		2000	Medium	56	226848	6148034	70	1	1	4	4	0	0	20.0	15.0	40.1	0.4	0.0	0.0	1	0	73.0	30.0	1	1	1	1	1	1	10.0
2155Lb17	133	48.	2000	Medium	56	220000.	9	190	1	0	6	3	0	3	5.0	0.0	35.0	0.5	0.0	0.2	1	1	47.0	1.5	1	0	1	1	1	1	15.0
02	4	8	2000	Medium	56	227727	6149114	167	2	2	4	6	1	3	15	5	35	2.0	0.1	0.5	0	0	75	6.5	1	1	1	0	0	C	35.0
1414	4	8	2000	Medium	56	227966	6149217	308	2	1	3	7	0	2.0	7	15.0	15.5	1.3	0.0	0.3	1	1	68.0	5.0	0	0	0	1	0	C	50.0
215511384 b	133	31. 9	2000	Poor	56	226827	6148328.	300	2	0	1	0	0	0	15.0	0.0	5.0	0.0	0.0	0.0	1	0	64.0	0.0	1	0	0	1	1	1	0.5
2155lb18	133	31. 9	2000	Poor	56	226881	6148375	119	1	1	6	2	0	1	1.0	0.5	45.0	0.8	0.0	0.1	0	0	76.0	0.0	0	0	0	0	0	1	5.0
24	133 4	31. 9	2000	Poor	56	228136	6149301	101	1	2	6	4	0	2	1.0	1.0	10.0	3.0	0.0	4.0	0	0	60.0	0.0	0	0	1	0	0	c	50.0
25	133 4	31. 9	2000	Poor	56	227875	6149491	100	2	3	4	2	0	2	1.0	1.0	15.0	5.0	0.0	3.0	0	0	65.0	0.0	0	0	1	0	0	c	55.0
26	133 4	31. 9	2000	Poor	56	228036	6149467	96	0	0	5	2	0	2	0.0	0.0	22.0	0.6	0.0	0.1	0	0	55.0	2.5	0	0	0	0	0		50.0
2155 1393 b	115 0	13. 7	2000	Medium	56	227242. 8	6147988. 7	23	3	3	3	6	0	1	25.0	10.6	5.6	0.7	0.0	0.1	0	0	78.0	30.0	1	1	1	1	0	1	20.0
2155l1424 b	115 0	13. 7	2000	Medium	56	227036	6147266. 4	200	2	5	3	1	0	1	30.0	20.5	6.2	0.2	0.0	0.1	0	0	78.0	15.0	1	1	1	0	0	c	0.0
2155lb22	115 0	13. 7	2000	Medium	56	227218	6148075	15	3	4	3	3	0	1	25.0	5.0	4.2	0.5	0.0	0.1	0	0	66.0	22.5	1	1	1	1	0	1	5.0

Appendix 5. Fauna survey species list and survey weather details

Group	Scientific name	Common name	Status	Observation	Observer
Amphibia	Crinia parinsianifera	Beeping froglet	Р	H	Simon Tweed
Amphibia	Crinia sianifera	clicking froglet	Р	н	Simon Tweed
Amphibia	Crinia signifera	clicking froglet	Р	н	Simon Tweed
Amphibia	Crinia signifera	clicking froglet	Р	но	Simon Tweed
Amphibia	Crinia signifera	clicking froglet	Р	н	Simon Tweed
Amphibia	Limnodynastes tasmaniensis	Spotted marsh Frog	Р	н	Simon Tweed
Amphibia	Limnodynastes tasmaniensis	Spotted marsh Frog	Р	н	Simon Tweed
Amphibia	Limnodynastes tasmaniensis	Spotted marsh Frog	Р	н	Simon Tweed
Amphibia	Limnodynastes tasmaniensis	Spotted marsh Frog	Р	н	Simon Tweed
Amphibia	Limnodynastes peronii	striped marsh frog	Р	н	Simon Tweed
Amphibia	Limnodynastes peronii	striped marsh frog	Р	н	Simon Tweed
Amphibia	Limnodynastes peronii	striped marsh frog	Р	н	Simon Tweed
Amphibia	Litoria verreauxii	whistling tree frog	Р	н	Simon Tweed
Amphibia	Litoria verreauxii	whistling tree frog	Р	н	Simon Tweed
Amphibia	Uperoleia rugosa		Р	н	Simon Tweed
Amphibia	Uperoleia rugosa		Ρ	н	Simon Tweed
Amphibia	Litoria verreauxii	whistling tree frog	Ρ	0	Simon Tweed
Amphibia	Litoria nudidigitus	southern leaf green tree frog	Ρ	0	Simon Tweed
Amphibia	Litoria lesueurii	stoney creek frog	Ρ	0	Simon Tweed
Amphibia	Litoria lesueurii	stoney creek frog	Р	0	Simon Tweed
Amphibia	Litoria verreauxii	whistling tree frog	Р	0	Simon Tweed, Matthew Stanton
Amphibia	Litoria nudidigitus	southern leaf green tree frog	Р	0	Simon Tweed, Matthew Stanton
Amphibia	Litoria lesueurii	stoney creek frog	Ρ	0	Simon Tweed, Matthew Stanton
Amphibia	Litoria lesueurii	stoney creek frog	Ρ	0	Simon Tweed, Matthew Stanton
Aves	Cracticus tibicen	Australian Magpie	Р	н	Simon Tweed
Aves	Cracticus tibicen	Australian Magpie	Ρ	НО	Simon Tweed
Aves	Cracticus tibicen	Australian Magpie	Р		Simon Tweed
Aves	Cracticus tibicen	Australian Magpie	Р	н	Simon Tweed
Aves	Aegotheles cristatus	Australian Owlet-nightjar	Ρ	н	Simon Tweed
Aves	Corvus coronoides	Australian Raven	Ρ	н	Simon Tweed
Aves	Corvus coronoides	Australian Raven	Ρ	ОН	Simon Tweed
Aves	Corvus coronoides	Australian Raven	Ρ	н	Simon Tweed
Aves	Corvus coronoides	Australian Raven	Ρ	ОН	Simon Tweed
Aves	Coracina novaehollandiae	Black-faced Cuckoo-shrike	Ρ	Н	Simon Tweed
Aves	Coracina novaehollandiae	Black-faced Cuckoo-shrike	Ρ	ОН	Simon Tweed
Aves	Artamus cinereus	Black-faced Woodswallow	Ρ	ОН	Simon Tweed
Aves	Coturnix ypsilophora	Brown Quail	Р	0	Simon Tweed
Aves	Coturnix ypsilophora	Brown Quail	Р	ОН	Simon Tweed

Group	Scientific name	Common name	Status	Observation type	Observer
Aves	Acanthiza pusilla	Brown Thornbill	Ρ	ОН	Simon Tweed
Aves	Acanthiza reguloides	Buff-rumped Thornbill	Р	ОН	Simon Tweed
Aves	Coracina tenuirostris	Cicadabird	Р	ОН	Simon Tweed
Aves	Coracina tenuirostris	Cicadabird	Р	ОН	Simon Tweed
Aves	Platycercus elegans	Crimson Rosella	Ρ	ОН	Simon Tweed
Aves	Platycercus elegans	Crimson Rosella	Р	ОН	Simon Tweed
Aves	Stagonopleura guttata	Diamond Firetail	V	H 50 m away	Simon Tweed
Aves	Stagonopleura guttata	Diamond Firetail	V	ОН	Simon Tweed
Aves	Acanthorhynchus tenuirostris	Eastern Spinebill	Ρ	н	Simon Tweed
Aves	Acanthorhynchus tenuirostris	Eastern Spinebill	Ρ	ОН	Simon Tweed
Aves	Acanthorhynchus tenuirostris	Eastern Spinebill	Р	ОН	Simon Tweed
Aves	Psophodes olivaceus	Eastern Whipbird	Ρ	ОН	Simon Tweed
Aves	Psophodes olivaceus	Eastern Whipbird	Р	ОН	Simon Tweed
Aves	Eopsaltria australis	Eastern Yellow Robin	Р	ОН	Simon Tweed
Aves	Eopsaltria australis	Eastern Yellow Robin	Ρ	ОН	Simon Tweed
Aves	Cacomantis flabelliformis	Fan-tailed Cuckoo	Р	ОН	Simon Tweed
Aves	Rhipidura albiscapa	Grey Fantail	Р	н	Simon Tweed
Aves	Rhipidura albiscapa	Grey Fantail	Ρ	ОН	Simon Tweed
Aves	Rhipidura albiscapa	Grey Fantail	Ρ	0	Simon Tweed
Aves	Rhipidura albiscapa	Grey Fantail	Ρ	ОН	Simon Tweed
Aves	Colluricincla harmonica	Grey Shrike-thrush	Ρ	н	Simon Tweed
Aves	Colluricincla harmonica	Grey Shrike-thrush	Р	ОН	Simon Tweed
Aves	Microeca fascinans	Jacky Winter	Р	0	Simon Tweed
Aves	Dacelo novaeguineae	Laughing Kookaburra	Р	0	Simon Tweed
Aves	Dacelo novaeguineae	Laughing Kookaburra	Ρ	ОН	Simon Tweed
Aves	Vanellus miles	Masked Lapwing	Ρ	ОН	Simon Tweed
Aves	Dicaeum hirundinaceum	Mistletoebird	Ρ	0	Simon Tweed
Aves	Dicaeum hirundinaceum	Mistletoebird	Ρ	ОН	Simon Tweed
Aves	Dicaeum hirundinaceum	Mistletoebird	Ρ	ОН	Simon Tweed
Aves	Phylidonyris novaehollandiae	New Holland Honeyeater	Ρ	ОН	Simon Tweed
Aves	Phylidonyris novaehollandiae	New Holland Honeyeater	Ρ	ОН	Simon Tweed
Aves	Philemon corniculatus	Noisy Friarbird	Ρ	0	Simon Tweed
Aves	Philemon corniculatus	Noisy Friarbird	Ρ	ОН	Simon Tweed
Aves	Philemon corniculatus	Noisy Friarbird	Ρ	ОН	Simon Tweed
Aves	Manorina melanocephala	Noisy Miner	Ρ	ОН	Simon Tweed
Aves	Geopelia striata	Peaceful Dove	Ρ	ОН	Simon Tweed
Aves	Strepera graculina	Pied Currawong	Р	н	Simon Tweed
Aves	Strepera graculina	Pied Currawong	Р	ОН	Simon Tweed
Aves	Strepera graculina	Pied Currawong	Ρ	ОН	Simon Tweed
Aves	Strepera graculina	Pied Currawong	Р	ОН	Simon Tweed
Aves	Strepera graculina	Pied Currawong	Ρ	ОН	Simon Tweed
Aves	Porphyrio porphyrio	Purple Swamphen	Ρ	ОН	Simon Tweed
Aves	Neochmia temporalis	Red-browed Finch	Ρ	ОН	Simon Tweed

Group	Scientific name	Common name	Status	Observation type	Observer
Aves	Neochmia temporalis	Red-browed Finch	Р	ОН	Simon Tweed
Aves	Psephotus haematonotus	Red-rumped Parrot	Р	ОН	Simon Tweed
Aves	Rhipidura rufifrons	Rufous Fantail	Р	ОН	Simon Tweed
Aves	Pachycephala rufiventris	Rufous Whistler	Р	ОН	Simon Tweed
Aves	Ptilonorhynchus violaceus	Satin Bowerbird	Р	ОН	Simon Tweed
Aves	Ptilonorhynchus violaceus	Satin Bowerbird	Р	ОН	Simon Tweed
Aves	Petroica boodang	Scarlet Robin	V	ОН	Simon Tweed
Aves	Petroica boodang	Scarlet Robin	V	ОН	Simon Tweed
Aves	Zosterops lateralis	Silvereye	Р	ОН	Simon Tweed
Aves	Zosterops lateralis	Silvereye	Р	0	Simon Tweed
Aves	Zosterops lateralis	Silvereye	Р	ОН	Simon Tweed
Aves	Pardalotus punctatus	Spotted Pardalote	Р	н	Simon Tweed
Aves	Pardalotus punctatus	Spotted Pardalote	Р	ОН	Simon Tweed
Aves	Pardalotus punctatus	Spotted Pardalote	Р	ОН	Simon Tweed
Aves	Pardalotus punctatus	Spotted Pardalote	Р	ОН	Simon Tweed
Aves	Pardalotus punctatus	Spotted Pardalote	Р	ОН	Simon Tweed
Aves	Pardalotus punctatus	Spotted Pardalote	Р	ОН	Simon Tweed
Aves	Cacatua galerita	Sulphur-crested Cockatoo	Р	ОН	Simon Tweed
Aves	Cacatua galerita	Sulphur-crested Cockatoo	Р	ОН	Simon Tweed
Aves	Malurus cyaneus	Superb Fairy-wren	Р	ОН	Simon Tweed
Aves	Malurus cyaneus	Superb Fairy-wren	Р	ОН	Simon Tweed
Aves	Malurus cyaneus	Superb Fairy-wren	Р	0	Simon Tweed
Aves	Malurus cyaneus	Superb Fairy-wren	Р	ОН	Simon Tweed
Aves	Malurus cyaneus	Superb Fairy-wren	Р	н	Simon Tweed
Aves	Menura novaehollandiae	Superb Lyrebird	Р	ОН	Simon Tweed
Aves	Menura novaehollandiae	Superb Lyrebird	Р	ОН	Simon Tweed
Aves	Menura novaehollandiae	Superb Lyrebird	Р	ОН	Simon Tweed
Aves	Podargus strigoides	Tawny Frogmouth	Р	ОН	Simon Tweed
Aves	Aquila audax	Wedge-tailed Eagle	Р	ОН	Simon Tweed
Aves	Sericornis frontalis	White-browed Scrubwren	Р	ОН	Simon Tweed
Aves	Sericornis frontalis	White-browed Scrubwren	Р	ОН	Simon Tweed
Aves	Sericornis frontalis	White-browed Scrubwren	Р	ОН	Simon Tweed
Aves	Sericornis frontalis	White-browed Scrubwren	Р	ОН	Simon Tweed
Aves	Phylidonyris niger	White-cheeked Honeyeater	Р	ОН	Simon Tweed
Aves	Lichenostomus leucotis	White-eared Honeyeater	Р	ОН	Simon Tweed
Aves	Lichenostomus penicillatus	White-plumed Honeyeater	Р	ОН	Simon Tweed
Aves	Gerygone albogularis	White-throated Gerygone	Р	ОН	Simon Tweed
Aves	Cormobates leucophaea	White-throated Treecreeper	Р	ОН	Simon Tweed
Aves	Cormobates leucophaea	White-throated Treecreeper	Р	ОН	Simon Tweed
Aves	Cormobates leucophaea	White-throated Treecreeper	Р	ОН	Simon Tweed
Aves	Cormobates leucophaea	White-throated Treecreeper	Ρ	ОН	Simon Tweed
Aves	Cormobates leucophaea	White-throated Treecreeper	Р	ОН	Simon Tweed
Aves	Corcorax melanorhamphos	White-winged Chough	Р	ОН	Simon Tweed

Group	Scientific name	Common name	Status	Observation type	Observer
Aves	Corcorax melanorhamphos	White-winged Chough	Р	ОН	Simon Tweed
Aves	Rhipidura leucophrys	Willie Wagtail	Р	0	Simon Tweed
Aves	Rhipidura leucophrys	Willie Wagtail	Р	ОН	Simon Tweed
Aves	Rhipidura leucophrys	Willie Wagtail	Р	ОН	Simon Tweed
Aves	Leucosarcia picata	Wonga Pigeon	Р	ОН	Simon Tweed
Aves	Acanthiza nana	Yellow Thornbill	Р	ОН	Simon Tweed
Aves	Acanthiza nana	Yellow Thornbill	Р	ОН	Simon Tweed
Aves	Acanthiza nana	Yellow Thornbill	Р	ОН	Simon Tweed
Aves	Lichenostomus chrysops	Yellow-faced Honeyeater	Р	ОН	Simon Tweed
Aves	Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo	Р	ОН	Simon Tweed
Aves	Aegotheles cristatus	Australian Owlet-nightjar	Р	0	Simon Tweed
Aves	Myiagra inquieta	Restless Flycatcher	Р	0	Simon Tweed
Aves	Daphoenositta chrysoptera	Varied Sittella	V	0	Simon Tweed
Aves	Corcorax melanorhamphos	White-winged Chough	Р	H distant	Simon Tweed
Aves	Cracticus tibicen	Australian Magpie	Р	H distant	Simon Tweed
Aves	Corvus coronoides	Australian Raven	Р	н	Simon Tweed
Aves	Cormobates leucophaea	White-throated Treecreeper	Р	ОН	Simon Tweed
Aves	Rhipidura albiscapa	Grey Fantail	Р	0	Simon Tweed
Aves	Malurus cyaneus	Superb Fairy-wren	Р	н	Simon Tweed
Aves	Gerygone albogularis	White-throated Gerygone	Р	ОН	Simon Tweed
Aves	Pardalotus punctatus	Spotted Pardalote	Р	ОН	Simon Tweed
Aves	Acanthorhynchus tenuirostris	Eastern Spinebill	Р	ОН	Simon Tweed
Aves	Acanthiza chrysorrhoa	Yellow-rumped Thornbill	Р	ОН	Simon Tweed
Aves	Aegotheles cristatus	Australian Owlet-nightjar	Ρ	0	Simon Tweed, Matthew Stanton
Aves	Myiagra inquieta	Restless Flycatcher	Ρ	h	Simon Tweed, Matthew Stanton
Aves	Daphoenositta chrysoptera	Varied Sittella	V	0	Simon Tweed, Matthew Stanton
Aves	Tyto tenebricosa	Sooty Owl	v	н	Simon Tweed, Matthew Stanton
Aves	Corcorax melanorhamphos	White-winged Chough	Р	H distant	Simon Tweed
Aves	Cracticus tibicen	Australian Magpie	Р	H distant	Simon Tweed
Aves	Corvus coronoides	Australian Raven	Р	н	Simon Tweed
Aves	Cormobates leucophaea	White-throated Treecreeper	Р	ОН	Simon Tweed
Aves	Rhipidura albiscapa	Grey Fantail	Р	0	Simon Tweed
Aves	Malurus cyaneus	Superb Fairy-wren	Р	н	Simon Tweed
Aves	Gerygone albogularis	White-throated Gerygone	Р	H s	Simon Tweed
Aves	Pardalotus punctatus	Spotted Pardalote	Р	O s	Simon Tweed
Aves	Acanthorhynchus tenuirostris	Eastern Spinebill	Ρ	H s	Simon Tweed
Aves	Acanthiza chrysorrhoa	Yellow-rumped Thornbill	Ρ	O s	Simon Tweed
Aves	Ninox strenua	Powerful Owl	Р	Calling about 1 km to the south.	Matthew Stanton
				In River Oak	
Aves	Neophema pulchella	Turquoise Parrot	V	but possibly	Matthew Stanton

Group	Scientific name	Common name	Status	Observation type	Observer
				coming in to drink	
Aves	Tyto tenebricosa	Sooty Owl	V	H - a couple of calls. Probably male bomb	Matthew Stanton
Aves	Calyptorhynchus lathami	Glossy Black-Cockatoo	V	н	Matthew Stanton
Mammalia	Trichosurus vulpecula	Common Brushtail Possum	Р	0	Simon Tweed
Mammalia	Trichosurus vulpecula	Common Brushtail Possum	Р	0	Simon Tweed
Mammalia	Macropus robustus	Common Wallaroo	Ρ	0	Simon Tweed
Mammalia	Vombatus ursinus	Common Wombat	Р	0	Simon Tweed
Mammalia	Vombatus ursinus	Common Wombat	Р	0	Simon Tweed
Mammalia	Macropus giganteus	Eastern Grey Kangaroo	Р	0	Simon Tweed
Mammalia	Macropus giganteus	Eastern Grey Kangaroo	Р	0	Simon Tweed
Mammalia	Macropus giganteus	Eastern Grey Kangaroo	Р	0	Simon Tweed
Mammalia	Macropus giganteus	Eastern Grey Kangaroo	Ρ	0	Simon Tweed
Mammalia	Vulpes vulpes	Fox	U	0	Simon Tweed
Mammalia	Vulpes vulpes	Fox	U	0	Simon Tweed
Mammalia	Vulpes vulpes	Fox	U	0	Simon Tweed
Mammalia	Oryctolagus cuniculus	Rabbit	U	0	Simon Tweed
Mammalia	Oryctolagus cuniculus	Rabbit	U	0	Simon Tweed
Mammalia	Oryctolagus cuniculus	Rabbit	U	0	Simon Tweed
Mammalia	Petaurus breviceps	Sugar Glider	Ρ	H and various incisions seen.	Simon Tweed
Mammalia	Petaurus breviceps	Sugar Glider	Р	H during spotlighting	Simon Tweed
Mammalia	Wallabia bicolor	Swamp Wallaby	Р	0	Simon Tweed
Mammalia	Wallabia bicolor	Swamp Wallaby	Р	O spotlighting	Simon Tweed
Mammalia	Wallabia bicolor	Swamp Wallaby	Р	0	Simon Tweed
Mammalia	Wallabia bicolor	Swamp Wallaby	Р	0	Simon Tweed
Mammalia	Pteropus poliocephalus	grey-headed flying-fox	V	0	Simon Tweed
Mammalia	Trichosurus vulpecula	Common Brushtail Possum	Р	0	Simon Tweed
Mammalia	Wallabia bicolor	Swamp Wallaby	Р	0	Simon Tweed
Mammalia	Vombatus ursinus	Common Wombat	Р	0	Simon Tweed
Mammalia	Petaurus australis	Yellow-bellied Glider	v	H distant faintly	Simon Tweed
Mammalia	Myotis macropus	large-footed myotis	V	O probable seen raking water.	Simon Tweed
Mammalia	Vespadelus vulturnus	little forest bat	Р	Harp trap	Simon Tweed
Mammalia	Miniopterus schreibersii	common bent-winged bat	V	Harp trap.	Simon Tweed
Mammalia	Pteropus poliocephalus	grey-headed flying-fox	V	0	Simon Tweed, Matthew Stanton
Mammalia	Trichosurus vulpecula	Common Brushtail Possum	Ρ		Simon Tweed, Matthew Stanton
Mammalia	Wallabia bicolor	Swamp Wallaby	Ρ	0	Simon Tweed, Matthew Stanton

Group	Scientific name	Common name	Status	Observation type	Observer
Mammalia	Vombatus ursinus	Common Wombat	Ρ	0	Simon Tweed, Matthew Stanton
Mammalia	Petaurus australis	Yellow-bellied Glider	V	H distant faintly	Simon Tweed, Matthew Stanton
Mammalia	Myotis macronus	large-footed myotis	V	O probable seen raking water.	Simon Tweed, Matthew Stanton
Mammalia	Vesnadelus vulturnus	little forest bat	P	Harn tran	Simon Tweed
Mammalia	Minionterus schreihersii	common hent-winged hat	v	Harn tran	Simon Tweed
Mammalia	Phascolarctos cinereus	Koala	V	H - male	Matthew Stanton
Mammalia	Phascolarctos cinereus	Koala	V	H - male	Matthew Stanton
Mammalia	Phascolarctos cinereus	Koala	V		Matthew Stanton
Mammalia	Potaurus australis	Vallow balliad Clidar	V		Matthew Stanton
Wallinalia	Petuurus uustruns	renow-benned Gilder	v	п	Matthew Stanton
Mammalia	Chalinolobus dwyeri	Large-eared Pied Bat	V	Anabat	Simon Tweed, Matthew Stanton
Mammalia	Chalinolobus dwyeri	Large-eared Pied Bat	V	Anabat	Simon Tweed, Matthew Stanton
Mammalia	Chalinolobus dwyeri	Large-eared Pied Bat	v	Anabat	Simon Tweed, Matthew Stanton
Mammalia	Chalinolobus dwyeri	Large-eared Pied Bat	v	Anabat	Simon Tweed, Matthew Stanton
Mammalia	Chalinolobus dwyeri	Large-eared Pied Bat	v	Anabat	Simon Tweed, Matthew Stanton
Mammalia	Chalinolobus gouldii		Ρ	Anabat	Simon Tweed, Matthew Stanton
Mammalia	Chalinolobus morio		Ρ	Anabat	Simon Tweed, Matthew Stanton
Mammalia	Miniopterus australis	Little Bent-wing Bat	V	Anabat	Simon Tweed, Matthew Stanton
Mammalia	Miniopterus schreibersii	Eastern Bent-wing Bat	V	Anabat	Simon Tweed, Matthew Stanton
Mammalia	Miniopterus schreibersii	Eastern Bent-wing Bat	V	Anabat	Simon Tweed, Matthew Stanton
Mammalia	Miniopterus schreibersii	Eastern Bent-wing Bat	v	Anabat	Simon Tweed, Matthew Stanton
Mammalia	Miniopterus schreibersii	Eastern Bent-wing Bat	v	Anabat	Simon Tweed, Matthew Stanton
Mammalia	Miniopterus schreibersii	Eastern Bent-wing Bat	V	Anabat	Simon Tweed, Matthew Stanton
Mammalia	Mormonterus ridei		D	Anabat	Simon Tweed,
Mammalia	Muotio magropui	Couthorn Musti-	F	Anabat	Simon Tweed,
Mammalia	Nyotis macropus	Southern Wyotis	V	Anabat	watthew Stanton
IVIdIIIIIdild	Nyctophilus spp.		۲	Anabat	

Group	Scientific name	Common name	Status	Observation type	Observer
Mammalia	Falsistrellus tasmaniensis	Eastern False Pipistrelle	v	Anabat	Simon Tweed, Matthew Stanton
Mammalia	Kerivoula papuensis	Golden-tipped Bat	V	Anabat	Simon Tweed, Matthew Stanton
Mammalia	Scotorepens ruppellii		Ρ	Anabat	Simon Tweed, Matthew Stanton
Mammalia	Rhinolophus megaphyllus		Ρ	Anabat	Simon Tweed, Matthew Stanton
Mammalia	Tadarida australis		Ρ	Anabat	Simon Tweed, Matthew Stanton
Mammalia	Vespadelus darlingtoni		Ρ	Anabat	Simon Tweed, Matthew Stanton
Mammalia	Vespadelus regulus		Ρ	Anabat	Simon Tweed, Matthew Stanton
Mammalia	Vespadelus vulturnus		Ρ	Anabat	Simon Tweed, Matthew Stanton
Mammalia	Saccolaimus flaviventris		Ρ	Anabat	Simon Tweed, Matthew Stanton
Reptilia	Physignathus lesueurii	eastern water dragon	Р	0	Simon Tweed
Reptilia	Pseudechis porphyriacus	red-bellied black snake	Р	0	Simon Tweed
Reptilia	Eulamprus quoyii	eastern water-skink	Ρ	0	Simon Tweed
Reptilia	Eulamprus quoyii	eastern water-skink	Ρ	0	Simon Tweed, Matthew Stanton

Key: P = Protected; V = Vulnerable; E = Endangered; - = not listed under act (exotic/introduced species); O = observed; H = Heard

Weather conditions during field survey

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	Direction of maximum wind gust	Speed of maximum wind gust (km/h)
1/02/2015	7.5	23.6	0	SSW	43
2/02/2015	10	21.9	19.2	SE	46
3/02/2015	7.6	21.8	0	SE	24
4/02/2015	7.8	20.2	0	ESE	39
5/02/2015	12.3	21.8	0.2	ESE	35
6/02/2015	10.9	23.5	0	E	30
7/02/2015	8.8	28.8	0	NNE	24
8/02/2015	9.4	32.6	0	W	43
9/02/2015	14.5	22.2	0	E	43
10/02/2015	15.8	27.2	0.4	E	35
11/02/2015	14.9	28.3	0	W	56
12/02/2015	16.8	25.1	14	SSE	44
13/02/2015	15.4	24.6	0	ESE	43
14/02/2015	12.1	23.2	0	SSW	43

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	Direction of maximum wind gust	Speed of maximum wind gust (km/h)
15/02/2015	10.6	27.2	17.4	W	39
16/02/2015	14.3	27.9	0.2	ENE	28
17/02/2015	13.5	28.1	0	NE	37
18/02/2015	13	26.7	0	E	39
19/02/2015	12.6	27.4	0	ENE	43
20/02/2015	12.1	27.4	0	SE	30
21/02/2015	13.7	23.8	0	ENE	30
22/02/2015	14	26.2	3.4	NE	35
23/02/2015	14.5	28.2	0	SSE	57
24/02/2015	16.3	22.3	0	SW	48
25/02/2015	13.9	18.8	0.4	SE	35
26/02/2015	14.3	26.9	0	SE	50
27/02/2015	10.9	27.2	0.6	NE	30
28/02/2015	13.2	31.3	0	W	31
1/03/2015	11.5	31.6	0	WNW	65
2/03/2015	5.6	23.3	0	E	39
3/03/2015	8.9	30.1	0	NW	41
4/03/2015	15.7	29.9	0	W	39
5/03/2015	11.2	23.8	0	W	57
6/03/2015	7.1	22.5	0	W	61
7/03/2015	3.6	26.7	0	W	37
8/03/2015	11.1	29.4	0	NW	35
9/03/2015	10.4	29	0	WSW	48
10/03/2015	8.5	25.4	0	Ν	43
11/03/2015	11.8	30.6	0	WSW	56
12/03/2015	13.2	29.6	0	SW	52
13/03/2015	12.3	19	0	SE	31
14/03/2015	5.1	26	0	WNW	44
15/03/2015	9.5	22.6	0	ESE	44
16/03/2015	4.3	21.9	0	SE	35
17/03/2015	4.3	25.3	0	W	28
18/03/2015	11.4	29.9	4.6	W	48
19/03/2015	7.5	30.9	5.6	WNW	33
20/03/2015	11.1	31.2	0	ENE	44
21/03/2015	9.6	19.3	0	SE	43
22/03/2015	10.9	22.4	0	NE	37
23/03/2015	8.3	28.8	0	WNW	48
24/03/2015	16.1	21	10.8	WSW	43
25/03/2015	9.1	21.1	9.8	ENE	30
26/03/2015	7.3	19.8	0	W	65
27/03/2015	5.2	18.7	0	WNW	57
28/03/2015	1.3	21.4	0	ENE	26
29/03/2015	2.9	21.6	0	W	35

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	Direction of maximum wind gust	Speed of maximum wind gust (km/h)
30/03/2015	2.6	22.3	0	NNW	20
31/03/2015	7.6	23	0.4	ESE	35



Appendix 6. Serious and Irreversible Impact (SAII) Criteria

White Box Yellow Box Blakely's Red Gum Grassy Woodland SAII criteria

SAII criteria	Address of SAII criteria	
(a) the action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII	See section 5.1 regarding avoidance.	
(b) the area (ha) and condition of the TEC to be impacted directly and indirectly by the proposed development. The condition of the TEC is to be represented by the vegetation integrity score for each vegetation zone.	 White Box Yellow Box Blakely's Red Gum Grassy Woodland aligns to PCT1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670) as mapped on Figure 12. Threatened Ecological Community Mapping. All areas of the TEC have been significantly impacted by historic logging, grazing, weed invasion, and feral animal impacts, and as such, no portions of the TEC within the Study Area are in a benchmark condition. Based on the plot surveys within and surrounding the development envelope, three vegetation condition classes were attributed to the TEC: Moderate condition: this condition class was the best condition within the Study Area. It consisting of clumps of scattered trees (mainly <i>E. melliadara with E. blakelyiX</i>) with a mix of native and introduced ground cover. The native ground cover generally comprised of native grasses, including <i>Bothriochloa macra, Austrodanthonia racemosa, Dichelachne micrantha.</i> Forbs and shrubs were relatively sparse. Cover of Nassella trichotoma (Serrated Tussock) was relatively high across much of the vegetation zone. The zone had a vegetation integrity score of 40.4 Poor condition: consisting of very few scattered <i>Eucalyptus melliodora, E. bosistoana,</i> and <i>E. blakelyi.</i> Canopy cover was low when compared to benchmark. Acacia parramattensis was scattered in clumps throughout the vegetation zone. Forbs and shrubs were relatively sparse and typically were concentrated under the canopy. Much of this condition class has been used historically for grazing. Portions toward the west at the site of the Western Overburden Emplacement are still grazed. Cover of Nassella trichotoma (Serrated Tussock) was relatively high across much of he vegenation zone and vegetation integrity score of 23.7. Acacia/assisted regeneration: consisting of planted and regenerating Acacias and occasional eucalypts (not a CEE under the EPBC Act). This vegetation zone had a vegetation integrity score of 23.7. Acacia/a	


SAII criteria	Address of SAII criteria
	impacted had relatively low vegetation integrity scores (<45 score) which is representative of the degraded condition and invasion by Nassella trichotoma (Serrated Tussock).
	Indirect impacts to the remaining White Box Yellow Box Blakely's Red Gum Woodland would be avoided by carrying out weed control, pest control, demarcating 'no go' areas, and contractor education. Details regarding these are provided in section 5.1.
(c) a description of the extent to which the impact exceeds the threshold for the potential entity that is specified in the Guidance to assist a decision- maker to determine a serious and irreversible impact	No impact threshold has been attributed to this TEC.
	In an attempt to determine the extent of White Box Yellow Box Blakely's Red Gum Woodland in the locality, mapping by Tozer et al. 2006 was examined as it covered the locality extent.
	A total of 3,304.6 ha of the best equivalent vegetation type (p24, Tableland Grassy Box Gum Woodland) has been mapped within a 10 km radius of the Study Area. It should be noted however, that the Tozer et al, 2006 mapping does not appear to account for areas of derived grassland areas which may also align to the TEC, and as such may underestimate the extend of the TEC.
	The mapped occurrence of White Box Yellow Box Blakely's Red Gum Woodland based on Tozer et al (2006) surrounding the development footprint is as follows:
potential TEC within an area of 1000ha, and then	• 1,000 ha = < 230 hectare
10,000ha, surrounding the proposed development footprint	• 10,000 ha = 600.6 hectares.
	The condition of White Box Yellow Box Blakely's Red Gum Woodland within both the 1,000 ha and 10,000 hectares circles is likely to be predominately in a low to moderate condition, given the rural pressure and historic clearing of the area. It is highly likely that weeds would occupy portions of the lower stratums similar to that of the Study Area.
	The largest patches of White Box Yellow Box Blakely's Red Gum Woodland have been mapped (Figure 8) include:
	• A patch greater than 20 hectares which occurs to the north of Peppertree Quarry. This patch has been assessed by Niche to be in a relatively good condition.
	• Scattered patches ranging in size from 5 hectares to 10 hectares occurring within private property, approximately 2 kilometres to the west of the Study Area.
(e) an estimate of the extant area and overall condition of the potential TEC remaining in the IBRA subregion before and after the impact of the	Throughout its range the TEC has been reduced in area and is highly fragmented because of clearance for cropping, grazing and pasture improvement due to the ecological community's occurrence on fertile soils. Very few high quality remnants remain anywhere across its former range. The EPBC Policy Guidelines (DoE 2014) state that over 90% of the



SAII criteria	Address of SAII criteria
proposed development has been taken into consideration	original extent of this ecological community has been cleared. This is supported by OEH (2014b) who regarded the equivalent Biometric Vegetation Type to be 90% cleared, and Thomas et al. (2000) estimate that within South-Eastern NSW 59,468 ha remain from the pre-1750 extent of 1,012,052 ha (approximately 94% cleared). Within the Bungonia IBRA subregion, Niche estimates that greater than 5,000 ha of the TEC remains, which is within a derived condition or as sparsely scattered woodland patches. Based on this estimate, the Project would reduce the extent of the Bungonia IBRA region extent by approximately 0.5 percent of the IBRA Subregion range.
(f) an estimate of the area of the potential TEC that is in the reserve system within the IBRA region and the IBRA subregion	Niche estimate that less than 3 percent of White Box Yellow Box Blakely's Red Gum Woodland within the Bungonia Subregion, and similarly for the IBRA region, is formally protected within National Parks or Conservation Areas.
 (g) the development, clearing or biodiversity certification proposal's impact on: (i) abiotic factors critical to the long-term survival of the potential TEC; for example, how much the impact will lead to a reduction of groundwater levels or the substantial alteration of surface water patterns (ii) characteristic and functionally important species through impacts such as, but not limited to, inappropriate fire/flooding regimes, removal of understorey species or harvesting of plants (iii) the quality and integrity of an occurrence of the potential TEC through threats and indirect impacts including, but not limited to, assisting invasive flora and fauna species to become established or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants which may harm or inhibit growth of species in the potential TEC 	 i. The Project will result in the loss to 88.6 ha of the TEC due to direct clearing. The position of the TEC to be impacted is already in a modified condition due to historic land clearing and the occurrence of Serrated Tussock and grazing by goats and rabbits. The patch to be removed is unlikely to result in changes to the flow regime or ground water levels that may impact upon other patches of the TEC within the locality. ii. The Project will not result in inappropriate fire and flooding regimes that would impact upon surrounding patches of TEC. The existing Bushfire Management Plan would be updated as part of the Project to minimise any potential fire ignition from the site, and to ensure that recommended fire management is carried out. iii. The removal of 88.6 ha of White Box Yellow Box Blakely's Red Gum Woodland opens the surrounding patches to edge effects. Edge effects include the invasion of weeds, erosion and sedimentation. Mitigation measures to be undertaken as part of the Project include: weed control, pest control, demarcating 'no go' areas, and contractor education. Details regarding these are provided in section 5.1.
(h) direct or indirect fragmentation and isolation of an important area of the potential TEC	The condition of the TEC within the Study Area is of a moderate to poor condition, typically containing a scattered canopy layer and mixture of native and introduced ground cover. It is likely that the patch would continue to decline without weed management, particularly targeting Serrated Tussock and Blackberry, and assisted tubestock or direct seeding regeneration.



SAII criteria	Address of SAII criteria
	The affected patches of White Box Yellow Box Blakely's Red Gum Woodland in the Study Area are already fragmented by access roads, exotic pasture and infrastructure. This is a common theme for the TEC which is highly fragmented in the locality (Tozer et al. 2006 mapping of map unit p24). The Project will lead to increased fragmentation of the ecological community in the local context through the development of the Project however connectivity will be retained within contiguous habitat around the periphery of the Study Area.
(i) the measures proposed to contribute to the recovery of the potential TEC in the IBRA subregion.	The Project will require a like-for-like offset to satisfy the requirements of the BAM and EPBC Act. As such, this will result in the establishment of a conservation area that will protect and enhance White Box Yellow Box Blakely's Red Gum Woodland. The proposed offset would achieve no net loss in extent and condition of the ecological community throughout its geographic distribution as per the requirement of the BAM.



Koala habitat

SAII criteria	Address of SAII criteria
(a) the action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII	See section 5 regarding avoidance.
(b) the size of the local population directly and indirectly impacted by the development, clearing or biodiversity certification	Impacts from the Project largely relate to the removal of foraging and dispersal habitat that has been defined as being critical to the survival of the Koala under the EPBC Act (DoE 2014; Appendix 8). Habitat mapped as good and moderate habitat potential within the Study Area (Figure 16) contained either two or more known feed trees (listed as primary, secondary or tertiary species under the species Recovery Plan (DECC 2008)) or a single feed species that occupied more than 50% of a 400 m2 floristic quadrat. Such habitat is recognised as critical habitat due to past impacts on similar habitat limiting the Koalas ability to persist throughout its former distribution. The Project would result in the removal of 132.4 ha of such habitat. Due to the apparent limited use of the Study Area (owing to lack of detection of Koala presence during the fieldwork) and its extremely small extent in relation to similar habitat for the Shoalhaven Gorge Koala population (7,500 ha), it is not considered that removal of this habitat alone would significantly adversely impact the relevant Koala population (centred around the Shoalhaven gorge) such that a decline would occur or that the population is placed at risk of extinction. Active sites for this population are concentrated within protected areas and the Study Area is not thought to provide a link between active areas within the population's distribution or to any other Koala population. Mitigation measures detailed in section 6.3 would be employed to reduce the indirect impact toward the Koala.
(c) the extent to which the impact exceeds any threshold for the potential entity that is specified in the Guidance to assist a decision-maker to determine a serious and irreversible impact	No impact threshold has been attributed to the Koala.
(d) the likely impact (including direct and indirect impacts) that the development, clearing or biodiversity certification will have on the habitat of the local population, including but not limited to:	 i. The Project would result in the removal of approximately 132.4 hectares of habitat. ii. Impacts from the Project largely relate to the removal of foraging and dispersal habitat. Due to the apparent limited use of the Study Area and its extremely small extent in relation to similar habitat for the Shoalhaven Gorge Koala population (7,500 ha), it is not considered that removal of this



SAII criteria

Address of SAII criteria

iii.

(i) an estimate of the change in habitat available to the local population as a result of the proposed development

(ii) the proposed loss, modification, destruction or isolation of the available habitat used by the local population, and

(iii) modification of habitat required for the maintenance of processes important to the species' life cycle (such as in the case of a plant – pollination, seed set, seed dispersal, germination), genetic diversity and long-term evolutionary development.

BioNet Atlas records or other documented, quantifiable means must be used by the assessor to estimate what percentage of the species' population and habitat is likely to be lost in the long term within the IBRA subregion due to the direct and indirect impacts of the development

(e) the likely impact on the ecology of the local population. At a minimum, address the following:

(i) for fauna: breeding, foraging, roosting, and dispersal or movement pathways

(f) a description of the extent to which the local population will become fragmented or isolated as a result of the proposed development habitat alone would significantly adversely impact the relevant Koala population (centred around the Shoalhaven gorge) such that a decline would occur or that the population is placed at risk of extinction. Active sites for this population are concentrated within protected areas and the Study Area is not thought to provide a link between active areas within the population's distribution or to any other Koala population.

The proposed development would result in the removal of approximately 132.4 hectares of koala habitat. This is a reduction of less than 1 percent of the available occupiable habitat (8,713 ha of similar habitat for the Shoalhaven Gorge Koala population). The remaining habitat would not be impacted by the Project and therefore would not result in extinction of the population. The population is likely to utilise existing habitat within the surrounding area.

As the area for removal is a small relative extent (less than 1percent) of habitat for the Shoalhaven population of Koala. It is not considered that the removal of this habitat alone would significantly adversely impact the Shoalhaven koala population which is centred within Bungonia Gorge and the Shoalhaven River.

Active sites for this population are concentrated within protected areas and the Study Area is not thought to provide a link between active areas within the population's distribution or to any other koala population.

No Koalas or evidence of Koalas were recorded within the Study Area, however the eucalypt species present in the Study Area are Koala feed trees. As discussed previously, the Study Area is not thought to provide a link between active areas within the population's distribution or to any other koala population. It is unlikely that the local koala population will become fragmented or isolated as a result of the Project, however fragmentation of foraging habitat would occur and be centred around the existing infrastructure.

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SAII	criteri	a		

Address of SAII criteria

(g) the relationship of the local population to other population/populations of the species. This must include consideration of the interaction and importance of the local population to other population/populations for factors such as breeding, dispersal and genetic viability/diversity, and whether the local population is at the limit of the species' range

(h) the extent to which the proposed development will lead to an increase in threats and indirect impacts, including impacts from invasive flora and fauna, that may in turn lead to a decrease in the viability of the local population

(i) an estimate of the area, or number of populations and size of populations that is in the reserve system in NSW, the IBRA region and the IBRA subregion

(j) the measure/s proposed to contribute to the recovery of the species in the IBRA subregion.

It is unlikely that the Study Area provides an important linkage to Koala populations. The species was not detected during field surveys, nor have there been any sightings within the Study Area historically. However, it is recognised that given the presence of feed trees, the Koala has the potential to utilise the Study Area on occasion. The Study Area is unlikely to be import for breeding, dispersal and genetic viability given the Shoalhaven Koala population is already centred and protected within the Bungonia Gorge.

The Project is likely to result in edge effects in the form of weed invasion, sedimentation and erosion within habitat for Koala immediately adjacent to the areas being cleared. However, mitigation measures detailed in section 5.1 would be employed to reduce the impact of edge effects occurring on habitat for the remaining population.

Based on previous mapping (Tozer et al 2006), the area of potential habitat in the locality is approximately 7,500 hectares. The proposed development would result in the removal of less than 1 percent of potential habitat in the locality. As can be seen from Figure 16, the records for the Koala predominately occur to the south of the Study Area within Bungonia Gorge, away from the Study Area. The habitat features in this area, would not be impacted by the Project.

The Project will require a like-for-like offset to satisfy the requirements of the BAM and EPBC Act. As such, this will result in the establishment of a conservation area that will protect and enhance Koala habitat. The proposed offset would achieve no net loss in extent and condition of the Koala habitat as per the requirement of the BAM.



Large-eared Pied Bat foraging habitat

SAII criteria	Address of SAII criteria
(a) the action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII	See section 5.1 regarding avoidance.
(b) the size of the local population directly and indirectly impacted by the development, clearing or biodiversity certification	 Impacts from the Project largely relate to the removal of foraging habitat for the Large-eared Pied Bat. Habitat mapped as good habitat is provided in Figure 16. This habitat includes potential foraging habitat within proximity to known caves and overhangs and main watercourses. The Project would result in the removal of 140.3 ha of such foraging habitat. The Project will not impact roosting habitat given it is positioned away from known caves, and overhangs likely to occur along Bungonia Gorge. Known cave site (located approximately 900 m to the south) which may contain roosting habitat for the species would not be impacted by the Project. Mitigation measures detailed in section 6.3 would be employed to reduce the indirect impact toward the Large-eared Pied Bat habitat.
(c) the extent to which the impact exceeds any threshold for the potential entity that is specified in the Guidance to assist a decision-maker to determine a serious and irreversible impact	Breeding habitat is identified as an SAII – however the Project would not impact upon breeding habitat for the Large- eared Pied Bat.
 (d) the likely impact (including direct and indirect impacts) that the development, clearing or biodiversity certification will have on the habitat of the local population, including but not limited to: (i) an estimate of the change in habitat available to the local population as a result of the proposed development 	 i. The Project would result in the removal of approximately 140.3 hectares of foraging habitat. No breeding habitat would be impacted. ii. Impacts from the Project largely relate to the removal of 140.3 ha of foraging habitat. The Large-eared Pied Bat is known to forage in a range of vegetation types, including dry and wet sclerophyll forest, grassy woodland, Callitris dominated forest, tall open eucalypt forest with a rainforest sub-canopy, sub-alpine woodland and sandstone outcrop country (Hoye & Dwyer 1995; Pennay 2002; DECC 2007). Foraging habitat on fertile soils (or within fertile valleys) is also considered an important overall requirement for the Large-eared Pied Bat (Pennay 2008), however the species has been recorded extensively within sandstone associated vegetation, indicating that whilst foraging habitat on fertile soils is



SAII criteria

Address of SAII criteria

iii.

(ii) the proposed loss, modification, destruction or isolation of the available habitat used by the local population, and

(iii) modification of habitat required for the maintenance of processes important to the species' life cycle (such as in the case of a plant – pollination, seed set, seed dispersal, germination), genetic diversity and long-term evolutionary development. likely to be important, foraging would by no means be confined to such areas. Based on an analysis of existing native vegetation mapping by Tozer et al (2006) and aerial interpretation, approximately 8,713 ha of potential foraging habitat has been mapped within the locality. The impact to approximately 140.3 ha of foraging habitat associated with the Project is relatively small in relation to similar habitat in the locality.

The proposed development would result in an impact to foraging habitat which is relatively extensive in the locality. It is unlikely that the modification of the habitat is detrimental to a population of the large-eared Pied Bat given the availability of similar habitat types through the locality. Furthermore, no breeding habitat would be impacted by the Project.

Breeding and roosting habitat: The Project would not result in any impact to known breeding habitat or roosting habitat for the Large-eared Pied Bat.

One cave is known to occur within 900m of the Study Area, known as Main Gully Spring (Bauer and Bauer 1998). The cave is located beneath the Mine and in periods of high discharge this cave acts as an overflow. A number of chambers and tunnels are described as occurring in this cave by Baeuer and Bauer (1998) including a chamber 1 m x 2.7 m wide.

BioNet Atlas records or other documented, quantifiable means must be used by the assessor to estimate what percentage of the species' population and habitat is likely to be lost in the long term within the IBRA subregion due to the direct and indirect impacts of the development

(e) the likely impact on the ecology of the local population. At a minimum, address the following:

(i) for fauna: breeding, foraging, roosting, and dispersal or movement pathways

Main Gully Spring is a potential bat roosting site. It could not be inspected during the current field survey due to safety and access issues. However, a site inspection by Boral representitives accompanied by an experienced caver was undertaken in August 2017 at the base of the cave, and approximately 10 meteres inside the entrance. During the site inspection, approximately 5 microbats were observed. It was not possible to determine the species from photographs that were provided. As such, it is not possible to state with certainty that a maternal roost could not be established for Large-eared Pied Bat.

Whilst microbats were recorded it is unlikely that long-term maternity roosts would be established in Main Gully Spring due to its limited size and occasional inundation of most, if not all parts of the cave in times of high flow.

Regardless of whether bat roosting or breeding occurs within the cave, it is highly unlikely that the Main Gully Spring Cave would would experience any impact associated with the Project. This is due to the distance of the subject cave from the Mine expansion activities that involve mining and blasting which is to occur over 900 metres to the north. There has been an ongoing history of mining within the existing south pit throughout which any roosting bats would have persisted if present. The Project is not forecast to increase noise or vibration to the subject cave or any other known caves in the locality.



SAII criteria	Address of SAII criteria
	 Foraging: Impacts from the Project largely relate to the removal of 140.3 ha of foraging habitat. The Large-eared Pied Bat is known to forage in a range of vegetation types, including dry and wet sclerophyll forest, grassy woodland, Callitris dominated forest, tall open eucalypt forest with a rainforest sub-canopy, sub-alpine woodland and sandstone outcrop country (Hoye & Dwyer 1995; Pennay 2002; DECC 2007). Foraging habitat on fertile soils (or within fertile valleys) is also considered an important overall requirement for the Large-eared Pied Bat (Pennay 2008), however the species has been recorded extensively within sandstone associated vegetation, indicating that whilst foraging habitat on fertile soils is likely to be important, foraging would by no means be confined to such areas. Based on an analysis of existing native vegetation mapping by Tozer et al (2006) and aerial interpretation, approximately 8,713 ha of potential foraging habitat has been mapped within the locality. The impact to approximately 140.3 ha of foraging habitat associated with the Project is relatively small in relation to similar habitat in the locality. Movement pathways: The Study Area is located adjacent to an operating Mine, and would essentially expand the footprint of the exiting Mine to the west. The foraging habitat to be impacted is unlikely to result in any disruption to flight paths and mobility given there will still be extensive unimpeded bushland is located throughout the locality and throughout Bungonia gorge. Patches of bushland will still exist on land surrounding the west of the Study Area. Given the mobility of the species, it is unlikely that the Project would disrupt the mobility of the species.
(f) a description of the extent to which the local population will become fragmented or isolated as a result of the proposed development	It is highly unlikely that the local Large-eared Pied Bat population would be significantly impacted by the removal of 140.3 ha of foraging habitat given the extent available within the locality. Furthermore, the removal of such habitat is unlikely to result in a change to flight movements as discussed above. The Project would also not result in any impact to known breeding or roosting sites.
(g) the relationship of the local population to other population/populations of the species. This must include consideration of the interaction and importance of the local population to other population/populations for factors such as breeding,	It is highly unlikely that the Project would impact upon any important local Large-eared Pied Bat population. No breeding habitat would be impact, nor would any limiting foraging habitat be impacted. Furthermore, the removal of such habitat is unlikely to result in a change to flight movements given the mobility of the species and habitat would still exist around the periphery of the Study Area.

dispersal and genetic viability/diversity, and



SAII criteria	Address of SAII criteria
whether the local population is at the limit of the species' range	
(h) the extent to which the proposed development will lead to an increase in threats and indirect impacts, including impacts from invasive flora and fauna, that may in turn lead to a decrease in the viability of the local population	The Project has the potential to result in edge effects in the form of weed invasion, sedimentation and erosion within foraging habitat for Large-eared Pied Bat immediately adjacent to the areas being cleared. However, mitigation measures detailed in section 5.1 would be employed to reduce the impact of edge effects occurring on foraging habitat for the remaining population.
(i) an estimate of the area, or number of populations and size of populations that is in the reserve system in NSW, the IBRA region and the IBRA subregion	Based on previous mapping (Tozer et al 2006), the area of potential habitat in the locality is approximately 7,500 hectares. The proposed development would result in the removal of less than 1 percent of potential habitat in the locality. As can be seen from Figure 8, a potential cave site occurs approximately 900 m to the south of the Study Area within Bungonia Gorge. This potential breeding site would not be impacted by the Project.
(j) the measure/s proposed to contribute to the recovery of the species in the IBRA subregion.	The Project will require a like-for-like offset to satisfy the requirements of the BAM and EPBC Act. As such, this will result in the establishment of a conservation area that will protect and enhance Large-eared Pied Bat habitat. The proposed offset would achieve no net loss in extent and condition of the Large-eared Pied Bat habitat as per the requirement of the BAM.



Eastern Bent-wing Bat foraging habitat

SAII criteria	Address of SAII criteria (undertaken to satisfy the SEARs in replace of section 9.2 of the FBA). It should be noted that the Eastern Bent-wing Bat is regarded as an ecosystem credit species in regards to the current Project.
(a) the action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII	See section section 5.1 regarding avoidance.
(b) the size of the local population directly and indirectly impacted by the development, clearing or biodiversity certification	 Impacts from the Project largely relate to the removal of foraging habitat for the Eastern Bent-wing Bat. Habitat mapped as good habitat is provided in Figure 10. This habitat includes potential foraging habitat within proximity to known caves and overhangs and main watercourses. The Project would result in the removal of 140.3 ha of such foraging habitat. The Project will not impact roosting habitat given it is positioned away from known caves, and overhangs likely to occur along Bungonia Gorge. Known cave sites (located approximately 900 metres to the south) which may contain roosting habitat for the species would not be impacted by the Project. Eastern Bent-wing Bats were recorded frequently during echolocation surveys within the area surveyed, occurring at all sites where recordings were made (Appendix 5). Nightly Eastern Bent-wing Bat recordings showed consistent arrival and departure times with bats typically recorded from around 8:20 pm in the evening until 5:50 am the following morning during the survey in early February 2015. It is expected that the majority of recorded bats arrived from the Drum Cave roost site where exit times for bats between the 10th and the 12th of February in 2004 were concentrated from 8:00 pm to 8:45 pm with a peak around 8:15 – 8:30 pm (Law and Chidel 2004). The Study Area is situated approximately 3.7 km north of a major breeding cave and maternity roost for the Eastern Bent-wing-bat known as Drum Cave. Drum cave is one of four known major maternity roosts for the species and is suspected contain between 10,000 and 15,000 individual bats (Law and Chidel 2004). Other caves in the vicinity are known to act as roost habitat for Eastern Bent-wing Bats, however maternity roosts have not been recorded in surrounding caves. As discussed previously in relation to the Large-eared Pied Bat, Main Gully Spring (Bauer and Bauer 1998) which occur
	within 900 m of the Study Area are unlikely to contain frequent bat roosting due to the water inundation within the caves. It is assumed unlikely that long-term maternity roosts would be established in Main Valley Spring due to its



SAII criteria	Address of SAII criteria (undertaken to satisfy the SEARs in replace of section 9.2 of the FBA). It should be noted that the Eastern Bent-wing Bat is regarded as an ecosystem credit species in regards to the current Project.
	limited size and occasional inundation of most if not all parts of the cave in times of high flow. However, given the lack of previous survey of this cave, it is not possible to state with certainty that a maternal roost could not be established for Eastern Bent-wing bat within Main Valley Spring. Regardless, as is the case with the Large-eared Pied Bat, the cave is located away from the Study Area and would not experience any impact associated with the Project. This is due to the distance of the subject caves from the Mine expansion activities that involve mining and blasting which is to occur over 900 metres to the north.
	Foraging habitat for Eastern Bent-wing Bat would be similar to that of the Large-eared Pied Bat, occupying 140.3 ha within the Study Area. Foraging habitat in the locality is considered important for the Eastern Bent-wing Bat due to the large population dependant on the roost site known from the area (Drum Cave). While foraging habitat of the type to be removed is considered important for both species, such habitat is considered locally common and the quantity of habitat to be removed is not considered critical to the overall species survival or the local occurrence of the species. It is estimated that 8,713 ha of native vegetation exists within the locality of the Study Area (within a 10 km radius of the Project site). Regardless, the 'species credit' component associated with this species is only triggered with impacts to breeding features (such as caves, tunnels, mines, culverts or other structures known or suspected to be used for breeding). As such, Eastern Bent-wing Bat is regarded as an 'ecosystem credit' species for this assessment. Mitigation measures detailed in section 6.3 would be employed to reduce the indirect impact toward the Large-eared Pied Bat habitat.
(c) the extent to which the impact exceeds any threshold for the potential entity that is specified in the Guidance to assist a decision-maker to determine a serious and irreversible impact	Breeding habitat is identified as an SAII – however the Project would not impact upon breeding habitat for the Eastern Bent-wing Bat.
(d) the likely impact (including direct and indirect impacts) that the development, clearing or biodiversity certification will have on the habitat of the local population, including but not limited to:	 i. The Project would result in the removal of approximately 140.3 hectares of foraging habitat. No breeding habitat would be impacted. ii. Impacts from the Project largely relate to the removal of 140.3 ha of foraging habitat. Foraging habitat for Eastern Bent-wing Bat would be similar to that of the Large-eared Pied Bat, occupying 140.3 ha within the Study Area. Foraging habitat in the locality is considered important for the Eastern Bent-wing Bat due to the large population dependant on the roost site known from the area (Drum Cave). While foraging habitat of the type to be removed is considered important for both species, such habitat is



Address of SAII criteria (undertaken to satisfy the SEARs in replace of section 9.2 of the FBA). It should be noted that

the Eastern Bent-wing Bat is regarded as an ecosystem credit species in regards to the current Project. considered locally common and the quantity of habitat to be removed is not considered critical to the overall species survival or the local occurrence of the species. It is estimated that 8,713 ha of native vegetation exists within the locality of the Study Area (within a 10 km radius of the Project site). The proposed development would result in an impact to foraging habitat which is relatively extensive in the locality. It is unlikely that the modification of the habitat is detrimental to a population of the Eastern Bent-wing Bat given the availability of similar habitat types through the locality. Furthermore, no breeding habitat would be impacted by the Project. Breeding and roosting habitat: The Project would not result in any impact to known breeding habitat or roosting habitat for the Eastern Bent-wing Bat.

BioNet Atlas records or other documented. guantifiable means must be used by the assessor to estimate what percentage of the species' population and habitat is likely to be lost in the long term within the IBRA subregion due to the direct and indirect impacts of the development

(e) the likely impact on the ecology of the local population. At a minimum, address the following:

(i) for fauna: breeding, foraging, roosting, and dispersal or movement pathways

The Study Area is situated approximately 3.7 km north of a major breeding cave and maternity roost for the Eastern Bent-wing-bat known as Drum Cave. Drum cave is one of four known major maternity roosts for the species and is suspected contain between 10,000 and 15,000 individual bats (Law and Chidel 2004). Other caves in the vicinity are known to act as roost habitat for Eastern Bent-wing Bats, however maternity roosts have not been recorded in surrounding caves.

As discussed previously in relation to the Large-eared Pied Bat, Main Gully Spring which occurs over 900 m to the south of the Study Area is unlikely to contain frequent bat roosting due to the water inundation within the caves. It is assumed unlikely that long-term maternity roosts would be established in Main Valley Spring due to its limited size and occasional inundation of most if not all parts of the cave in times of high flow. However, given the lack of previous survey of this cave, it is not possible to state with certainty that a maternal roost could not be established for Eastern Bent-wing bat within Main Valley Spring. Regardless, as is the case with the Large-eared Pied Bat, the caves are located away from the Study Area and would not experience any impact associated with the Project. This is due to the distance of the subject caves from the Mine expansion activities that involve mining and blasting which is to occur over 900 metres to the north.

SAII criteria

(i) an estimate of the change in habitat available to the local population as a result of the proposed development

(ii) the proposed loss, modification, destruction or isolation of the available habitat used by the local population, and

(iii) modification of habitat required for the maintenance of processes important to the species' life cycle (such as in the case of a plant – pollination, seed set, seed dispersal, germination), genetic diversity and long-term evolutionary development.



SAII criteria	Address of SAII criteria (undertaken to satisfy the SEARs in replace of section 9.2 of the FBA). It should be noted that the Eastern Bent-wing Bat is regarded as an ecosystem credit species in regards to the current Project.
	Foraging : Foraging habitat for Eastern Bent-wing Bat would be similar to that of the Large-eared Pied Bat, occupying 140.3 ha within the Study Area. Foraging habitat in the locality is considered important for the Eastern Bent-wing Bat due to the large population dependant on the roost site known from the area (Drum Cave). While foraging habitat of the type to be removed is considered important for both species, such habitat is considered locally common and the quantity of habitat to be removed is not considered critical to the overall species survival or the local occurrence of the species. It is estimated that 8,713 ha of native vegetation exists within the locality of the Study Area (within a 10 km radius of the Project site). Regardless, the 'species credit' component associated with this species is only triggered with impacts to breeding features (such as caves, tunnels, mines, culverts or other structures known or suspected to be used for breeding). As such, Eastern Bent-wing Bat is regarded as an 'ecosystem credit' species for this assessment. Movement pathways: The Study Area is located adjacent to an operating Mine, and would essentially expand the footprint of the exiting Mine to the west. The foraging habitat to be impacted is unlikely to result in any disruption to flight paths and mobility given there will still be extensive unimpeded bushland located throughout the locality and throughout Bungonia gorge. Patches of bushland will still exist on land surrounding the west of the Study Area. Given the mobility of the species, it is unlikely that the Project would disrupt the mobility of the species.
(f) a description of the extent to which the local population will become fragmented or isolated as a result of the proposed development	It is highly unlikely that the local Eastern Bentwing Bat population would be significantly impacted by the removal of 140.3 ha of foraging habitat given the extent available within the locality. Furthermore, the removal of such habitat is unlikely to result in a change to flight movements as discussed above. The Project would also not result in any impact to known breeding or roosting sites.
(g) the relationship of the local population to other population/populations of the species. This must include consideration of the interaction and importance of the local population to other population/populations for factors such as breeding, dispersal and genetic viability/diversity, and whether the local population is at the limit of the species' range	It is highly unlikely that the Project would impact upon any important local Eastern Bentwing Bat population. No breeding habitat would be impacted, nor would any limiting foraging habitat be impacted. Furthermore, the removal of such habitat is unlikely to result in a change to flight movements given the mobility of the species and habitat would still existing around the periphery of the Study Area.
(h) the extent to which the proposed development will lead to an increase in threats and indirect	The Project has the potentialto result in edge effects in the form of weed invasion, sedimentation and erosion within foraging habitat for the Eastern Bentwing Bat immediately adjacent to the areas being cleared. However, mitigation



SAII criteria	Address of SAII criteria (undertaken to satisfy the SEARs in replace of section 9.2 of the FBA). It should be noted that the Eastern Bent-wing Bat is regarded as an ecosystem credit species in regards to the current Project.
impacts, including impacts from invasive flora and fauna, that may in turn lead to a decrease in the viability of the local population	measures detailed in section 5.1 would be employed to reduce the impact of edge effects occurring on foraging habitat for the remaining population.
(i) an estimate of the area, or number of populations and size of populations that is in the reserve system in NSW, the IBRA region and the IBRA subregion	Based on previous mapping (Tozer et al 2006), the area of potential habitat in the locality is approximately 7,500 hectares. The proposed development would result in the removal of less than 1 percent of potential habitat in the locality. As can be seen from Figure 8, a potential cave site occurs approximately 900 m to the south of the Study Area within Bungonia Gorge. This potential breeding site would not be impacted by the Project.
(j) the measure/s proposed to contribute to the recovery of the species in the IBRA subregion.	The Project does not require an offset under the BAM for the Eastern Bentwing Bat given it is an ecosystem credit species. The Study Area however, will be rehabilitated following decommissioning which will re-establish foraging habitat for the species.



Appendix 7. Biodiversity Credit Calculator Report



Proposal Details

BAM Credit Summary Report

Proposal Name BAM data last updated * Assessment Id 2155 Marulan South Project 00011994/BAAS17066/19/00012596 04/01/2019 October 2018 Assessor Name **Report Created** BAM Data version * Sian Griffiths 07/03/2019 6 * Disclaimer: BAM data last updated may indicate either complete or partial update of Assessor Number the BAM calculator database. BAM calculator database may not be completely aligned BAAS17066 with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Candidate SAII	Ecosystem credits
Broad-l	leaved Peppermin	t - Red Stringyba	nrk grassy o	oen forest o	on undulating hills, South Eastern Highl	ands Bioregion		
4	731_Medium	54.1	12.0	0.25	High Sensitivity to Potential Gain	2.00		325
							Subtotal	325



BAM Credit Summary Report

Coast G	irey Box - stringyba	irk dry woodland	d on slopes	of the Shoa	alhaven Gorges, southern Sydney Bas	in Bioregion		
2	778_Medium	45.6	57.9	0.25	High Sensitivity to Potential Gain	1.50		990
7	778_Poor	18.3	7.5	0.25	High Sensitivity to Potential Gain	1.50		52
9	778_Waterdepen dent	8.9	0.1	0.25	High Sensitivity to Potential Gain	1.50		0
							Subtotal	1042
Silverto	p Ash - Blue-leaved	d Stringybark sh	rubby open	forest on i	idges, north east South Eastern High	lands Bioregion		
3	1150_Medium	45.4	13.7	0.25	High Sensitivity to Potential Gain	1.50		233
8	1150_Poor	27.2	2.6	0.25	High Sensitivity to Potential Gain	1.50		27
							Subtotal	260
Yellow	Box grassy woodlaı	nd of the northe	rn Monaro	and Upper	Shoalhaven area, South Eastern High	lands Bioregion		
1	1334_Medium	40.4	48.8	0.25	High Sensitivity to Potential Gain	2.00	TRUE	985
5	1334_Poor	23.7	31.9	0.25	High Sensitivity to Potential Gain	2.00	TRUE	378
6	1334_Acacia_plan tings	26.1	7.9	0.25	High Sensitivity to Potential Gain	2.00	TRUE	103
							Subtotal	1466
							Total	3093

Species credits for threatened species



BAM Credit Summary Report

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Candidate SAII	Species credits
Chalinolobus dwyeri /	Large-eared Pied Bat (Fau	na)				
1334_Medium	40.4	48.8	0.25	3	True	1478
778_Medium	45.6	57.9	0.25	3	True	1980
1150_Medium	45.4	13.7	0.25	3	True	467
731_Medium	54.1	12	0.25	3	True	487
1334_Poor	23.7	0	0.25	3	True	0
1334_Acacia_plantings	26.1	7.9	0.25	3	True	155
778_Poor	18.3	0	0.25	3	True	0
1150_Poor	27.2	0	0.25	3	True	0
					Subtotal	4567
Phascolarctos cinereus	; / Koala (Fauna)					
1334_Medium	40.4	48.8	0.25	2	N/A	985
778_Medium	45.6	57.9	0.25	2	N/A	1320
1150_Medium	45.4	13.7	0.25	2	N/A	311
731_Medium	54.1	12	0.25	2	N/A	325
					Subtotal	2941



BAM Credit Summary Report

Solanum celatum / Solanum celatum (Flora)									
778_Medium	45.6	0.1	0.25	2 False	2				
				Subtotal	2				

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8.1 Introduction

Matters of National Significance (MNES) have been addressed throughout the BDAR, and have been specifically compiled and added to this chapter at the request of the Biodiversity Conservation Division (BCD) and DPIE on the 27th of April 2020.

This chapter should be read in conjunction with the BDAR to provide context of the proposed development. Where relevant, we have referred to applicable sections of the BDAR to avoid significant duplication.

This chapter also includes the formal Assessments of Significance for the following Commonwealth listed threatened biodiversity that may be impacted by the Project:

- Threatened Ecological Communities
 - > Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland
- Threatened Fauna
 - o Koala
 - Large-eared Pied Bat
 - Grey-headed Flying-fox
 - Regent Honeyeater
- Migratory Species
 - Great Egret
 - Cattle Egret
 - o Rainbow Bee-eater
 - o Black-faced Monarch
 - o Rufous Fantail.

8.2 Commonwealth Threatened Ecological Communities

8.2.1 Survey Effort and Occurrence

The vegetation survey effort was undertaken using the BAM, and involved extensive vegetation and data interrogation to accurately map the extent of vegetation across the Study Area and surrounds. Details associated with the vegetation validation survey and results are provided in section 3.2 of the BDAR.

The survey confirmed the presence of one EPBC Act listed TEC – White Box - Yellow Box Blakely's Red Gum Woodland and Derived Native Grassland (Box Gum Woodland), which coincides with the occurrence of PCT1334 Yellow Box - Blakely's Red Gum grassy woodland (SR670). No other TECs under the EPBC Act occur within the Study Area (Appendix 1).

Our validated vegetation mapping of Box Gum Woodland within the Study Area, has taken into consideration the descriptions and identification guidelines presented in the DEH (2006) White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Grasslands (Box Gum Woodland) Policy Statement. As discussed in Appendix 2 and section 3.2.5, the detailed survey and analysis concluded that the following two condition classes of PCT1334 that occur within the Study Area, meet that of the DEH (2006) guidelines for Box Gum Woodland:

• Moderate condition: this condition class occupies 48.8 ha of the Study Area. The zone consists of clumps of scattered trees (mainly *E. melliodora* with *E. blakelyiX*) with a mix of native and introduced ground cover. The native ground cover generally comprised of native grasses, including *Bothriochloa macra, Austrodanthonia racemosa,* and *Dichelachne micrantha*. Forbs and shrubs were relatively

sparse. Cover of *Nassella trichotoma* (Serrated Tussock) was relatively high across much of the vegetation zone.

• Poor condition: this condition classes occupies 31.9 ha of the Study Area. The zone consists of very few scattered *Eucalyptus melliodora, E. bosistoana,* and *E. blakelyi*. Canopy cover was low when compared to benchmark. *Acacia parramattensis* was scattered in clumps throughout the vegetation zone. Forbs and shrubs were relatively sparse and typically were concentrated under the canopy. Much of this condition class has been used historically for grazing. Portions toward the west at the site of the Western Overburden Emplacement are still grazed. Cover of *Nassella trichotoma* (Serrated Tussock) was relatively high across much of the vegetation zone.

Together, a total of 80.7 ha of EPBC Act listed Box Gum Woodland occurs within the Study Area as shown on Figure 13.

During the field survey, Niche also mapped areas of EPBC Act listed Box Gum Woodland within Boral's lease holding, and undertook a desktop mapping exercise outside of the lease (supplemented with road-side assessment where no access was permitted within private landholdings) to understand the occurrence of the TEC within the locality for the initial purpose of determining suitable offset sites for the Project.

Our mapping has confirmed that the extent of EPBC Act listed Box Gum Woodland is not limited to the Study Area. Rather, we have mapped a total of 185.6 hectares of the TEC surrounding the Study Area as shown in Figure 13.

Within a larger local context, areas that Niche could not assess (eg. within extensive private landholdings) we have examined the regional mapping completed by Tozer et al 2006. A total of 3,304.6 ha of the best equivalent vegetation type (p24, Tableland Grassy Box Gum Woodland) has been mapped within a 10 km radius of the Project area. The p24 mapping unit has been described by Tozer et al (2006) as "potentially aligning to the CEEC and the state listed EEC, however it would include some areas that do not meet the CEEC". As a precautionary measure, we have assumed in this assessment that half of the total p24 area would be an approximate representation of the remaining Commonwealth CEEC (i.e. 1,652.3 ha).

Based on our vegetation investigations, patches of Box Gum Woodland within the locality are relatively fragmented, which is evident on Figure 13. It is highly likely that many of these patches are in a similar condition to that of the Study Area – ie. historically cleared, subject to edge effects, or grazed. This is common across the range of the TEC.

8.2.2 Direct and Indirect Impacts to Commonwealth Threatened Ecological Communities

A total of 80.7 ha of Box Gum Woodland under the EPBC Act would be directly impacted as a result of unavoidable vegetation clearing for the Project. The Box Gum Woodland to be impacted is in a modified state, due to previous land clearing, grazing, feral pest grazing, over abundant herbivore grazing, and due to the abundance and spread of Serrated Tussock. Of the Box Gum Woodland to be impacted, approximately 31.9 ha (poor condition) is significantly modified through historic clearing, leaving scattered canopy trees with no shrub layer, and a mix of native and introduced grasses. This is a common theme for the TEC, as throughout its range, the TEC has been reduced in area and highly fragmented. Very few high-quality remnants remain anywhere across its former range. The EPBC Policy Guidelines (DoE 2014) state that over 90% of the original extent of the ecological community has been cleared. This is supported by OEH (2014) who regarded the equivalent Biometric Vegetation Type to be 90% cleared, and Thomas et al. (2000) estimate that within South-Eastern NSW 59,468 ha remain from the pre-1750 extent of 1,012,052 ha (approximately 94% cleared).

Large patches of the Box Gum Woodland are important in retaining seeds, flora diversity, and support the fauna that specifically rely on the vegetation mix. The Project would result in the removal of an already fragmented patch of modified Box Gum Woodland from the locality, however similar patches within the surrounding locality would not be impacted, including a patch to the immediate north of the Western Overburden Emplacement which was a in a better condition (stratum layers intact, high species diversity) compared to the Study Area. One of the best condition patches of the TEC encountered during our field investigations occurs to the north-east of Peppertree Quarry. This patch is approximately 20 ha in size, and supports a higher diversity than that in the Study Area.

The areas of Box Gum Woodland within the Study Area are already fragmented by access roads, infrastructure and non-native vegetation (Figure 13). The Project will lead to increased fragmentation of the TEC in the local context through the combination of the emplacement areas. In particular, an 18.8 ha patch of native vegetation (consisting of approximately 6.7 ha of Box Gum Woodland) would be fragmented between the existing Marulan South Limestone Mine and the Study Area.

Indirect impacts in the form of weed incursion, dust, and feral pests have the potential to occur immediately adjacent to the Study Area resulting in impacts to remaining patches of Box Gum Woodland. Quantifying the extent of indirect impacts without mitigation measures is difficult and highly variable given the relatively unpredictable nature. Without any form of mitigation measure, we have assumed that indirect impacts may occur within 50-100 m from the edge of the Study Area, which takes into account the potential seed dispersal and dust from construction and operation (Figure 9). As indicated on Figure 13, areas of indirect impacts without mitigation have the potential to occur within Box Gum Woodland patches immediately surrounding the Study Area, including the 6.7 ha patch discussed above that occurs between the existing Marulan South Limestone Mine and the Study Area (Figure 9; Figure 13).

To prevent or minimise the indirect impacts specific to Box Gum Woodland from extending outside of the Study Area, mitigation measures are provided in Table 17. In summary, through the successful implementation of the mitigation measures, the indirect impacts are not expected to result in any degradation of surrounding Box Gum Woodland to such an extent to result in further decline outside of the Study Area. The proposed measures would be detailed in the updated Biodiversity Management Plan (section 6.4).



Indirect impact (likelihood)	Potential indirect impact during construction and operation without mitigation measures	Potential extent of the indirect impact prior to mitigation	Mitigation measure (These to be included in the site Biodiversity Management Plan)	Expected success of mitigation measure
Edge effects	Unavoidable vegetation clearing associated with the Project would result in the fragmentation of Box Gum Woodland, which is evident on Figure 13. Fragmentation would create a number of new edges along all boundaries of the Study Area, in particular areas where there are no existing buffers (roads, existing emplacements, cleared area) between the disturbance and areas of woodland/native vegetation. This assessment has estimated that the edge effects may occur approximately 50-100 m from the Study Area boundary, into areas of Box Gum Woodland immediately adjacent as identified on Figure 13. Without management of edge effects (eg. fence demarcation during construction and operation, weed control, pest control, prevention of unlawful access), adjacent areas of Box Gum Woodland may be exposed to increased weeds, trampling, rubbish and pests. In turn, resulting in an overall decline in the health of the Box Gum Woodland patch.	Varying distance from subject site. Potentially occurring within 50 - 100 metres of disturbance area throughout the active life of the Project.	Demarcation of the boundary of vegetation clearing at the edge of the Study Area where it occurs within 5 metres to native vegetation. Signposting will be used to inform Project personnel and site visitors of areas of conservation value to restrict entry or inform behaviour that will reduce incidental interactions with fauna. Weed management and pest management and monitoring to be implemented in Biodiversity Management Plan. Sedimentation management to be applied in areas that may result in runoff during construction and operation.	Active weed, and pest management are anticipated to be successful at managing edge effects into areas of adjacent Box Gum Woodland.
Weeds	All areas of Box Gum Woodland within the Study Area, and immediately adjacent are subject to weed occurrence. This is evident in the BAM plot data collected, and the extent of Serrated Tussock throughout portions of the Study Area and surrounds. The greatest concentrations are within the open areas (mapped as condition class – poor). Weeds have the opportunity to be established in adjacent areas of Box Gum Woodland during both the construction and operation phase of the Project via machinery carrying seed, and through clearing of weeds within the Study Area (eg. Serrated Tussock). Quantifying the distance of potential weed spread in adjacent areas without mitigation measures is difficult. It seems likely that such impacts would extent 50 metres into adjacent areas. We have identified such areas on Figure 13.	Variable depending on topography. However, typically would occur within close proximity to disturbance area. Nominally 50 metres without mitigation measures.	Weed management and monitoring to be implemented in Biodiversity Management Plan. Weed management would be active in preventing the spread of weeds caused by construction and operation of the Project into adjacent Box Gum Woodland therefore preventing edge effects. At present Boral is undertaking aerial weed spraying to maximise weed control coverage.	Active weed control methods are likely to be successful in managing the spread of weeds within adjacent areas of Box Gum Woodland.
Erosion and sedimentation	Areas of Box Gum Woodland that occur immediately adjacent to disturbance areas may be subject to erosion and sedimentation during the construction phase (vegetation clearing) and operational phase (eg. water runoff from hard stand areas) if no mitigation measures are undertaken.	Variable depending on topography and operation.	Adequate sediment controls (fencing, barriers) applied where appropriate. Set down areas are not located on steep slopes. All surface water from hard stand	Sedimentation control is known to reduce sedimentation spills. Surface water flows have been designed to follow natural

Table 17. Indirect Impact and Mitigation Measures Specific to Box Gum Woodland



Indirect impact (likelihood)	Potential indirect impact during construction and operation without mitigation measures	Potential extent of the indirect impact prior to mitigation	Mitigation measure (These to be included in the site Biodiversity Management Plan)	Expected success of mitigation measure
	If such impacts were to occur, the edges of the adjacent Box Gum Woodland may ultimately result in the gradual edge loss of ground cover through erosion of soil. The increase of surface water flow from the Study Area during rain events into the woodland areas could exacerbate the impact. Mitigation measures will be put in place during the construction and operation to limit the potential for erosion and sedimentation caused by the Project. With the mitigation measures in place, it is likely that the potential for erosion and sedimentation would be contained within the confines of the Study Area.		areas adequately managed as per legislative requirements. All tracks/roads maintained to ensure surface water does not run off into adjacent areas of vegetation. Procedures for the management of spills throughout the Study Area including the requirements for vehicles to carry spill kits. Surface water flows were designed to follow natural drainage (Advisian 2018), therefore are unlikely to create new gullies/drainage channels. The change to bedrock flows into and out of the alluvium of Shoalhaven River is negligible and is expected to be undetectable (AGEC 2018). Sediment basins proposed to reduce sedimentation and flows. Details provided in the Project's specialist studies. The rehabilitated landforms will be designed to shed water without causing excessive erosion or increasing downstream pollution (LAMAC 2018).	drainage and as such, are unlikely to be diverted into adjacent Box Gum Woodland areas.
Dust	Dust from the Project has been assessed by Todoroski Air Sciences (2018). In summary, the assessment predicts that there is a low potential for dust impacts to occur at the privately-owned residences surrounding the Mine with dispersion modelling predicting no exceedances of the various dust criteria that the assessment utilised. Whilst the assessment did not specifically assess the impacts to Box Gum Woodland, it is unlikely that dust from the Project would be extensively dispersed throughout the locality resulting in decline of Box Gum Woodland. Based on similar quarry projects, it is not uncommon for a 50m – 100m buffer to be placed around the area of direct impact during construction and operation to encapsulate the potential	Variable depending on wind conditions however areas of Box Gum Woodland immediately adjacent to the Study Area are more susceptible. Potential for dust emissions likely	Boral has a detailed Dust Management Plan for its current operations at Marulan which has been prepared in accordance with the requirements of AS/NZS ISO 14001: 2004 (Boral 2017). This Plan would be updated where relevant to reflect the Project. Current dust suppression activities undertaken at the Mine are extensive. We have summarised some of the relevant mitigation measures that would be applied to the Project:	Boral would continue current dust suppression and dust monitoring. Through successful implementation of dust mitigation, in combination with weed control, it is unlikely that any significant decline in adjacent Box Gum Woodland would occur.



Indirect impact (likelihood)	Potential indirect impact during construction and operation without mitigation measures	Potential extent of the indirect impact prior to mitigation	Mitigation measure (These to be included in the site Biodiversity Management Plan)	Expected success of mitigation measure
	extent of dust. We have shown this buffer in relation to the Study Area on Figure 9 and Figure 13. It is reasonable to suggest that without any mitigation measures, areas of Box Gum Woodland immediately adjacent to construction vegetation clearing events or adjacent to operational areas, would be more exposed to dust deposition. Significant dust accumulation within Box Gum Woodland on foliage or within the ground layer could impede species diversity and abundance. It should be noted that areas of significant dust sediment accumulation were not recorded within Box Gum Woodland during our survey.	throughout life of Mine.	 Dust impacts will be mitigated through the onsite use of water suppression. Enforcement of speed restrictions (to 20km in stockpile areas) Compaction of soil batters to minimise wind pickup Regular use of wash-down stations Progressive rehabilitation of cleared areas upon decommissioning. Stockpile Management The area containing mine stockpiles and the primary and secondary crushers with associated conveyors is considered to be the largest dust source at the site. The following is undertaken to minimise fugitive dust from stockpile handling: Where possible, consolidation of existing stockpiles to reduce their overall numbers and footprint. Truck speed restriction to 20km/hour in stockpile areas. Compaction of stockpile batters to minimise wind pick up of dust. To keep stockpile surfaces wet in dry weather, consistent application of water sprays for all stockpiles or use of a water cart with pumping facilities if adequate water sprayers cannot be installed. 	



Indirect impact (likelihood)	Potential indirect impact during construction and operation without mitigation measures	Potential extent of the indirect impact prior to mitigation	Mitigation measure (These to be included in the site Biodiversity Management Plan)	Expected success of mitigation measure
			-When adverse weather conditions are experienced or predicted, stockpile creation and extraction activities stopped until the weather changes.	
			Unsealed Haul Roads - During windy conditions and in prolonged dry weather water spraying is carried out repeatedly during the day.	
			 Restriction of speed to 40km/hr on unsealed haul roads. 	
			-Regular use of truck wash station, especially before leaving the site.	
			<u>Crushers and transfers.</u> - Dust collection systems upgraded between 2009 – 2015 above all tertiary crushers and screens	
			- Dust collection systems in place at secondaries and main transfer points up to tertiary crushers	
			- All Dust collection systems on schedule Planned Maintenance program	
			Further, vegetation clearing protocols for the Project will seek to minimise exposed areas with the potential to generate dust by completing progressive vegetation clearing as close to mining as practical.	
Fire	The potential for unplanned fire as a result of the Project is likely to be minimal. However, there is always the potential during construction and operation that such events may occur. For example, during summer, following prolonged periods of rain events, dry swards of grasses pose a bushfire hazard when a source of ignition is placed in the near vicinity. Vehicles driven through long grass and hot exhaust may attribute to fire	Potential to be widespread in locality, though unlikely.	The Bushfire Management Plan will incorporate bushfire management protocols to prevent and deal with the potential for bushfire.	Given the existing Mine operations have not resulted in any significant fires, the implementation of the Bushfire Management Plan would likely assist in fire prevention into



Indirect impact (likelihood)	Potential indirect impact during construction and operation without mitigation measures	Potential extent of the indirect impact prior to mitigation	Mitigation measure (These to be included in the site Biodiversity Management Plan)	Expected success of mitigation measure
	ignition. If such an event were to occur, it would be during construction and operation of the Project particularly during the hotter months. Should such an event occur, all adjacent areas of Box Gum Woodland may be exposed to unplanned bushfire event.			adjacent areas of Box Gum Woodland.

To formally determine the significance of the Box Gum Woodland to be impacted, an Assessment of Significance has been completed and attached to the end of this chapter. Our Assessment concluded that the Project is likely to have a significant impact due to the removal of 80.7 ha of the TEC. We conclude that through the successful implementation of mitigation measures described in this assessment, that significant impacts would not extent outside of the Study Area. A biodiversity offset for the significant impact to the TEC has been discussed in section 7.

8.3 Commonwealth Threatened Flora

8.3.1 Survey Effort and Occurrence

A review of spatial records of threatened flora within a 10 km radius of the Study Area was undertaken using data obtained from the Bionet Atlas, and predicted threatened biodiversity were generated from an EPBC Act Protected Matters Search. The review identified 23 threatened flora on the EPBC Act that have been previously recorded or have modelled habitat within a 10 km radius of the Study Area (Appendix 1; Appendix 9). The results aided in survey planning and threatened flora consideration for the Project.

In order to confirm the likelihood of occurrence for threatened species to be present within the Study Area and immediate surrounds, field surveys were undertaken considering the field survey requirement of each threatened flora (section 3.3). In summary, the survey entailed approximately 38 hours of targeted threatened flora survey (19 hour each consultant) conducted between 3rd and 6th February 2015, 5th February 2018, and between 31st July and 1st August 2018. Threatened flora were also surveyed opportunistically during all the other survey activities (eg. during BAM and FBA plots, SAT searches, habitat assessments etc).

No threatened flora as listed on the EPBC Act were recorded within the Study Area, or the immediate surrounds during the intensive field survey. The absence of detection during the field survey coupled with an analysis of suitable habitat and previous records has concluded that the likelihood for EPBC Act threatened flora to be present within the Study Area, was low (Appendix 1, section 3.3).

8.3.2 Direct and Indirect Impacts to Threatened Flora

Given the low likelihood for threatened flora to occur within the Study area, no threatened flora as listed on the EPBC Act would be directly impacted by the Project.

Indirect impacts to threatened flora as a result of the Project are low. This is supported by the field survey which confirmed the absence of EPBC Act listed threatened flora within the Study Area and immediate surrounds (section 3.3, Appendix 1). Indirect impacts in the form of weed spread, increased pests, and sedimentation and erosion, have been addressed specifically in relation to the Project in section 6.3. Through the successful implementation of the mitigation measures proposed, it is unlikely that any potential indirect impacts would result in impacts to Commonwealth listed threatened flora.

Given the low likelihood for impact to Commonwealth threatened flora, no formal Assessments of Significance and subsequent biodiversity offsetting, are required.

8.4 Commonwealth Threatened Fauna

8.4.1 Survey Effort and Occurrence

As detailed in section 4.1, a review of spatial records of threatened fauna within a 10 km radius of the Study Area was undertaken using data obtained from the Bionet Atlas, and predicted threatened biodiversity were generated from an EPBC Act Protected Matters Search (Appendix 9). Forty-one Commonwealth threatened fauna have been previously recorded or have modelled habitat within a 10 km radius of the Study Area (Appendix 1, Appendix 9) according to the database searches. The results aided in survey planning and threatened fauna consideration for the Project.

The survey effort associated with fauna is detailed in section 4.2 of the BDAR and survey sightings provided in Appendix 5. Weather conditions during the field survey days are provided in Appendix 6.

The fauna survey effort was conducted over four main fauna survey periods corresponding to the different Project components:

- Study Area and surrounds surveyed over four days between 26th November and 1st December 2014. This included spotlighting, call playback, and habitat-based assessment.
- Targeted fauna survey across the Study Area from the 2nd to 6th February 2014. This included camera trapping, spotlighting, and habitat assessment.
- Amphibian and habitat survey along Barbers Creek, Bungonia Creek and areas of Shoalhaven River between the confluences with the above creeks. This was undertaken on the 2nd to 4th March 2015, and involved camping near the Shoalhaven River.
- Flora and fauna survey undertaken on 19th to 21st May 2015 and included Koala SAT surveys, spotlighting, call-play back, habitat assessment, bird surveys and Anabat analysis.
- Koala SAT surveys completed within the Northern Overburden Emplacement Area on 5th February 2018.

The survey effort associated with only the Commonwealth listed threatened species has been provided in Table 18. The survey effort considered the EPBC Act Species Survey Guidelines and included an assessment against historic threatened fauna records and specific habitat requirements to assist in complimenting the survey effort undertaken by Niche.



Table 18. Commonwealth Fauna Survey Effort

Method	Effort and Timing	Total effort	Details	Target species (Commonwealth)	EPBC species survey guidelines met in relation to Study Area?
Ultrasonic call recording for bats	Each unit set for 10 hour recording for one night: 3 units x 29/10/2014 3 units x 30/10/2014 3 units x 31/10/2014	90 hours	One Anabat II bat detector and two Anabat CF recorder unit was deployed at three separate sites. Each unit was left along potential flyways or watercourses. The location of the detectors has been provided in Figure 14.		We have completed a total of 262 hours of
Ultrasonic call recording for bats	Each unit set for 10 hour recording: 5 units x 02/02/2015 3 units x 03/02/2015 1 unit x 04/02/2015 1 unit x 05/02/2015	100 hours	Wildlife Acoustics SM2BAT ultrasonic recorders were deployed at five sites and set to record from dawn to dusk (10 hours). The detectors were placed on the ground or elevated up to a metre where possible and, pointed upwards at approximately a 45 degree angle. The location of the detectors has been provided in Figure 14.	Large-eared Pied Bat	targeted threatened microbat survey using a combination of techniques (unattended Bat Detectors, Harp trapping, habitat assessment) as per the DEH (2010) Survey Guidelines for Australia's Threatened Bats. Our survey effort recorded the large-eared Pied bat across the anabat devices demonstrating the species would be foraging across the Study Area and surrounds.
Harp Trapping	2 x nights; 02/02/2015 1 x night; 04/02/2015 1 x night; 05/02/2015 2 x nights 04/02/2015	72 hours	5 Harp traps were deployed along identified flyways along tracks or close to waterways. Each anabat was left overnight and checked each morning. The location of the detectors has been provided in Figure 14.		



Method	Effort and Timing	Total effort	Details	Target species (Commonwealth)	EPBC species survey guidelines met in relation to Study Area?
Diurnal bird surveys (2 hectare)	 0.75 hours 02/02/2015 start: 06:55). 1 hour 02/02/2015 (start: 07:12). 1 hours 03/02/2015 (start: 07:22). 1 hour 04/02/2015 (start: 07:35). 0.75 hours 05/02/2015 (start: 07:55). 0.75 hours 05/02/2015 (start: 07:35). 0.75 hours 02/03/2015 (start: 07:05). 0.75 hours 03/03/2015 (start: 07:05). 1.75 hours 03/03/2015 (start: 07:05). 1 hour 20/05/2015 (start: 07:11). 2 hours 21/05/2015 (start: 06:54). 1 hours 01/08/2018 (start: 06:06). 2 hours 03/08/2018 (start: 06:02). 	27.5 hours	Two ecologists completed 20 minute, 2 hectare bird surveys which were extended in time due to relatively low bird activity in most areas and additional species being recorded after or at the end of the typical standard 20 min period. Incidental bird sightings were made throughout surveys activities with species of note being recorded spatially. Birds were identified with the use of 10 X 42 binoculars or from their calls.	All birds, including Regent Honeyeater	We have completed a total of 27.5 hours of targeted survey for the Regent Honeyeater. We have also examined the habitat types present in relation to the Bionet database, and relevant Recovery Plans and Determinations. We have looked at historic records for the Bungonia region.
Reptile survey	20 mins 05/02/2015 45 mins 06/02/2015 25 mins 05/02/2018	90 mins	Random meander turning over surface rocks. Note that such habitat was very restricted and sparse.	Pink-tailed Legless Lizard Striped Legless Lizard Broad-headed Snake	Habitat in Study Area limited to non-existent. Survey effort therefore suitable given the lack of habitat present.
Remote Cameras	27 nights x 2 cameras (37,38) 06/02/2015 31 nights x 4 cameras (40,45,39,43) 02/03/2015 27 nights x 3 cameras (41,78,74) 06/02/2015 30 nights x 2 cameras (46,48) 03/02/2015 30 nights x 2 cameras (75,77) 03/02/2015	3,408 hours	Moultrie 990i infrared cameras were deployed. Half of the cameras were baited with a mix of peanut-butter/oats/honey while the other half were baited with sardines. Cameras were placed along animal tracks near water points or other features.	Spotted-tail Quoll, Brush-tail Rock Wallaby, Long- nosed Potoroo, New Holland Mouse.	3,408 hours of trapping is extensive for a range of threatened mammals. Threatened Mammals unlikely to be present given the habitat requirements of subject species (Appendix 1)



Method	Effort and Timing	Total effort	Details	Target species (Commonwealth)	EPBC species survey guidelines met in relation to Study Area?
Spotlighting	Per ecologist: 30 mins; 03/02/2015 30 mins; 03/02/2015 45 mins; 05/02/2015 30 mins; 03/02/2015 45 mins; 04/02/2015 45 mins; 05/02/2015 2 hours; 02/03/2015 2 hours; 03/03/2015 60 mins 05/02/2018 30 mins 31/08/2018	22.5 hours total	Spotlighting surveys targeting arboreal mammals and nocturnal birds were performed, primarily on foot by two ecologist. Areas near existing access tracks were also surveyed via a slow moving vehicle throughout parts of the Study Area.	Greater Glider, Grey-headed Flying Fox, Koala	Yes – the survey effort combined with habitat assessment and SAT surveys is suitable to determine the presence/absence of the Study Area. We have assumed the presence of the Koala and Grey-headed Flying fox despite both species not being recorded in the Study Area. The Greater Glider lacks potential habitat within the Study Area (Appendix 1)
Vegetation surveys for Grey-headed Flying Fox	Undertaken during flora/vegetation survey effort	-	Analysis of flora recorded in BAM plots, and PCT descriptions in relation to the feed trees and habitat types identified in section 3.2.	Grey-headed Flying Fox	Yes – our analysis of habitat has ranked the feeding habitats of Grey-headed flying foxes within the Study Area with consideration of the DEWHA (2008).
Grey-headed Flying Fox Camp site investigation	Undertaken during all survey activities	-	Targeted survey effort to confirm absence of camp sites within Barbers Creek and Bungonia Gorge undertaken on 4 th November 2014.	Grey-headed Flying Fox	Yes – the Grey-headed Flying-fox occupies most areas in their distribution in highly irregular patterns, and, therefore, surveys based on animal sightings are unlikely to be reliable (DEWHA 2010). A more effective survey method is to search appropriate databases and other sources for the locations of camps, and to conduct vegetation surveys to identify feeding habitat (DEWHA 2010). No Grey-headed Flying Fox camp site as evident by field inspection within the Study Area and surrounds. Note that the survey effort also involved traversing Bungonia Gorge. The nearest known camp site is in Moss Vale, approximately 30 km north of the Study Area.



Method	Effort and Timing	Total effort	Details	Target species (Commonwealth)	EPBC species survey guidelines met in relation to Study Area?
Call playback and Owl Listening	3 x 45 minute surveys: 03/02/2015, 05/02/2015 1 x 45 minute survey: 04/2/2015	3 hours	Target species – Powerful Owl, Masked Owl, Sooty Owl, Koala, Yellow-bellied Glider and Sugar Glider. Call-playback sites were established at three locations within the Study Area over the three nights. After an initial listening period of five minutes, calls of the target species were broadcast through a 10 watt megaphone for five minutes followed by a five minute listening period and a period of spotlighting.	Koala and all other BC Act listed threatened species (such as Powerful Owl)	Yes – Koala assumed to be present.
Frog chorus survey and aquatic habitat surveys.	15 mins; 03/02/2015 20 mins; 03/02/2015 30 mins; 05/02/2015 60 mins; 04/02/2015 30 mins; 04/02/2015 3 hours; 02/03/2015 3 hours; 03/03/2015 3 hours; 03/03/2015	11 hours	Frogs were listened for at dams and permanent and ephemeral drainage lines throughout the Study Area. Active searching for frogs using spotlights was also conducted around watercourses. Frog surveys were done outside of the Study area along the Shoalhaven River and its tributaries recognising the potential for indirect impacts through water discharge.	Littlejohn's Tree Frog, Green and Golden Bell Frog, Giant Burrowing Frog.	Yes – lack of habitat in Study Area.
Koala SAT	3 x surveys; 03/02/2015 1 x survey; 05/02/2015 1 x survey 05/02/2018 1 x survey 02/08/2018	4 hours	SAT (Koala scat) surveys were conducted across the Study Area. In addition to SAT surveys random tree inspections were carried out during traverses of the Study Area at selected feed trees searching for scats and characteristic bark scratches.	Koala	Yes – Koala assumed to be present.
Opportunistic survey	During all activities	48 hours	Opportunistic observations were made of fauna aided with binoculars and photography as appropriate. Opportunistic survey included searches of habitat such as under logs, rocks or waste piles (where limited areas of such habitat existed) or within heaped leaf litter, casual bird or mammal observations or observations of their calls, including during overnight activities within the Shoalhaven River area, and observations of indirect evidence for certain species such as scats tracks and other traces.	All species	

8.4.2 Threatened Fauna Survey Results

As discussed in section 4.5, during the field survey four threatened fauna listed on the EPBC Act were recorded:

- Koala Recorded outside of the Study Area during general habitat assessment for the Project. The Koala was recorded on a *Eucalyptus punctata*. Multiple Koalas were also heard bellowing during aquatic and amphibian surveys of Bungonia Gorge during November 2014 (Figure 15).
- Large-eared Pied Bat Recorded throughout the Study Area and adjacent areas where anabat and harp traps were deployed. Given the records at each anabat, it seems likely that the species would use the Study Area to forage regularly.
- Grey-headed Flying Fox Recorded outside of the Study Area during aquatic and amphibian surveys of Bungonia Gorge during November 2014 (Figure 15)
- Rufous Fantail recorded outside of the Study Area near Bungonia Gorge (approximately 200m south of Study Area) during general habitat surveys (Figure 15).

The field survey and the results of the likelihood of occurrence (Appendix 1) concluded that following Commonwealth threatened fauna may utilise the Study Area:

- Vulnerable species: Koala, Grey-headed Flying-fox, Large-eared Pied Bat
- Migratory Species (marginal usage): Great Egret, Cattle Egret, Rainbow Bee-eater, Black-faced Monarch, Rufous Fantail.

It should be noted that the Regent Honeyeater was also identified in correspondence by the Department of Environment and Energy (DoEE) as likely to utilise the Study Area. Despite our assessment concluding low likelihood for occurrence, we have conservatively assessed the potential for the species to use the Study Area as detailed below.

Each of the species have been discussed below, in relation to their potential occupancy within the Study Area and surrounds:

Koala: Surveys and collection of anecdotal evidence of Koala sightings conducted within the Study Area and surrounds as part of this assessment revealed that Koalas have been sighted sporadically within the south of the Study Area over the past decade, with a Koala observed every 2- 3 years around the Mine (pers. comm. Grant Thompson – Boral).

Scat surveys, spotlighting, call-playback and tree surveys did not identify repeated or on-going use of trees within the Study Area, however a single Koala was recorded whilst spotlighting to the east of the existing Mine (outside of direct impact area) and multiple Koalas was heard bellowing during aquatic surveys of Bungonia Gorge during November 2014 (Figure 15).

There are 137 Koala records from the Bionet Atlas within a 10 km radius of the Study Area (Figure **16**). The majority of these records (105) are from the Bungonia National Park and Bungonia State Conservation Area (SCA) which occur approximately 1 - 4 km south of the Study Area. The large number of records from the conservation areas can largely be attributed to establishment of a monitoring program based on park visitors and staff reporting Koala sightings. However, the program has not allowed for a reliable estimate of Koala numbers in the area (pers. comm. Audrey Kutzner NSW NPWS). Nonetheless the area where the majority of Koala records occur is considered one of the primary known active sites for a Koala population centred along the Shoalhaven Gorge and extending approximately 40 km to the south of the Study Area towards Nerriga and approximately 30 km east towards Tallowa Dam (Allen 2002). The population area encompasses large areas of Morton National Park.

Within the Shoalhaven Gorge population area, it has been estimated that some 7,500 ha of secondary koala habitat exists (the same habitat status as habitat within the Study Area under the classification scheme used within Allen 2002), supporting between 80 and 150 Koalas (Allen 2002). The Shoalhaven Gorge Koala population was described as a low-density population utilising secondary habitat, spread at least in patches and consisting of breeding associations linked by the movements of dispersing young (Allen 2002). Of direct relevance to the Study Area, it was noted that west of the gorge human disturbance is greater and that Koala densities may be very low in such areas (Allen 2002).

North and west of the protected areas around the Bungonia and Shoalhaven gorges, Koala records within the Bionet Atlas are very limited, with sporadic observations from private land and along roadsides, one being from the Mine and two additional records (including road-kill) each from around the townships of Marulan and Tallong. These areas are more disturbed predominantly private tenure. They generally have been developed traditionally for agriculture. It is clear that Koalas are able to travel through such areas and feed trees, including primary feed trees, are available to them throughout such areas. Targeted Koala survey in these areas (private land on the tablelands) is likely to have been minimal and therefore actual Koala distribution and abundance within such areas is poorly known. Therefore, whilst it is acknowledged that limits exist regarding predictions of Koala distribution and abundance within the higher elevation areas away from the protected areas around the Bungonia and Shoalhaven gorges, it is considered unlikely that active Koala areas (with permanent and moderate to high densities of Koalas) such as those within the Bungonia National Park/SCA would extend into the Study Area.

Whilst the Koala was not recorded within the Study Area during the targeted surveys, it is recognised given previous sightings throughout the locality, that the Koala may use the habitat features of the Study Area on occasion. In order to determine the area of habitat within the Study Area that the Koala may utilise, the area of occupancy has been determined by considering the density and composition of preferred feed trees listed as primary, secondary and tertiary feed species under the National Recovery Plan for the Koala (DEC 2008). Occupiable habitat was considered as areas where either two or more known feed tree species occurred, or a single feed species occurred and occupied more than 50% of the canopy cover within a 400 m2 floristic guadrat. Highly disturbed and substantially cleared areas were excluded as habitat.

The area of habitat has been split into areas deemed poor/unsuitable (very limited use/if any), moderate (contains Koala feed trees however is limited in movement due to steepness of terrain), and good (containing Koala feed trees with relatively limited obstacles in regards to movement). The Koala has therefore been attributed to an area of 132.4 ha of occupiable habitat within the Study Area (Figure 16).

Grey-headed Flying Fox: During the field survey, the species was recorded outside of the Study Area during aquatic and amphibian surveys of Bungonia Gorge during November 2014. The species was recorded flying over-head by the survey team at the location shown on Figure 18.

The field survey and analysis confirmed that no camp/breeding/roosting sites occur within the Study Area and immediate surrounds. The closest known camp site is located in Moss Vale which occurs approximately 30 km north of the Study Area.

Foraging habitat for the Grey-headed Flying Fox is relatively broad as the species is a canopy-feeding frugivore and nectarivore, which utilises vegetation communities including rainforests, open forests, closed and open woodlands, Melaleuca swamps and Banksia woodlands. It also feeds on commercial fruit crops and on introduced tree species in urban areas. The primary food source is blossom from Eucalyptus and related genera but in some areas it also utilises a wide range of rainforest fruits (Eby 1998).
Given relatively broad foraging preferences, all eucalypt/Acacia dominated vegetation zones within the Study Area have been conservatively considered foraging habitat for the species (Table 19). We have determined that approximately 140.3 ha of foraging habitat exists for the species.

Table 19. Grey-headed Flying Fox habitat within Study Area

PCT recorded within Study Area	Vegetation zone condition	Area (ha)
PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670)	Medium	48.8
PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670)	Acacia	7.9
PCT 778 Coast Grey Box – stringybark dry woodland on slopes of the Shoalhaven Gorges -Southern Sydney Basin (SR534)	Medium	57.9
PCT 1150 - Silvertop Ash - Blue-leaved Stringybark shrubby open forest on ridges, north east South Eastern Highlands Bioregion (SR624)	Medium	13.7
PCT 731 - Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion (SR524)	Medium	12.0
Total area of habitat for Grey-headed Flying Fox		140.3

Large-eared Pied Bat: The Large-eared Pied Bat was recorded at all of the anabat survey locations within, and adjacent to the Study Area. As such, portions of native vegetation within the Study Area have been considered foraging habitat for the species.

Breeding habitat, which as described on the BioNet Atlas as including PCTs associated with the species within 100 m of rocky areas containing caves, overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings. As the site, does not occur within 100 m of any of these features known to contain the species, breeding habitat is unlikely to be present within the Study Area.

The Large-eared Pied Bat is known to forage in a range of vegetation types, including dry and wet sclerophyll forest, grassy woodland, Callitris dominated forest, tall open eucalypt forest with a rainforest sub-canopy, sub-alpine woodland and sandstone outcrop country (Hoye & Dwyer 1995; DECC 2007). Almost all records of the species are within several kilometres of cliff lines or rocky terrain, indicating that foraging habitat is limited to approximately 2 km from clifflines.

Foraging habitat on fertile soils (or within fertile valleys) is also considered an important overall requirement for the Large-eared Pied Bat (Pennay 2008), however the species has been recorded extensively within sandstone associated vegetation, indicating that whilst foraging habitat on fertile soils is likely to be important, foraging would by no means be confined to such areas.

Given the Study Area occurs within 2 km of Bungonia Gorge, and the cliffs/steep slopes of Barbers Creek, native vegetation within the Study Area may be utilised as foraging habitat. This is supported during our field investigations whereby the Large-eared Pied Bat was recorded within the Study Area and surrounds (Table 20). As such, the area of foraging habitat within the Study Area includes PCTs with a 'moderate condition' class, and 'Acacia condition' class. PCTs that have been assigned a 'poor' or 'non-EEC water dependant' condition class have been excluded from the foraging habitat given these habitat types are not likely to support a significant portion of foraging resources when compared to habitat descriptions in BioNet Atlas and the Recovery Plan. Approximately 140.3 ha of habitat for the Large-eared Pied Bat has therefore been mapped within the Study Area.

Table 20. Large-eared Pied Bat habitat within Study Area

PCT recorded within Study Area	Vegetation zone condition	Area (ha)
PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670)	Medium	48.8
PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670)	Acacia	7.9
PCT 778 Coast Grey Box – stringybark dry woodland on slopes of the Shoalhaven Gorges -Southern Sydney Basin (SR534)	Medium	57.9
PCT 1150 - Silvertop Ash - Blue-leaved Stringybark shrubby open forest on ridges, north east South Eastern Highlands Bioregion (SR624)	Medium	13.7
PCT 731 - Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion (SR524)	Medium	12.0
Total area of habitat for Large-eared Pied Bat		140.3

Regent Honeyeater: The Regent Honeyeater is endemic to mainland south-east Australia, and has a patchy distribution which extends from south-east Queensland, through New South Wales (NSW) and the Australian Capital Territory (ACT), to central Victoria. The Study Area is within the distribution range of the species. The Study Area does not occur within the four known key breeding areas where the species is regularly recorded. These are the Bundarra-Barraba, Capertee Valley and Hunter Valley districts in New South Wales, and the Chiltern area in north-east Victoria.

The species is highly mobile, occurring only irregularly in most sites, and in variable numbers, often with long periods with few observations anywhere. This presents an obstacle when confirming presence/absence or likely usage of the site, and thus we have approached this assessment by completing a field survey, analysing previous consultant surveys at the mine, and historic surveys of the site and surrounds.

During our analysis, we did not record the species, nor any historic records within the Study Area and immediate surrounds. Only three historical records have been made since 1983 within 12 km of the Study Area as per below:

- Approximately 4.8 km south of the Study Area near Lockdown Road, Bungonia. This record was made in 2005 within a gully environment near Bungonia Creek weir.
- Approximately 5 km south of the Study Area near the Bungonia State Conservation Area office. This record was made in 1998.
- Approximately 11.9 km south of the Study Area within private property. This record was made in 1983.

Furthermore, a bird survey the Marulan South Limestone Mine was completed in 2012 by Birdchasers, Wildlife and Habitat Ecoservices (2012), which include a compilation of the bird survey results completed at the mine since 1997 by the following consultant reports:

- Gunninah Environmental Consultants (1997) Biodiversity Assessment
- URS (2006) : Marulan South Limestone Mine Flora and Fauna Assessment
- RPS Harper Somers O'Sullivan (2009) Flora and Fauna Assessment for the Proposed Waste Emplacement at Marulan South Limestone Mine.

As presented in Birdchasers Wildlife and Habitat Ecoservices (2012) the Regent Honeyeater was not detected during their survey, nor the consultant assessments above.

Given Bungonia State Conservation Area and Morton National Park are relatively popular for bird watchers, if the Regent Honeyeater were to frequent the area, it seems reasonable to suggest that the records would be greater than three records within 36 years.

Most records of regent honeyeaters come from box-ironbark eucalypt associations, where the species seems to prefer more fertile sites with higher soil water content, including creek flats, broad river valleys and lower slopes. Other forest types regularly utilised by regent honeyeaters include wet lowland coastal forest dominated by swamp mahogany (Eucalyptus robusta), spotted gum-ironbark associations and riverine (Menkhorst, 1997; Geering & French, 1998; Oliver et al., 1998; Oliver et al., 1999).

This riparian habitat is also selected as breeding habitat in some years (Geering and French, 1998; Oliver et al., 1998; Oliver et al., 1999). Often this is adjacent to box-ironbark woodland. Remnant stands of timber, roadside reserves, travelling stock routes and street trees also provide important habitat for regent honeyeaters at certain times (Franklin et al., 1987, 1989; Ley & Williams, 1992; Webster & Menkhorst, 1992; Oliver, 1998).

The Study Area is not located within a high fertile soil with high water content, this is owing to its location away from creek flats, gullies and valleys. Furthermore, the Study area also lacks taller and larger diameter trees which the species prefers. Regardless, the Study Area does contain a favourable feed tree – *Eucalyptus melliodora*, which coincides with the occurrence of PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland (SR670) and occurs occasionally in PCT 778 Coast Grey Box – stringybark dry woodland on slopes (SR534).

Larger *Eucalyptus melliodora* trees throughout the Study Area are very limited and relatively sparse within the PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland (SR670) occurring as isolated stands.

The habitat present is different in some respects to common habitat where the species is found, however, given the species can utilise a range of habitat types (plantings, gardens, dry sclerophyll forest) we have conservatively estimated 140.3 ha of foraging habitat occurs in the Study Area (Table 21).

PCT recorded within Study Area	Vegetation zone condition	Area (ha)
PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670)	Medium	48.8
PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670)	Acacia	7.9
PCT 778 Coast Grey Box – stringybark dry woodland on slopes of the Shoalhaven Gorges -Southern Sydney Basin (SR534)	Medium	57.9
PCT 1150 - Silvertop Ash - Blue-leaved Stringybark shrubby open forest on ridges, north east South Eastern Highlands Bioregion (SR624)	Medium	13.7
PCT 731 - Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion (SR524)	Medium	12.0
Total area of habitat for Regent Honeyeater		140.3

Table 21. Regent Honeyeater habitat within Study Area

8.4.3 Commonwealth Migratory Species

During the field survey, no migratory species listed under the EPBC Act were recorded within the Study Area, however one individual of the Rufous Fantail was recorded outside of the Study Area within PCT 1334

Yellow Box - Blakely's Red Gum grassy woodland (SR670). A number of listed migratory species have also been recorded within the locality and in some cases have the potential to fly over the Study Area (see Appendix 1).

Migratory species that have a relatively wider distribution across NSW and broad habitat preferences (as described in DAWE Species Profile and Threats Database) include: Cattle Egret, Great Egret, Rainbow Beeeater, Black-faced Monarch, and Rufous Fantail. All these species have relatively broad habitat preferences, and as such, have been considered as potentially using the Study Area on occasion (Appendix 1). We have conservatively assigned 140.3 ha of foraging habitat for all species which is made up of all PCTs with a 'moderate condition' class, and 'Acacia condition' class.

8.4.4 Direct and Indirect Impacts to Commonwealth Threatened Fauna

The Project will result in the unavoidable clearing of native vegetation and associated habitat, conservatively estimated to be 182.4 ha. The majority of vegetation likely to be affected by the Project has been subject to historic logging, grazing, and other agricultural activities, and is therefore thinned in areas, and dominated in areas by Serrated Tussock (section 4.4 and 4.4.1).

Indirect impacts associated with the Project have been discussed in section 6.3 along with the associated mitigation measures that would be undertaken. As discussed, indirect impacts may occur within and adjacent to areas of direct impact as a result of Mine construction and operation. The indirect impacts are variable in terms of the distance they may extend, and quantifying the exact distance is not possible given the relatively unpredictable nature. To account for a quantitative measure of indirect impacts, without mitigation measures, we have assumed that many indirect impacts could extend within a 100 m buffer from the disturbance. This buffer would likely encapsulate the potential spread of weeds, edge effects in surrounding vegetated areas, erosion, dust, intensive light spill, and sedimentation during construction and operation without any mitigation measure imposed. Such impacts will largely operate on a short to medium timeframe (i.e. the life of the Mine) and will be minimised through management procedures.

The specific indirect impacts to Commonwealth threatened fauna, along with corresponding mitigation measures are discussed in detail in Table 22. The mitigation measures provided would be consistent with industry best practice to ensure that mitigation is effective. Monitoring of the effectiveness of the mitigation measures would be incorporated as part of the management actions associated with the Project.



Indirect impact	Impact entities	Potential indirect impact during construction and operation without mitigation measures	Potential extent of the indirect impact prior to mitigation	Mitigation measure (To be included in Site Biodiversity Management Plan)	Expected success of mitigation measure
Increased weeds spread during construction and operation into adjacent habitat	Koala; Large-eared Pied Bat; Grey-headed Flying Fox; Regent Honeyeater; Migratory species.	All areas of habitat within the Study Area, and immediately adjacent, are subject to weed occurrence. This is evident in the BAM plot data collected, and the extent of Serrated Tussock throughout portions of the Study Area and surrounds. The greatest concentrations are within the open areas (mapped as condition class – poor). Regardless of the condition, the subject species have potential to utilise such areas. Weeds have the opportunity to establish in adjacent areas of habitat during both the construction and operation phase of the Project via machinery carrying seed, and through clearing of vegetation within the Study Area exposing introduced weed seed. Quantifying the distance of potential weed spread in adjacent areas without mitigation measures is difficult. It seems likely that such impacts would extent 50 metres into adjacent areas of habitat.	Variable depending on topography. However, typically would occur within close proximity to disturbance area. Nominally 50 m without mitigation measures.	Weed management and monitoring to be implemented in Biodiversity Management Plan. Weed management would be active in preventing the spread of weeds caused by construction and operation of the Project into adjacent habitat therefore preventing habitat decline. At present Boral is undertaking aerial weed spraying to maximise weed control coverage.	Active weed control methods are likely to be successful in managing the spread of weeds within adjacent areas of habitat. It is highly unlikely that weed occurrence would result in any significant decline in adjacent habitat, resulting in the inability for the subject species to utilise it.
Erosion and sedimentation during construction and operation resulting in impacts to adjacent habitat	Koala; Large-eared Pied Bat; Grey-headed Flying Fox; Regent Honeyeater; Migratory species.	Areas of habitat that occur immediately adjacent to disturbance areas may be subject to erosion and sedimentation during the construction phase (vegetation clearing) and operational phase (eg. water runoff from hard stand areas) if no mitigation measures are undertaken. If such impacts were to occur, the edges of adjacent habitat may ultimately result in the gradual edge loss of ground cover through erosion of soil or through sedimentation. The increase of surface water flow from the Study Area during rain events into the woodland areas could exacerbate the impact. Mitigation measures will be put in place during the construction and operation to limit the potential for erosion and sedimentation caused by the Project. With the mitigation measures in place, it is likely that the potential for erosion and sedimentation would be contained within the confines of the Study Area.	Variable depending on topography and operation.	Adequate sediment controls (fencing, barriers) will be applied where appropriate (eg. in areas that may cause runoff during construction and operation). All surface water from hard stand areas adequately managed as per legislative requirements. All tracks/roads maintained to ensure surface water does not run off into adjacent areas of vegetation. Procedures for the management of spills throughout the Study Area including the requirements for vehicles to carry spill kits. Surface water flows were designed to follow natural drainage (Advisian 2018), therefore are unlikely to create new gullies/drainage channels in adjacent habitat areas. The change to bedrock flows into and out of the alluvium of Shoalhaven River is negligible and is expected to be undetectable (AGEC 2018).	Boral has proposed a number of sedimentation controls during the design of the Project, and during the construction and operational phase of the Project. In particular, surface water flows have been designed to follow natural drainage and as such, are unlikely to be diverted into adjacent areas of habitat. As detailed in the Assessments of Significance, the relatively mobile nature of each species, coupled with the proposed mitigation measures, it seems unlikely that sedimentation would result in any significant decline in adjacent habitat, resulting in the inability for the subject species to utilise it.

Table 22. Indirect impacts and proposed mitigation measures for threatened fauna



Indirect impact	Impact entities	Potential indirect impact during construction and operation without mitigation measures	Potential extent of the indirect impact prior to mitigation	Mitigation measure (To be included in Site Biodiversity Management Plan)	Expected success of mitigation measure
				Sediment basins proposed to reduce sedimentation and flows. Details provided in the Project's specialist studies. The rehabilitated landforms will be designed to shed water without causing excessive erosion or increasing downstream pollution (LAMAC 2018).	
Dust during construction and operation	All species	Dust from the Project has been assessed by Todoroski Air Sciences (2018). In summary, the assessment predicts that there is a low potential for dust impacts to occur at the privately-owned residences surrounding the Mine with dispersion modelling predicting no exceedances of the various dust criteria that the assessment utilised. Whilst the assessment did not specifically assess the impacts to Box Gum Woodland, it is unlikely that dust from the Project would be extensively dispersed throughout the locality. Based on similar quary projects, it is not uncommon for a 50m – 100m buffer to be placed around the area of direct impact during construction and operation to encapsulate the potential extent of dust. We have shown this buffer in relation to the Study Area on Figure 9. It is reasonable to suggest that without any mitigation measures, areas of habitat immediately adjacent to construction vegetation clearing events or adjacent to operational areas, would be more exposed to dust deposition. Significant dust accumulation within patches of native vegetation/habitat on foliage or within the ground layer could impede flowering times of feed resources, or prevent regeneration.	Variable depending on wind conditions however areas of Box Gum Woodland immediately adjacent to the Study Area are more susceptible. Potential for dust emissions likely throughout life of Mine.	 Boral has a detailed Dust Management Plan for its current operations at Marulan which has been prepared in accordance with the requirements of AS/NZS ISO 14001: 2004 (Boral 2017). This Plan would be updated where relevant to reflect the Project. Current dust suppression activities undertaken at the Mine are extensive. We have summarised some of the relevant mitigation measures that would be applied to the Project: Dust impacts will be mitigated through the onsite use of water suppression. Enforcement of speed restrictions (to 20km in stockpile areas) Compaction of soil batters to minimise wind pickup Regular use of washdown stations progressive rehabilitation of cleared areas upon decommissioning. Stockpile Management The area containing mine stockpiles and the primary and secondary crushers with associated conveyors is considered to be the largest dust source at the site. The following is undertaken to minimise fugitive dust from stockpile handling: -Where possible, consolidation of existing stockpiles to reduce their overall numbers and footprint. -Truck speed restriction to 20km/hour in stockpile areas. 	Boral would continue current dust suppression and dust monitoring. Through successful implementation of dust mitigation, in combination with weed control, it is unlikely that any significant decline in adjacent habitat for any of Commonwealth listed fauna would occur.



Indirect impact	Impact entities	Potential indirect impact during construction and operation without mitigation measures	Potential extent of the indirect impact prior to mitigation	Mitigation measure (To be included in Site Biodiversity Management Plan)	Expected success of mitigation measure
		without mitigation measures	prior to mitigation	 Biodiversity Management Plan) -Compaction of stockpile batters to minimise wind pick up of dust. -To keep stockpile surfaces wet in dry weather, consistent application of water sprays for all stockpiles or use of a water cart with pumping facilities if adequate water sprayers cannot be installed. -When adverse weather conditions are experienced or predicted, stockpile creation and extraction activities stopped until the weather changes. <u>Unsealed Haul Roads</u> During windy conditions and in prolonged dry weather water spraying is carried out repeatedly during the day. Restriction of speed to 40km/hr on unsealed haul roads. -Regular use of truck wash station, especially before leaving the site. <u>Crushers and transfers.</u> Dust collection systems upgraded between 2009 – 2015 above all tertiary crushers and screens - Dust collection systems on schedule Planned Maintenance program 	measure
				progressive vegetation clearing as close to mining as practical.	
Unplanned fire from construction or operation resulting in	All species	The potential for unplanned fire as a result of the Project is likely to be minimal. However, there is always the potential during construction and operation that such events may occur. For example, during summer, following rain events, dry swards of grasses pose a bushfire hazard when placed near a source	Potential to be widespread in locality, though unlikely to occur.	The Bushfire Management Plan will incorporate current bushfire management protocols to prevent and deal with the potential for bushfire. A review of the existing protocols will occur and be updated in light of the current Project.	It seems highly unlikely that an unplanned bushfire as a result of construction and mine operations would result in an impact to adjacent habitat areas. Given the



Indirect impact	Impact entities	Potential indirect impact during construction and operation without mitigation measures	Potential extent of the indirect impact prior to mitigation	Mitigation measure (To be included in Site Biodiversity Management Plan)	Expected success of mitigation measure
impacts to adjacent habitat		of ignition. Vehicles driven through long grass and hot exhaust may attribute to fire ignition. This may occur during construction and operation of the Project particularly during the hotter months. Should such an event occur, all adjacent areas habitat may be exposed to unplanned bushfire event. The impact of such to all threatened species could result in short-term loss to habitat within adjacent areas. Loss of individuals of less mobile species (eg. Koala) could occur depending on the speed of the fire in adjacent areas of habitat.			existing Mine operations have not resulted in any significant fires, the implementation of the Bushfire Management Plan would continue to assist in fire prevention into adjacent areas of potential habitat.
Noise from machinery during construction and operation	All species	Noise impacts have been occurring from the current operations since the Mine began. Such historic impacts have subjected fauna immediately surrounding the existing Mine to noise levels which may have deterred them from occupying areas immediately adjacent to the existing Mine footprint. In terms of the Project, noise likely to be generated was assessed by Wilkinson and Murray (2018). Whilst the noise assessment did not address the impact of the Project noise upon fauna, the conclusions from the assessment were based on a comparison to human noise criteria. Conclusions include that the Project would not result in exceedance of noise criteria to humans during operation; no exceedance of relevant noise criteria for off-site traffic noise would occur. In relation to the Koala, the species is known to occur within urban areas, around mines/quarries/and road verges. It seems unlikely that noise would deter the Koala from moving through the landscape, nor foraging within the adjacent habitat areas if the food source is preferred. Noise from the mine during construction and operation is also unlikely to determine the other subject species (Large-eared Pied Bat, Grey-headed Flying Fox, Regent Honeyeater and the migratory birds). All of these species can occupy urban, disturbed areas (cropping, road verges) depending on the habitat availability. Given fauna have historically been exposed to noise impacts immediately surrounding the Study Area for many years (since 1929 – See EIS main document) due to the ongoing mining operations at the site, the Project is unlikely to result in any	Variable depending on wind conditions. Potential for noise impacts likely throughout life of Mine.	 The Project would reduce noise by the following: A Noise Management Plan be developed and implemented throughout the life of the Project which will serve to further reduce the noise exposure at surrounding residences and to fauna occupying surrounding bushland. It is proposed that future operation of the Mine would incorporate an ongoing attended noise monitoring program, as required, throughout its operational life. 	It seems unlikely that noise during construction and operation would be so significant to deter all the subject threatened fauna from occupying adjacent areas of habitat. As discussed in the Assessments of Significance, all of these species can occupy urban, disturbed areas (cropping, road verges) depending on the habitat availability. Given fauna have historically been exposed to noise impacts immediately surrounding the Study Area for many years (since 1969) due to the ongoing mining operations at the site, the Project is unlikely to result in any significant decline or edge effects toward fauna and their habitats within the locality.



Indirect impact	Impact entities	Potential indirect impact during construction and operation without mitigation measures	Potential extent of the indirect impact prior to mitigation	Mitigation measure (To be included in Site Biodiversity Management Plan)	Expected success of mitigation measure
		significant decline or edge effects toward fauna and their habitats within the locality.			
Vibration impacting roosting habitat for threatened microbats	Large-eared Pied Bat	 Vibration from the blasting associated with the Project is unlikely to result in any impacts to the fauna habitat including the Karst systems and caves known to occur within the Locality, particularly in Bungonia Conservation Reserve and Bungonia National Park based on the following: Blasting is currently conducted within the existing Mine which occurs closer to the National Parks than where the proposed blasting would take place. No reported impacts from the current blasting are known to occur within the Karst systems or known caves. It is considered unlikely that microbat roosting habitat within Main Gully Cave (detailed in section 4.6) would be impacted by the Project due to the distance of the subject cave from the Mine expansion activities that involve mining and blasting, which is to occur approximately 600 m north of the southern tip of the existing south pit (approximately 900 m from the identified cave). There has been an ongoing history of mining within the existing south pit throughout which any roosting bats would have persisted if present. The Project is not forecast to increase noise or vibration to the subject cave or any other known caves in the locality. 	Unlikely to occur outside of disturbance area, or immediately surrounding the area of the blast.	The Mine currently monitors its blasts. The Project would require this monitoring to continue. In the unlikely event that blasting impacts result in reported damage to Karst systems of caves within the Locality, such impacts should be reviewed.	Currently not an issue.
Increased artificial lighting deterring species from occupying adjacent areas of habitat.	Large-eared Pied Bat; Grey-headed Flying Fox.	As detailed in Richard Lamb & Associates (RLA 2018) three types of lighting are currently operating at the Mine: general and security lighting, lighting for safe mining activities and vehicle guidance lighting and headlights. Each of these lighting types would be required for the Project during both construction and operation. The light from the existing Mine would continue with the Project resulting in localised effect of illuminating features adjacent to the vehicles particularly as they move (e.g. trees or rock faces), constant low intensity lighting as a result of security lighting around the existing facilities, and luminance as a result of the mining activities. As detailed in RLA (2015),	During construction, light impacts will be short-term and intermittent (e.g. vehicles, construction guidance lighting etc.). Operational impacts will continue for life of mine but will be directional, with	RLA (2018) recommend that during the course of the Project a strategy relating to lighting be introduced to reduce lighting to the lowest level possible that also maintains an appropriate standard of safety and security and to minimise obtrusive lighting. Type 2 mobile lighting used for in-pit works would employ lamps that produce light in the red or yellow areas of the spectrum rather than the blue or white and be shrouded as much as possible to reduce lateral spread of the light and excess reflection of light, as well as being directed downward.	Mitigation measures likely to be successful at reducing light spill during both construction and operation. The Large-eared Pied Bat was recorded around the existing Mine which seems to indicate that current lighting is not deterring the species from occupying in adjacent habitat. Similarly, the Grey-headed Flying Fox is known to forage within urban areas, so lighting may not be a significant deterrent for it.



Indirect impact	Impact entities	Potential indirect impact during construction and operation without mitigation measures	Potential extent of the indirect impact prior to mitigation	Mitigation measure (To be included in Site Biodiversity Management Plan)	Expected success of mitigation measure
		much of these impacts would be minimised through lighting design and directional lighting. Impact of increased light has some potential to deter the Large-eared Pied Bat and Grey-headed Flying Fox from using the immediately adjacent foraging habitat during construction and operation. It will not have any potential impact on each of the species breeding and roosting habitat, as no such features occur immediately adjacent to the Study Area.	some light bleed into immediately adjacent areas of habitat.	A strategy is also required for control of the potential visibility of type 3 lighting associated with night time use of vehicles in the Project, specifically the potential for headlight or directional lighting during development or contouring of overburden emplacements at night, if that occurs. It is therefore recommended that for each new lift on the western and south-western edges of the Western Overburden Emplacement, or the northern margins of the Northern Overburden Emplacement, overburden emplacement should begin at the margins of the lift relative to potential view directions and then progress in rows behind the margin, providing a light barrier to vehicle headlights. Overburden emplacement work will also be carried out at night in the South Pit, where light spill will be increasingly controlled by the work being generally below view lines and also shielded by walls of the Pit. Some light will be visible at times, however because of the use of these areas being largely confined to daylight hours, it is considered that the above strategy would be successful in mitigating light spill of type 3 light from vehicles.	
Vehicle strikes during construction and operation	Koala	There is a low likelihood that during construction and operation that vehicle strikes to the Koala would occur. If such impacts were to occur, it would likely be along Marulan South Road given it would be used on a daily basis for transport to and from the site. As shown on Figure 16, Koala habitat is present on both sides of Marulan South Road. It is not possible to predict the species precise movement without a sophisticated monitoring/tracking program, however based on the results of our field survey, the Study Area and immediate surrounds are not subjected to high Koala activity. This is likely attributed to the core population being present within Bungonia Gorge, and the steep slopes present a significant obstacle reaching the Study Area and surrounds on a regular basis.	Marulan South Road during both construction and operation	Maintain existing speed limits set along Marulan South Road. Consider revising speed limits if Koala interactions are encountered during the Project life. Continue to implement vehicle safety and awareness of biodiversity interactions during inductions and tool box talks during construction and operation as relevant.	 There is a low likelihood that Koala vehicle strikes will occur during both the construction and operational phase of the Project. This is attributed to the following: No known Koala vehicle strikes as a result of mine activities. The general limited usage/occasional movement of the Koala is likely through the areas. The areas immediately



Indirect impact	Impact entities	Potential indirect impact during construction and operation without mitigation measures	Potential extent of the indirect impact prior to mitigation	Mitigation measure (To be included in Site Biodiversity Management Plan)	Expected success of mitigation measure
					surrounding the Study Area is not know to have high Koala activity. - The Mine currently has strict speed limit requirements that comply with legislative requirements.

8.4.5 Direct and Indirect Impacts to the Koala

Impacts from the Project largely relate to the removal of foraging and dispersal habitat that has been defined as being critical to the survival of the Koala under the EPBC Act (DoE 2014; See Assessment of Significance). Habitat mapped as good and moderate habitat potential, totalling 132.4 ha (Figure **16**), contained either two or more known feed trees (listed as primary, secondary or tertiary species under the species Recovery Plan (DECC 2008)) or a single feed species that occupied more than 50% of a 400 m2 floristic quadrat.

Such habitat is recognised as critical habitat due to past impacts on similar habitat limiting the Koalas ability to persist throughout its former distribution. The proposal includes the removal of 132.4 ha of such habitat (good and moderate areas as shown on Figure 16), which through application of the guidelines is considered a significant impact under the EPBC Act (see attached MNES Assessments of Significance for the Koala).

Due to the apparent limited use of the Study Area and its extremely small extent in relation to similar habitat for the Shoalhaven Gorge Koala population (7,500 ha), it is not considered that removal of this habitat alone would significantly adversely impact the relevant Koala population (centred around the Shoalhaven Gorge) such that a decline would occur or that the population is placed at risk of extinction. Active sites for this population are concentrated within protected areas and the Study Area is not thought to provide a link between active areas within the population's distribution or to any other Koala population.

It is unlikely that the local koala population will become fragmented or isolated as a result of the Project, however fragmentation of foraging habitat would occur and be centred around the existing infrastructure. Such habitat would be reconnected during rehabilitation works upon decommissioning. Given the species is known to occupy and move through modified vegetation, as is evident in the records for the Koala near the Marulan township, it seems unlikely that the Project would change the movement corridor of the Koala such that the population would be significantly impacted.

Indirect impacts, such as a decline in quality and extent in adjacent habitat to the Study Area due to weeds and pest species, is unlikely due to the proposed mitigation measures. Through effective mitigation controls (eg. weed control, pest control), such potential indirect impacts are likely to have negligible or minimal impacts upon surrounding Koala habitat.

The potential for vehicle strikes to the Koala is relatively unlikely. This is attributed to the limited usage of the Study Area and immediate surrounds by the Koala as evident in our survey result and historic records. No known Koala deaths have been recorded along Marulan South road near the mine despite it being used on a daily basis for existing operations.

The 2019/2020 bushfire event took place 8 months after the BDAR was submitted. As shown on Figure 16, the extent of the bushfire occurred approximately 3km to the east of the Study Area. The location appears to have not occurred in the area where the Bungonia Koala population predominately resides (as indicates by the Koala records). As indicated on Figure 16, the bushfire event did not substantially impact upon foraging habitat surrounding the Mine and Bungonia Gorge, nor potential Koala movement corridors

A formal Assessment of Significance under the EPBC Act has also been completed for the Koala, which has been provided at the end of this chapter (Appendix 8). The Assessment concluded that a significant impact to the Koala was likely due to the removal of 132.4 hectares of critical habitat, which through application of the guidelines is considered a significant impact.

A biodiversity offset for the unavoidable impacts to the Koala would be provided as detailed in section 7. In summary, the offset would be established as per the requirements of the BAM through a Biodiversity Stewardship Site at Coolumburra.

8.4.6 Direct and Indirect Impacts to the Grey-headed Flying Fox

Direct impacts to the Grey-headed Flying Fox relate to the removal of 140.3 ha of potential foraging habitat. As discussed in section 8.4.2, this is a conservative estimate given the foraging habitat for the Grey-headed Flying Fox is relatively broad as the species is a canopy-feeding frugivore and nectarivore, which utilises vegetation communities including rainforests, open forests, closed and open woodlands, Melaleuca swamps and Banksia woodlands. It also feeds on commercial fruit crops and on introduced tree species in urban areas.

The Project will not result in any impacts to camp sites/ breeding sites for the Grey-headed Flying-fox due to the absence of such features from the Study Area and immediate surrounds.

Whilst we have approached this assessment by taking a conservative approach to the area of potential foraging habitat, it is important to note that vegetation communities and preference tree species within the core range of Grey-headed Flying Foxes have been identified in terms of importance as feeding habitat in Eby and Law (2008). Within the South-eastern region, this includes 26 species of plants in the nectar diet of Grey-headed flying foxes occur in the South-east NSW region including one hybrid. We have completed a review of the feed trees in comparison to the vegetation mapped within and immediately adjacent to the Study Area (Table 23). Our review has determined that important feed trees (*Corymbia gummifera, Eucalyptus amplifolia, E. tereticornis, E. melliodora, E.punctata*) are associated with the following PCTs in the Study Area as dominants, or associated canopy species:

- PCT 1334 Yellow Box Blakely's Red Gum grassy woodland (SR670),
- PCT 778 Coast Grey Box stringybark dry woodland.

Based on the 'medium' and 'acacia' condition zones of both PCTs, the area of habitat equates to 114.6 ha. It should be noted however, that in the case of PCT 778 Coast Grey Box – Stringybark dry woodland, the dominant canopy tree present was *E. bosistiana*, which is not an important feed tree.

In the locality, our review determined that important feed trees (*Corymbia gummifera, Eucalyptus amplifolia, E. tereticornis, E. melliodora, E.punctata, Acemena smithii, Syzygium australe*) correspond with diagnostic species of the following PCTs (Table 23). The total mapped area⁵ of these PCTs within the locality (5km of Study Area) is approximately 6,541 ha.

Equivalent Tozer et al 2006	PCT Name	Important Grey-headed Flying Fox feed trees that are dominant species associated with the PCT
P27. Bungonia Slates Woodland	Grey Gum - Blue-leaved Stringybark open forest on gorge slopes, southern Sydney Basin and north east South Eastern Highlands (SR549)	Grey Gum (<i>Eucalyptus punctata</i>)
P38. Grey Myrtle Dry Rainforest	Grey Myrtle dry rainforest of the Sydney Basin and South East Corner (SR552)	Lilly Pilly (Syzygium smithii), Sweet Pittosporum (Pittosporum undulatum)

⁵ Based on Tozer et al (2006) mapping, as this is the only mapping Project that covers the region.

Equivalent Tozer et al 2006	PCT Name	Important Grey-headed Flying Fox feed trees that are dominant species associated with the PCT
P24. Tableland Grassy White Box Yellow Box Blakely's Red Gum Woodland	Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670)	Yellow Box (<i>Eucalyptus melliodora</i>), Blakely's Red Gum (<i>Eucalyptus blakelyi</i>)
P35. Wollondilly -Box Shoalhaven Gorge Forest	Forest Red Gum - Yellow Box woodland of dry gorge slopes, southern Sydney Basin and South Eastern Highlands (SR547)	Forest Red Gum (<i>Eucalyptus tereticornis</i>), Yellow Box (<i>Eucalyptus melliodora</i>), Grey Box (<i>Eucalyptus</i> <i>moluccana</i>)

Based on the above analysis, it seems likely that the significance of foraging habitat within the Study Area that would be impacted by the Project is not high, given similar foraging habitat within the locality is relatively extensive. As such, whilst the Project would remove 140.3 ha of potential foraging habitat (including a conservative estimate of 114.6 ha of vegetation zones containing an important feed tree), a relatively large amount would remain within the locality, thus it is reasonable to conclude that the Project would not cause a substantial loss to potential foraging habitat.

Given the mobility of the species, and the ability for the species to use isolated trees/urban area for foraging, the Project would not result in any significant fragmentation of potential foraging habitat.

Indirect impacts are also unlikely to cause any substantial impacts to potential foraging habitat. We concluded that the Project is unlikely to increase invasive species being established in adjacent areas that would impact upon the Grey-Headed Flying Fox, due to the following:

- It is unlikely that invasive weeds would spread into adjacent areas given Boral would implement weed control and suppression activities detailed in the Biodiversity Management Plan. Boral is currently undertaking such activities for their exsting operations. For instance, Boral has undertaken weed control measures such as weed spraying (in particular targeting Serrated Tussock), aerial spraying, and pest control on their surrounding landholdings. Boral would maintain such mitigation measures to ensure that indirect impacts are reduced (as detailed in section 6.3)
- Potential invasive predators such as the fox are present within the Project area and immediate surrounds as evident during our field survey sightings. Boral will continue their current pest management to reduce any potential for pests to occur within adjacent foraging habitat.

It is noted that the 2019/2020 bushfire occurred 8 months after the BDAR was submitted. The occurrence within the locality in relation to potential Grey-headed Flying Fox habitat is shown on Figure 18. As indicated on Figure 18, the extent of the bushfire occurred approximately 3km to the east of the Study Area and did not substantially impact upon foraging habitat immediately surrounding the Mine. However, it is noted that across NSW larger portions of habitat loss for the species would have occurred. The relatively mobile nature of the species (ability to travel greater than 30km in a night to forage) may be a considering factor in the species recovery across its range. The loss of foraging habitat associated with the Project is not likely to substantially deplete the available foraging habitat surrounding the mine despite the bushfire event (as evident on Figure 18).

A formal Assessment of Significance under the EPBC Act has also been completed and attached for impacts on the Grey-headed Flying Fox (Appendix 8). The Assessment concluded that a significant impact to the Grey-headed Flying Fox was unlikely due to the following:

- No roosting habitat would be impacted by the Project
- No critical foraging habitat would be impacted by the Project
- The habitat to be removed is not considered to be particularly important foraging habitat in terms of its constitution or size
- Similar foraging habitat (that contains important feed trees) occurs throughout the locality including within areas that are currently retained as protected areas
- Indirect impacts into adjacent potential foraging habitat are likely to be minimal given the mitigation measures that would be undertaken.

8.4.7 Direct and Indirect Impact to the Large-eared Pied Bat habitat

A total of 140.3 ha of foraging habitat would be directly impacted by the Project. The habitat to be impacted has been subject to historic logging, grazing, and other agricultural activities (section 4.4 and 4.4.1) however as evident by the records during the field survey, is used for foraging.

Within the locality of the Study Area (attributed to a 5km radius of the Study Area), we have attempted to map the area of foraging habitat for the species using existing vegetation mapping. We have used the Tozer et al 2006 mapping project, and corresponded the vegetation communities to PCTs that are associated with the Large-eared Pied Bat as per Bionet. We have then considered the condition for foraging based on the aerial interpretation and connectivity. The vegetation was then clipped within 2 km of steep slopes/cliffs/gorges. Our mapping analysis determined that 6,364.6 ha of potential foraging habitat for the species occurs within the locality (Figure 17).

Condition based on potential for foraging	Area (ha)
High	5846.6
Moderate	518.0
None	1727.3
Poor	432.9

The loss of 140.3 ha of habitat due to the Project would therefore reduce the potential foraging habitat within the locality by 2%. A large portion of the remaining foraging habitat is protected within Morton National Park and Bungonia Conservation Area, and the steeper vegetated land within private properties that is unlikely to be developed or grazed. The removal of the foraging habitat associated with the Project is unlikely to be critical to the overall species' survival or the local occurrence of the species given the protection of foraging habitat for the Large-eared Pied Bat within Bungonia State Conservation Area and Morton Nation Park that occurs within the locality.

Foraging habitat on fertile soils (or within fertile valleys) is also considered an important overall requirement for the Large-eared Pied Bat (Pennay 2008), however the species has been recorded extensively within sandstone associated vegetation, indicating that whilst foraging habitat on fertile soils is likely to be important, foraging would by no means be confined to such areas.

The Study Area is already fragmented from cliffs lines and rock outcrops along Bungonia Gorge and Shoalhaven River where the species is likely to roost. In particular, the Study Area is obstructed to the

immediate east by the Marulan South Limestone Mine. However, despite such fragmentation, the species was recorded across the Study Area and surrounds which suggests that the species is relatively mobile being able to utilise thin vegetative corridors and open areas. The Project will decrease the amount of foraging habitat by 2 %, however it is unlikely that the Project would increase fragmentation to an extent that would result a population being split into two or more.

Indirect impacts are also unlikely to cause any substantial impacts to potential foraging habitat. We conclude that the Project is unlikely to increase invasive species being established in adjacent areas that would impact upon the Large-eared Pied Bat, due to the following:

- It is unlikely that invasive weeds would spread into adjacent areas given Boral would implement weed control and suppression activities detailed in the Biodiversity Management Plan. Boral is currently undertaking such activities for their operations (as detailed in section 6.4)
- Potential invasive predators such as the fox are present within the Project area and immediate surrounds as evident during our field survey sightings. Boral will continue their current pest management to reduce any potential for pests to occur within adjacent foraging habitat.
- Lighting placed around infrastructure is directional towards infrastructure/construction areas, and unlikely to result in significant areas of light bleed into surrounding habitat, to the extent the species would no longer use the area.

Within the locality of the Study Area, the Large-eared Pied Bat is known to occur within Bungonia National Park and Morton National Park, which coincides with steep sandstone cliffs which is likely to offer potential roosting habitat for the species. However, the breeding location of the species across the locality, and general distribution of the species are relatively unknown.

The structure of nursery roosts appears to be very specific, i.e. arch caves with dome roofs (that need to be deep enough to allow juvenile bats to learn to fly safely inside) and with indentations in the roof (presumably to allow the capture of heat). These physical characteristics are very uncommon in the landscape and therefore a limiting factor.

One cave is known to occur within 900m of the Study Area, known as Main Gully Spring (Bauer and Bauer 1998). The cave is located beneath the Mine and in periods of high discharge this cave acts as an overflow. A number of chambers and tunnels are described as occurring in this cave by Baeuer and Bauer (1998) including a chamber 1 m x 2.7 m wide.

Main Gully Spring is a potential bat roosting site. It could not be inspected during the current field survey due to safety and access issues. However, a site inspection by Boral representatives accompanied by an experienced caver was undertaken in August 2017 at the base of the cave, and approximately 10 meters inside the entrance. During the site inspection, approximately 5 microbats were observed. It was not possible to determine the species from photographs that were provided. As such, it is not possible to state with certainty that a maternal roost could not be established for Large-eared Pied Bat. However, whilst microbats were recorded it is unlikely that long-term maternity roosts would be established in the Main Gully Spring cave due to its limited size and occasional inundation of most, if not all parts of the cave in times of high flow.

Regardless, the cave is located away from the Study Area and would not experience any impact associated with the Project. This is due to the distance of the subject cave from the Mine expansion activities that involve mining and blasting which is to occur over 900 m to the north. There has been an ongoing history of mining within the existing south pit throughout which any roosting bats would have persisted if present.

The Project is not forecast to increase noise or vibration to the subject cave or any other known caves in the locality and as such, the Project would not impact upon breeding habitat.

It is noted that the 2019/2020 bushfire occurred 8 months after the BDAR was submitted. The occurrence within the locality in relation to potential Large-eared Pied Bat habitat is shown on Figure 17. As indicated on Figure 17, the extent of the bushfire occurred approximately 3km to the east of the Study Area and did not substantially impact upon foraging habitat immediately surrounding the Mine. The loss of foraging habitat associated with the Project is not likely to substantially deplete the available foraging habitat surrounding the mine for a local important population of the Large-eared Pied Bat despite the bushfire event (as evident on Figure 17). It should be noted that the loss of foraging habitat from the bushfire is a short-term loss given the resilience of the bushland to recover.

A formal Assessment of Significance under the EPBC Act has also been completed for impacts on the Largeeared Pied Bat (Appendix 8). The Assessment concluded that a significant impact to the Large-eared Pied Bat was unlikely due to the following:

- No roosting or breeding habitat would be impacted by the Project.
- The habitat to be removed is not considered to be particularly important foraging habitat in terms of its constitution or size.
- Much of the foraging habitat is currently protected within Morton National Park and Bungonia State Conservation Area which occur to the south and east of the Study Area which provides inperpetuity protection of habitat. As such, the foraging habitat protected within these reserves would remain used by the Large-eared Pied Bat population in the long-term thus unlikely for the species to decline in the locality.
- The Project is unlikely to result in a population being fragmented into two or more populations.
- The Project is unlikely to impact the breeding lifecycle of the species.
- The removal of habitat within the Study Area is unlikely to result in a decline of the species.
- Important foraging habitat occurs throughout the locality including within protected areas. Thus the species is not solely reliant upon the Study Area for survival.
- Indirect impacts into adjacent potential foraging habitat are likely to be minimal given the mitigation measures that would be undertaken.

Whilst a significant impact was not determined, it should be noted that the species would be subsequently offset in accordance with the BAM to satisfy the BC Act offsetting requirement (section 7).

8.4.8 Direct and Indirect Impacts to the Regent Honeyeater

As discussed in section 8.4.2, the habitat types within the Study Area do not neatly match up with the preferred habitat for the Regent Honeyeater. For instance, the Study Area:

- is typically not located within an area of high fertile soils with high water content which the species tends to prefer.
- does not contain a Box-Ironbark eucalypt combination.
- generally lacks taller and larger diameter trees.

Furthermore, no population is known to occur within the Study Area or the Bungonia region on a regular basis, which is reflective of the lack of records over the past 36 years. Given Bungonia is a popular birding spot, it seems likely that regular usage of the wider area by the species would result in greater records. This could indicate that the use of the Study Area by the Regent Honeyeater on a permanent, semi-permanent or even an intermittent basis for foraging, is unlikely.

Notwithstanding the above, we acknowledge the species can utilise a range of habitat types (plantings, gardens, dry sclerophyll forest), and may only visit an area intermittently over decades. Therefore, it is not possible to exclude habitat within the Study Area from being used, and we have conservatively estimated 140.3 ha of foraging habitat occurs in the Study Area.

The 140.3 ha would be directly impacted for the Project via unavoidable vegetation clearing. The habitat to be cleared has already been impacted by historic clearing events and high levels of weed and pest occurrence (eg. goats) (section 4.4 and 4.4.1).

Within the locality of the Study Area (attributed to a 5 km radius of the Study Area), we have attempted to map the area of foraging habitat for the species using existing vegetation mapping. We have used the Tozer et al (2006) mapping Project, and corresponded the vegetation communities to PCTs that are associated with the Regent Honeyeater as per Bionet. The mapping determined that 9,672 ha of potential habitat occurs within the locality, including 1,798 ha of Box-Ironbark PCTs for which the species prefers as per the habitat descriptions for the species on Bionet (Figure 19).

The Project would impact 1.5% of foraging habitat within the locality, and 7.8% of favourable habitat (Box-Ironbark PCTs) noting that a large portion is protected within conservation areas. As such, it seems unlikely that the removal of potential foraging habitat in the Study Area would be such that the population would decline in the long-term due to a reduction in habitat in the locality.

No breeding habitat occurs within the Study Area, and no known breeding areas would be directly or indirectly impacted.

Indirect impacts are also unlikely to cause any substantial impacts to potential foraging habitat. The Project is unlikely to increase the likelihood of invasive weeds being established in potential foraging areas resulting in die back of eucalypts and native vegetation. Mitigation measures, such as weed and pest control would be undertaken as required. Furthermore, the Project is unlikely to increase pest species, such as more aggressive honeyeaters, the noisy miner, noisy friarbird, the red wattlebirds, and the honeybee (Apis mellifera) (Menkhorst 1997).

Similar to that already discussed in relation to the Large-eared Pied Bat, Koala and Grey-headed Flying Fox, the 2019/2020 bushfire has impacted potential foraging habitat across the species range. In the locality, the occurrence of the bushfire event in relation to the Regent Honeyeater habitat is shown on Figure 19. The loss of potential foraging habitat associated with the Project, coupled with the bushfire event is not likely to substantially deplete the available foraging habitat in the immediate locality. Furthermore, the bushfire event was located away from 'favourable foraging habitat (box-ironbark combination' within the locality as shown on Figure 19. It should be noted that the loss of potential foraging habitat from the bushfire is a short-term loss given the resilience of the bushland to recover.

A formal Assessment of Significance under the EPBC Act has also been completed for impacts on the Regent Honeyeater (Appendix 8). The Assessment concluded that a significant impact to the Regent Honeyeater was unlikely due to the following:

- Known breeding habitat will not be impacted by the Project.
- The species has only been detected three times in the past 36 years within the Bungonia region suggesting that the species potential usage of the Study Area is likely to be marginal/low.
- The Project will impact upon 'potential foraging habitat' which we have conservatively assessed. It will not impact upon 'known habitat' or 'critical habitat'.

- The Project is unlikely to impact upon any flight movement of the species, or impact upon the life cycle of the species.
- The Project is unlikely to introduce or contribute to any invasive species becoming established that would impact upon the species.

8.4.9 Direct and Indirect Impacts to Migratory Species

The Migratory species (Cattle Egret, Great Egret, Rainbow Bee-eater, Black-faced Monarch, and Rufous Fantail) have a relatively wider distribution across NSW and broad habitat preferences (as described in DAWE Species Profile and Threats Database) (Appendix 1). Conservatively, 140.3 ha of foraging habitat for these species may be directly impacted by the project through unavoidable vegetation clearing.

Given the proposed mitigation measures, indirect impacts to the species are unlikely to occur within adjacent areas of habitat, or ultimately have an effect on the migration pathways for any of the species.

A formal Assessment of Significance under the EPBC Act has also been completed and attached for impacts on the migratory species at the end of this chapter (Appendix 8). The Assessment concluded that a significant impact to any migratory species was unlikely due to the following:

- The Study Area and immediate surrounds are not known to support a significant proportion of the migratory species
- The Study Area is only considered potential foraging habitat due to the broad habitat preferences for each migratory species
- The potential foraging habitat within the Study Area is not limiting
- The Project will not impact upon roosting, feeding, breeding or resting behaviour of the migratory species.
- No critical habitat would be impacted.

8.5 Conclusion

Our assessment has included a formal assessment against the MNES Assessment Significant criteria which concludes that the Project may have a significant impact to the following Commonwealth listed threatened biodiversity:

- Box Gum Woodland CEEC
- Koala.

As detailed in section 7 of the BDAR, a biodiversity offset for both Box Gum Woodland and the Koala would be provided for the unavoidable impacts.

Our assessment concludes that the Project is unlikely to result in a significant impact to any other threatened biodiversity listed under the EPBC Act.

Through the successful implementation of proposed mitigation measures, our assessment concludes that potential indirect impacts (such as weed spread, increase in feral pests, noise, and dust) are unlikely to significantly increase impacts to any Commonwealth threatened biodiversity.

8.6 Matters of National Significance – Assessments of Significance

Assessments of Significance and supplementary information (where relevant) are presented for the following MNES in relation to the Project:

- Threatened Ecological Communities
 - Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland
- Threatened Fauna
 - Koala
 - Large-eared Pied Bat
 - Grey-headed Flying-fox
 - Regent Honeyeater
- Migratory Species
 - Great Egret
 - Cattle Egret
 - Rainbow Bee-eater
 - Black-faced Monarch
 - Rufous Fantail



Yellow Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Woodland)	Likelihood
An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will: reduce the extent of an ecological community	
A total of 80.7 hectares of Yellow Box Yellow Box Blakely's Red Gum Woodland (hereafter referred to as Box-Gum Woodland) will be removed by the Project.	
The Box-Gum Woodland CEEC has been heavily cleared across its range, with the remaining extent of the ecological community being highly fragmented, occurring in small isolated patches within a cleared environment, or within a landscape of other disturbed woodlands (DoE 2014). This is evident throughout the Study Area and within the wider Project area.	
The EPBC Policy Guidelines (DoE 2014) also state that over 90% of the original extent of this ecological community has been cleared. This is supported by OEH (2014b) who regarded the equivalent Biometric Vegetation Type to be 90% cleared, and Thomas et al. 2000 estimate that within South-Eastern NSW 59,468 ha remain from the pre-1750 extent of 1,012,052 ha (approximately 94% cleared).	
During the field survey, Niche also mapped areas of EPBC Act listed Box Gum Woodland within Boral's lease holding, and undertook a desktop mapping exercise outside of the lease (supplemented with road-side assessment where no access was permitted within private landholdings) to understand the occurrence of the TEC within the locality for the initial purpose of determining suitable offset sites for the Project.	
Our mapping has confirmed that the extent of EPBC Act listed Box Gum Woodland is not limited to the Study Area. Rather, we have mapped a total of 185.6 hectares of the TEC surrounding the Study Area as shown in Figure 13.	
Within a larger local context, areas that Niche could not assess (eg. within extensive private landholdings) we have examined the regional mapping completed by Tozer et al 2006. A total of 3,304.6 ha of the best equivalent vegetation type (p24, Tableland Grassy Box Gum Woodland) has been mapped within a 10 km radius of the Project area. The p24 mapping unit has been described by Tozer et al (2006) as "potentially aligning to the CEEC and the state listed EEC, however it would include some areas that do not meet the CEEC". As a precautionary measure, we have assumed in this assessment that half of the total p24 area would be an approximate representation of the remaining Commonwealth CEEC (i.e. 1,652.3 ha).	Known
The potential habitat removed by the Project is therefore estimated to represent only 4.8% of the community in the locality.	
Indirect impacts in the form of weed incursion, dust, and feral pest have the potential to occur immediately adjacent to the Study Area resulting in impacts to remaining patches of Box Gum Woodland. Quantifying the extent of indirect impacts without mitigation measures is difficult and highly variable. Without any form of mitigation measure, we have assumed that indirect impacts may occur within 100 m from the edge of the Study Area, which takes into account the potential seed dispersal and dust from construction and operation. As indicated on Figure 13, areas of indirect impacts without mitigation have the potential to occur within Box Gum Woodland patches immediately surrounding the Study Area, including the patch that occurs immediately west of the Marulan South mine (Figure 9;Figure 13).	
The indirect impacts specific to Box Gum Woodland, along with the proposed mitigation measures are provided in Table 17. In summary, through the successful implementation of the mitigation measures, the indirect impacts are not expected to result in any degradation of surrounding Box Gum	

Yellow Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Woodland)



Yellow Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Woodland)	Likelihood
Woodland such to an extent to result in further decline outside of the Study Area. The proposed measures would be detailed in the updated Biodiversity Management Plan (section 6.4).	
fragment or increase fragmentation of an ecological community	
All of the CEEC within the Study Area has experienced weed invasion, grazing pressures and clearing, which has resulted in a predominantly degraded condition of this community. The CEEC within the disturbance area is currently fragmented, however the Project will increase fragmentation by expanding the existing Mine pit to the west and developing additional out-of-pit overburden emplacements. Large patches of the Box Gum Woodland are important in retaining seeds, flora diversity, and support the fauna that specifically rely on the vegetation mix. The Project would result in the removal of already fragmented patch of modified Box Gum Woodland from the locality, however similar patches within the surrounding locality would not be impacted. One of the best condition patches of the TEC encountered during our field investigations occurs to the north-east of Peppertree Quarry. This patch is approximately 20 ha in size, and supports a higher diversity than that in the Study Area. Similarly, another patch to the immediate north of the Marulan South Road was in a better condition to that of the Study Area, which will be retained. The areas of Box Gum Woodland within the Study Area are already fragmented by access roads, infrastructure and non-native vegetation (Figure 9; Figure 13). The Project will lead to increased fragmentation of the TEC in the local context through the combination of the semplacement areas. In particular, an 18.8 ha patch of native vegetation (consisting of approximately 6.7 ha of Box Gum Woodland) would be fragmented between the existing Marulan South Quarry and the Study Area. It should be noted that fragmented patches. Without any form of mitigation measure, we have assumed that indirect impacts may occur within 100 m from the edge of the Study Area, which takes into account the potential seed dispersal and dust from construction and operation. Through the successful implementation of mitigation measures detailed in section 8.2.2, indirect impacts are not expected to result in any degradation of	Likely to increase fragmentation.
adversely affect habitat critical to the survival of an ecological community	
The CEEC to be disturbed by the Project consists of two condition classes as detailed in Appendix 2. Both of the condition classes meet the Commonwealth listing despite prior historic disturbance and clearing due to the patch size and the presence of regenerating eucalypts. The Box-Gum Woodland Recovery Plan regards all areas of Box-Gum Woodland which meet the minimum condition criteria to be considered critical to the survival of the ecological community. Based on this statement, it would mean that all patches of the CEEC within the disturbance area, no matter of condition or size, are critical to the survival of the community and similarly, this would extend to all areas of the community within the locality. As stated in the EPBC Act Policy Guidelines, the CEEC has been heavily cleared across most of its range with the remaining extent of the ecological community being highly fragmented, occurring in small isolated patches within a cleared environment, or within a landscape of other disturbed	Likely



Yellow Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Woodland)	Likelihood
woodlands. With this in mind, any clearing of large patches of the CEEC may result in an adverse affect to critical habitat, however, given the Study Area only represents that 4.8 percent of the CEEC in the locality, the Project alone would not result in the removal of habitat critical to the CEEC survival as other areas of the CEEC would remain.	
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns.	
The direct impacts will result in the destruction of abiotic factors within the disturbance area necessary for the CEEC survival given that the CEEC will be cleared. The clearing of the CEEC will modify soil and soil seed bank within the disturbance area. As previously discussed, the potential of indirect impacts to occur outside of the Study Area would be mitigation using the control measures described in section 8.2.2. This includes weed control, pest control, dust suppression activities, and sedimentation works. Such control measures are currently being undertaken at the Mine as part of current operations. Proposed surface water drainage associated with the Project follows natural drainage lines which are unlikely to be impacted such that water availability to the surrounding CEEC is altered. Suitable sedimentation control would be employed to minimise risks of indirect water flows and potential erosion into areas outside of the Study Area.	Unlikely to be a factor outside of disturbance area- impacts restricted to clearing of the proposed disturbance area
cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	
The Project will result in the loss of the CEEC within the Study Area. Without mitigation measures, Box Gum Woodland surrounding the Study Area may experience an increase in introduced species via increased edge effects. Such impacts could extent to 100 m from the edge of vegetation clearing. However, mitigation measures would be undertaken to prevent the risk of indirect impacts from occurring into adjacent areas of Box Gum Woodland. The mitigation measures are detailed in section 8.2.2, and would include weed control, boundary demarcation, pest control, sedimentation and erosion control. We conclude that through successful implementation of mitigation measures, indirect impacts to surrounding patches of Box Gum Woodland are likely to be minimal. The Project has some potential to alter the fire frequency of the area, however fire is already discouraged from occurring around the Mine area due to the presence of Mine infrastructure. The Biodiversity Management Plan to be prepared for the site, will consider the potential to implement a fire	Unlikely
frequency appropriate to the existing remaining vegetation communities.	
cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: assisting invasive species, that are harmful to the listed ecological community, to become established, or	
The Project will result in the loss of the CEEC within the Study Area. Without mitigation measures, Box Gum Woodland surrounding the Study Area may experience an increase in introduced species via increased edge effects. Such impacts could extent to 100 m from the edge of vegetation clearing. However, mitigation measures would be undertaken to prevent the risk of indirect impacts from occurring into adjacent areas of Box Gum Woodland. The mitigation measures are detailed in section 8.2.2, and would include weed control, boundary demarcation, pest control, sedimentation and erosion	Potential



Yellow Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Woodland)	Likelihood
control. We conclude that through successful implementation of mitigation measures, indirect impacts such as the spread of invasive species in surrounding patches of Box Gum Woodland are likely to be minimal.	
causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or	
The Project will not involve any spraying of fertilizers, herbicides or other chemicals of pollutants which will kill or inhibit the growth of the CEEC. Herbicides and fertilizers may be required for bushland restoration and rehabilitation purposes to reduce the spread of weeds and promote seed germination and growth of seedlings, however these will only be used in accordance within bushland restoration principles and best practise and will not result in any significant impacts to the CEEC.	Unlikely
interfere with the recovery of an ecological community.	
The National Recovery Plan for White Box–Yellow Box–Blakely's Red Gum Grassy Woodland and Derived Native Grassland has been prepared under the provisions of the EPBC Act.	
The overall aim of the recovery plan is to promote the recovery and prevent the extinction of the CEEC. The specific objectives of the recovery plan is to minimise the risk of extinction of the ecological community through:	
 achieving no net loss in extent and condition of the ecological community throughout its geographic distribution; increasing protection of sites in good condition: 	
 increasing landscape function of the community through management and restoration of degraded sites; increasing transitional areas around remnants and linkages between remnants; and 	Likely however greater recovery
 bringing about enduring changes in participating land manager attitudes and behaviours towards environmental protection and sustainable land management practices to increase extent, integrity and function of Box-Gum Grassy Woodland. 	benefits will be achieved through an offset.
The Project will interfere with recovery of the CEEC given that 80.7 hectares of the community will be cleared.	
The Project would not be consistent with the first objective of the above stated recovery aims for the community unless offsetting arrangements for the Project secure and improve the condition of the community elsewhere within the region to the extent that a 'no net loss' outcome is achieved. The Project will satisfy the NSW Offsets Policy for Major Projects which will result in a no net loss (otherwise known as improve or maintain) outcome for the community at a regional level by securing patches of the CEEC and managing these in perpetuity. In the long-term the offset is expected to benefit the recovery of the community given that a larger area of CEEC will be protected and managed in perpetuity.	
Conclusion: The proposal is likely to result in a significant impact on Box-Gum Grassy Woodland, primarily through the removal of habitat considered critical to the survival of the community.	



Koala

In assessing the significance of the impact from the proposed action on the Koala the '*EPBC Act referral guidelines for the vulnerable koala*' were applied to the assessment. The following information is presented prior to the Assessment of Significance for the Koala to demonstrate application of the guidelines and to assist with understanding the assessment and its conclusion.

Koala Habitat Assessment Scoring (Department of the Environment (2014). EPBC Act Referral Guidelines for the vulnerable Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory). Commonwealth of Australia, 2014.):

Attribute	Score	Habitat Appraisal
Koala occurrence	+2	Koalas have been encountered infrequently adjacent to the existing Mine (the most recent in December of 2017 along Marulan South Road approximately 1 km from the Mine) according to communications with site personnel; A number of Koala records exist from contiguous habitat approximately 1-2 km south of the proposed disturbance area.
Vegetation Structure and composition	+2	Habitat scoring was applied across the Project area using floristic data and Braun Blanquet cover values from 400m ² quadrats. The mapping indicated that the majority of the Project area contained either 2 or more known feed trees or a single feed species that occupied more than 50% of the quadrat.
Habitat connectivity	+2	The area is part of a contiguous landscape of > than 1,000 hectares, however the existing Mine and perimeter roads (incorporating steep rocky embankments in places) form a significant barrier to accessing the Study Area from the south, where extensive vegetated areas occur (the most extensive of which are within the Morton and Bungonia National Parks). There are no major barriers to Koala movement to the Study Area from the immediate south and west which allows for connectivity between the Study Area and the Bungonia State Conservation Area (despite the presence of steep terrain) where the majority of the Koala records for the region occur.
Key existing threats	+2	There is no known documented or anecdotal evidence of Koala mortality from dog attack or vehicle collision within the Study Area or surrounds. Dogs, trucks, and train movements are all present within the Study Area however wild dogs are not common (not detected on infrared cameras or seen during



		survey) and vehicle movements within the Study Area are regulated at low speeds.
Recovery value	+1	Uncertain whether the habitat within the Study Areas will be important in achieving the interim recovery objectives. There is some relevance to the recovery objectives for inland areas (as per table 1 of the referral guidelines (DoE 2014) in regard to the development area representing habitat on fertile soil, however the habitat is not thought to specifically act as a habitat refuge. There is some relevance to the objective of maintaining habitat around refuges (i.e. the area within Bungonia State Conservation Area is a known refuge). However, connectivity to the known refuge area is somewhat limited though the existing Mine and gorge habitat. Additionally, given the extensive reserve network surrounding the existing refuge areas, the importance of the Project area is lessened.
Total	9/10	

Koala (vulnerable)

Preamble

There are 137 Koala records from the NSW Atlas of Wildlife within a 10 km radius of the Study Area, all but three of which are post 1980 records. The majority of these records (105) are from the Bungonia National Park (NP) and Bungonia State Conservation Area (SCA) which occur approximately 1 - 2 km south of the Project area and collectively are considered one of the primary known active sites for a Koala population centred along the Shoalhaven Gorge and extending approximately 30 km to the south of the Study Area (e.g. Allen 2002) encompassing large areas of Morton National Park. The Bungonia NP/SCA active Koala area includes popular walking areas and a camping site and therefore observations of Koalas from this area are relatively frequent. Other unknown active Koala areas may exist within the locality where access is limited. The Bungonia NP/SCA areas are separated from the Study Area by the Bungonia Gorge, a limestone gorge approximately 350 m deep. The steepness of the gorge would

undoubtedly limit connectivity between the main known breeding area of Koalas in the locality (Bungonia NP/SCA) and the Project area, however there are records of the Koala from both sides of the gorge (albeit very limited from the northern side) and connectivity to the Study Area exists indirectly, west of the main gorge area.

North and west of the protected areas around the Bungonia and Shoalhaven gorges Koala records within the NSW Atlas of Wildlife are very limited with sporadic observations from private land and along roadsides, one being from the Mine and two additional records (including road-kill) each from around the townships of Marulan and Tallong. These areas are more disturbed, predominantly private tenure. They generally consist of more fertile areas that have been developed traditionally for agriculture. It is clear that Koalas are able to travel through such areas and feed trees including primary feed trees are available to them throughout such areas. Targeted Koala survey in these areas (private land on the tablelands) is likely to have been minimal and therefore actual Koala distribution and abundance within such areas is poorly known. Despite the limits regarding Koala distribution and abundance, given previous disturbance resulting in fragmented vegetation and the lack of Koala records within the higher elevation areas away



from the protected areas around the Bungonia and Shoalhaven gorges, it is considered unlikely that active Koala areas (with permanent and moderate to high densities of Koalas) such as those within the Bungonia NP/SCA would occur.

Surveys and collection of anecdotal evidence of Koala sightings conducted within the Study Area as part of this assessment revealed that Koalas have been sighted sporadically within the south of the Study Area over the past decade, with Koalas observed every 2- 3 years around the Mine (pers. comm. Grant Thompson – Boral). However, no Koala observations are known from the Study Area. Scat surveys, spotlighting, call-playback and tree surveys did not identify repeated or on-going use of trees within any of the proposed disturbance areas. Therefore, whilst it is known that Koalas occur within these areas and that feed trees exist within them, it is likely that very low densities of Koalas occur or that Koalas use the areas whist moving through the landscape.

Criteria (Vulnerable Species)	Likelihood	
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
lead to a long-term decrease in the size of an important population of a species;		
It is considered unlikely that the Project would lead to a long-term decrease in the size of an important population of the Koala. It is considered that the population of Koalas occurring around the Shoalhaven and Bungonia gorges (as described in Allen - 2002) is an important population, however it has not been listed specifically as such within a recovery plan. The identified active Koala area within the Bungonia NP/SCA, which acts as a known breeding and regular feeding habitat is one of several active areas for this population. The Project is not considered to have impacts on the population such that it will lead to a long-term decline as records away from protected areas within the locality of the Project area are very sparse and use of the Study Area is thought to be transient only or support a very limited number of individuals.	Very unlikely	
reduce the area of occupancy of a important population;		
The Project would not impact the area of occupancy of any population of the Koala as the areas to be cleared are not sufficient in extent to impact the area of occupancy of the Koala at a 2km grid square scale (which is the standard unit for measuring area of occupancy according to the IUCN). Koalas would still be expected to occur within the vicinity of the Project area (e.g. to the west of the proposed western and central emplacement areas).	Unlikely	
fragment an existing important population into two or more populations;		
It is unlikely that the local koala population will become fragmented or isolated as a result of the Project, however fragmentation of foraging habitat would occur and be centred around the existing infrastructure. Such habitat would be reconnected during rehabilitation works upon decommissioning. Given the species is known to occupy and move through modified vegetation, as is evident in the records for the Koala near the Marulan township, it seems unlikely that the Project would change the movement corridor of the Koala such that the population would be significantly impacted.	Unlikely	
adversely affect habitat critical to the survival of a species;		
Habitat within the Study Area to be impacted constitutes habitat critical to Koala survival as determined through application of the Koala habitat assessment tool (DOE 2014), which is illustrated in the table above. The habitat within the disturbance area scores a 9/10. As such, the Project will impact upon critical habitat to the Koalas survival.	Likely	
disrupt the breeding cycle of an important population		



Habitat within the disturbance area is not thought to be a key breeding area due to the low number of records. Therefore removal of the habitat is unlikely to disrupt the breeding cycle of the population. The area constitutes a very small proportion of the overall habitat for the population, (considered to be the population centred on the Shoalhaven gorge (Allen 2002)), with active population areas, including the Bungonia NP/SCA site, being the prime candidate sites for breeding activity.	Unlikely
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;	
The area to be removed is a patch supporting 132.4 ha of Koala habitat for the population and the species. Its removal may have a minor impact on patterns of Koala movement and no isolation between populations would occur from the Project.	
Indirect impacts, such as a decline in quality and extent in adjacent habitat to the Study Area due to weeds and pest species, is unlikely due to the proposed mitigation measures. Through effective mitigation controls (eg. weed control, pest control), such potential indirect impacts are likely to have negligible or minimal impacts upon surrounding Koala habitat.	Unlikely
The potential for vehicle strikes to the Koala is relatively unlikely. This is attributed to the limited usage of the Study Area and immediate surrounds by the Koala as evident in our survey result and historic records. And given no known Koala deaths have occurred along Marulan South road near the mine, despite it being used on a daily basis for existing mine operations.	
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;	
Invasive species such as foxes that may impact on the Koala are already established within the Project area. The Project is unlikely to further encourage these threats from occurring.	
Indirect impacts, such as a decline in quality and extent of Koala habitat due to weeds and pest species, is unlikely due to the proposed mitigation measures. Through effective mitigation controls (eg. weed control, pest control), such potential indirect impacts are likely to have negligible or minimal impacts upon surrounding Koala habitat.	Unlikely
The potential for vehicle strikes to the Koala is relatively unlikely. This is attributed to the limited usage of the Study Area and immediate surrounds by the Koala as evident in our survey result and historic records. And given no known Koala deaths have occurred along Marulan South road near the mine despite it being used on a daily basis for existing mine operations.	
introduce disease that may cause the species to decline, or	
The main diseases affecting Koalas are chlamydial infections. The Project would not increase exposure to such infections as Koalas from the local population would not have increased contact with other Koala populations including infected populations.	Unlikely
interfere substantially with the recovery of the species.	
The following aspects are considered in relation to the possibility of the Project to interfere with the recovery of the Koala (from DOE 2014): Increasing koala fatalities in habitat critical to the survival of the koala due to dog attacks to a level that is likely to result in multiple, ongoing mortalities. There is no reason to suspect that dogs would become more prevalent within the Project area or surrounds as a result of the Project; Increasing koala fatalities in habitat critical to the survival of the koala due to vehicle-strikes to a level that is likely to result in multiple, ongoing mortalities. mortalities.	Unlikely



There have been no reported Koala fatalities due to vehicle strike within the Mine site or along access roads. Additional vehicle movements are expected to occur as a result of the Project but would be negligible, with the Project mostly ensuring the continuation of the current regime of vehicle movements within the Project area. There are strict speed controls on the vehicles operating within the Mine (20 and 40 km/hr) and given the very low number of Koala sightings from this area and the absence of recorded fatalities it is considered that the risk of increased fatalities such that multiple ongoing fatalities occur is very low;

Facilitating the introduction or spread of disease or pathogens for example Chlamydia or Phytophthora cinnamomi, to habitat critical to the survival of the koala, that are likely to significantly reduce the reproductive output of koalas or reduce the carrying capacity of the habitat;

This is considered unlikely as there would be no new sources of contamination as a result of the Project. The Project would not lead to Koalas being transported to the site from other areas. If vehicles coming to and from the Mine are considered to be a potential agent of *Phytophthora cinnamomi*, the Project would not lead to a change in the source areas where vehicles travel from to arrive at the Mine and therefore it is not considered that the Project increases the risk of *Phytophthora cinnamomi* spread;

Creating a barrier to movement to, between or within habitat critical to the survival of the koala that is likely to result in a long-term reduction in genetic fitness or access to habitat critical to the survival of the koala.

The proposed disturbance footprint is an extremely small proportion of Koala habitat for the population and the species. Its removal would have a minor impact on patterns of Koala movement and no isolation between populations would occur from the Project; and

Changing hydrology which degrades habitat critical to the survival of the koala to the extent that the carrying capacity of the habitat is reduced in the long-term.

The Project would strive to maintain, pre-development drainage regimes and water quality in areas outside the disturbance footprint. The Project is therefore unlikely to alter the hydrology to the extent that it would result in the degradation of remaining habitat critical to the survival of the Koala.

Conclusion: Impacts from the Project largely relate to the removal of habitat that has been defined as being critical to the survival of the Koala. Such habitat is recognised as critical habitat due to past impacts on similar habitat limiting the Koalas ability to persist throughout its former distribution. The Project includes the removal of 132.4 hectares of critical habitat, which through application of the guidelines is considered a significant impact.

Due to the apparent limited use of the Study Area and its extremely small extent in relation to other habitat where Koala records occur, it is not considered that removal of this habitat alone would significantly adversely impact the relevant Koala population (centred around the Shoalhaven gorge) such that a decline would occur, as active sites for this population are concentrated within protected areas and the Project area is not thought to provide a link between active areas within the population's distribution or to any other Koala population.



Large-eared Pied Bat

Large-eared Pied Bat (Vulnerable)	
Criteria (Vulnerable Species)	Likelihood
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
lead to a long-term decrease in the size of an important population of a species;	
The Large-eared Pied Bat occurs mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW.	
The species requires a combination of sandstone cliff/escarpment to provide roosting habitat that is adjacent to higher fertility sites particularly box gum woodlands or river/rainforest corridors which are used for foraging (Pennay, pers. comm., 2010).	
Within the locality of the Study Area, the Large-eared Pied Bat is known to occur within Bungonia National Park and Morton National Park, which coincides with steep sandstone cliffs which is likely to offer potential roosting habitat for the species, however, the breeding location of the species across the locality, and general distribution of the species are relatively unknown.	
The structure of nursery roosts appears to be very specific, i.e. arch caves with dome roofs (that need to be deep enough to allow juvenile bats to learn to fly safely inside) and with indentations in the roof (presumably to allow the capture of heat). These physical characteristics are very uncommon in the landscape and therefore a limiting factor.	
No roost sites occur within the Study Area, and no known roost sites occur within close proximity to the Study Area.	
One cave is known to occur within 900m of the Study Area, known as Main Gully Spring (Bauer and Bauer 1998). The cave is located beneath the Mine and in periods of high discharge this cave acts as an overflow. A number of chambers and tunnels are described as occurring in this cave by Baeuer and Bauer (1998) including a chamber 1 m x 2.7 m wide.	Unlikely
Main Gully Spring is a potential bat roosting site. It could not be inspected during the current field survey due to safety and access issues. However, a site inspection by Boral representatives accompanied by an experienced caver was undertaken in August 2017 at the base of the cave, and approximately 10 meters inside the entrance. During the site inspection, approximately 5 microbats were observed. It was not possible to determine the species from photographs that were provided. As such, it is not possible to state with certainty that a maternal roost could not be established for Large-eared Pied Bat. However, whilst microbats were recorded it is unlikely that long-term maternity roosts would be established in the Main Gully Spring cave due to its limited size and occasional inundation of most, if not all parts of the cave, it is highly unlikely that the Main Gully Spring Cave would experience any impact associated with the Project. This is due to the distance of the subject cave from the Mine expansion activities that involve mining and blasting which is to occur over 900 metres to the north. There has been an ongoing history of mining within the existing south pit throughout which any roosting bats would	
have persisted if present. The Project is not forecast to increase noise or vibration to the subject cave or any other known caves in the locality. As such, the Project is unlikely to impact upon any roosting/breeding site for the Large-eared Pied Bat.	



Areas of vegetation within 2 km of sandstone cliffs and known potential habitat area likely to be used as foraging habitat for the species. The Large-eared Pied Bat is known to forage in a range of vegetation types, including dry and wet sclerophyll forest, grassy woodland, Callitris dominated forest, tall open eucalypt forest with a rainforest sub-canopy, sub-alpine woodland and sandstone outcrop country (Hoye & Dwyer 1995; Pennay 2002; DECC 2007). Foraging habitat on fertile soils (or within fertile valleys) is also considered an important overall requirement for the Large-eared Pied Bat (Pennay 2008), however the species has been recorded extensively within sandstone associated vegetation, indicating that whilst foraging habitat on fertile soils is likely to be important, foraging would by no means be confined to such areas.

Given the Study Area occurs within 2km of Bungonia Gorge, and the cliffs/steep slopes of Barbers Creek, native vegetation within the Study Area may be utilised as foraging habitat. This is supported during our field investigations whereby the Large-eared Pied Bat was recorded with the Study Area and surrounds (Figure 17). As such, the area of foraging habitat within the Study Area includes PCTs with a 'moderate condition' class, and 'Acacia condition' class. PCTs that have been assigned a 'poor' or 'non-EEC water dependant' condition class have been excluded from the foraging habitat given these habitat types are not described in BioNet Atlas nor the Recovery Plan as being areas of important foraging. Approximately 140.3 ha of habitat for the Large-eared Pied Bat has therefore been mapped within the Study Area, which would be directly impacted by the Project.

Most of the foraging habitat to be removed associated with the Project occurs on fertile soils that are connected indirectly to areas of sandstone outcrops within Morton National Park and Bungonia State Conservation Area via vegetated links, though, it should be noted that the linkages are relatively limited to the direct east of the Study Area given the Marulan South Mine.

Within the locality of the Study Area (attributed to a 5km radius of the Study Area), we have mapped 6,364.6 ha of potential foraging habitat. The mapping has taken into consideration vegetation communities associated with the Large-eared Pied Bat (as per Bionet), and that occur within 2km of steep slopes/cliffs/gorges. It should be noted that this may be a slightly conservative estimate, as we recorded the Large-eared Pied Bat approximately 3km from the gullies of Bungonia and Barbers Creek (Figure 17).

Despite the loss of foraging vegetation due to the Project, approximately 6,364.6 ha ha of potential foraging habitat would remain within the locality. This is largely attributed to the conservation areas protecting foraging habitat within Morton National Park and Bungonia Conservation Area, and the steeper vegetated land within private properties that is unlikely to be developed or grazed.

The removal of foraging habitat is unlikely to cause a long-term decrease to any population of the species given the availability of habitat within the conservation areas and given the disturbance is not impacting roosting habitat. It should be further noted that upon Project decommissioning, the Study Area would be rehabilitated to create a woodland structure, thus providing future Large-eared Pied Bat habitat.

reduce the area of occupancy of an important population;

Within the locality of the Study Area (attributed to a 5km radius of the Study Area), we have mapped 6,364.6 ha of potential foraging habitat. The mapping has taken into consideration vegetation communities associated with the Large-eared Pied Bat (as per Bionet), that occur within 2km of steep slopes/cliffs/gorges. The Project will result in the direct impact to 140.3 ha of foraging habitat for the species, which equates to 2 % of potential foraging habitat for the Large-eared Pied Bat. The remaining habitat in the locality is largely protected within Morton National Park and Bungonia Conservation Area, and the steeper vegetated land within private properties that is unlikely to be developed or grazed. Given such protected areas, it is unlikely that the availability of foraging habitat would be significantly impacted as a result of the Project, such that the species would be significantly disrupted and leave occupancy of the area.

Marginal



The removal of foraging habitat associated with the Project is unlikely to result in any population being displaced its current occupancy given the availability of foraging habitat available, and given no roost sites would be impacted.	
fragment an existing important population into two or more populations;	
The Project would result in the clearing of approximately 140.3 ha of foraging habitat around the existing Marulan South Quarry. It will therefore extend the existing area of cleared land associated with the mine.	
The Study Area is already fragmented from cliffs lines and rock outcrops along Bungonia Gorge and Shoalhaven River where the species is likely to roost. In particular, the Study Area is obstructed to the immediate east by the Marulan South Quarry. However, despite such fragmentation, the species was recorded across the Study Area and surrounds which suggests that the species is relatively mobile being able to utilise thin vegetative corridors and open areas.	
The Project will increase the current cleared land and reduce the amount of foraging habitat by 2 %, however it is unlikely that expanding the currently fragmented vegetation corridor would result in any significant disturbance to a population resulting that population to be split into two or more, given the extent of habitat available within in Morton National Park and Bungonia State Conservation Area that provides formal protection of a Large-eared Pied Bat habitat including that of breeding and roosting habitat.	Unlikely
No roosting habitat would be directly or indirectly impacted by the Project, thus the Project will not fragment known breeding areas.	
Based on the mobility of the species; the foraging habitat that will not be impacted; and given no roosting habitat would be impacted, it is therefore	
unlikely that a population of the species would be fragmented into two or more populations.	
unlikely that a population of the species would be fragmented into two or more populations. adversely affect habitat critical to the survival of a species;	
unlikely that a population of the species would be fragmented into two or more populations. adversely affect habitat critical to the survival of a species; Habitat critical to the survival of the species is discussed in the DERM (2011) Large-eared Pied Bat Recover Plan, and includes roosting habitat and 'sandstone cliffs and fertile wooded valley habitat within close proximity of each other'.	
unlikely that a population of the species would be fragmented into two or more populations. adversely affect habitat critical to the survival of a species; Habitat critical to the survival of the species is discussed in the DERM (2011) Large-eared Pied Bat Recover Plan, and includes roosting habitat and 'sandstone cliffs and fertile wooded valley habitat within close proximity of each other'. Foraging habitat within close proximity to cliff lines or rock outcrops of the type to be removed by the Project has been considered important for the species.	
unlikely that a population of the species would be fragmented into two or more populations. adversely affect habitat critical to the survival of a species; Habitat critical to the survival of the species is discussed in the DERM (2011) Large-eared Pied Bat Recover Plan, and includes roosting habitat and 'sandstone cliffs and fertile wooded valley habitat within close proximity of each other'. Foraging habitat within close proximity to cliff lines or rock outcrops of the type to be removed by the Project has been considered important for the species. Approximately 140.3 ha of habitat for the Large-eared Pied Bat has been mapped within the Study Area, which would be directly impacted by the Project. The Large-eared Pied Bat is unlikely to rely solely on the Study Area as its only source of foraging habitat for the population survival.	
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meters inside the entrance. During the site inspection, approximately 5 microbats were observed. It was not possible to determine the species from



photographs that were provided. As such, it is not possible to state with certainty that a maternal ro However, whilst microbats were recorded it is unlikely that long-term maternity roosts would be est limited size and occasional inundation of most, if not all parts of the cave in times of high flow. Regardless of whether bat roosting or breeding occurs within the cave, it is highly unlikely that the N associated with the Project. This is due to the distance of the subject cave from the Mine expansion occur over 900 metres to the north. There has been an ongoing history of mining within the existing have persisted if present. The Project is not forecast to increase noise or vibration to the subject cave the Project is unlikely to impact upon any roosting/breeding site which would be an adverse impact	Main Gully Spri activities that south pit thro ve or any other to the Large-e	be establish e Main Gully ng Cave wo involve min ughout whi known cave ared Pied B	ed for Large-eared Pied Bat. y Spring cave due to its uld experience any impact ing and blasting which is to ch any roosting bats would es in the locality. As such, at	
disrupt the breeding cycle of an important population				
The Project is unlikely to disrupt the breeding cycle of the species as breeding events for this species primarily take place within caves or other suitable roost habitats, none of which are expected to be impacted by the Project.				
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that	at the species is	likely to de	ecline;	
Therefore it is highly unlikely that any roosting habitat will be impacted by the Project that would ca Approximately 140.3 ha of habitat for the Large-eared Pied Bat has been mapped within the Study A The foraging habitat is made up of the following vegetation communities, which have been historica	ause the specie Area, which wo ally grazed and	s to decline uld be direc cleared:	ctly impacted by the Project.	
PCT recorded within Study Area	condition	Area (ha)		
PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670)	Medium	48.8		
PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670)	Acacia	7.9		
PCT 778 Coast Grey Box – stringybark dry woodland on slopes of the Shoalhaven Gorges -Southern Sydney Basin (SR534)	Medium	57.9		
PCT 1150 - Silvertop Ash - Blue-leaved Stringybark shrubby open forest on ridges, north east South Eastern Highlands Bioregion (SR624)	Medium	13.7		Unlikely
PCT 731 - Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion (SR524)	Medium	12.0		c milely
Total area of habitat for Large-eared Pied Bat		140.3		
The foraging habitat is currently fragmented from cliffs lines and rock outcrops along Bungonia Gorg roost. In particular, the Study Area is obstructed to the immediate east by the Marulan South Quarr was recorded across the Study Area and surrounds which suggests that the species is relatively mob open areas. As previously detailed, within the locality of the Study Area (attributed to a 5km radius of the Study foraging habitat (Figure 17). The mapping has taken into consideration vegetation communities asso and that occur within 2km of steep slopes/cliffs/gorges. Much of this foraging habitat is formally pro-	ge and Shoalha y. However, de bile being able t Area), we have ociated with th otected within	ven River w espite such f to utilise thi e mapped 6 e Large-ear Morton Nat	where the species is may fragmentation, the species n vegetative corridors and ,364.6 ha of potential ed Pied Bat (as per Bionet), tional Park and Bungonia	



the immediate locality, it seems unlikely that the clearing of foraging habitat within the Study Area would limit habitat to an extent to which the species would decline.	
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;	
The Project is unlikely to increase invasive species being established in adjacent areas that would impact upon the Large-eared Pied Bat, due to the following: - It is unlikely that invasive weeds would spread into adjacent areas given Boral would implement weed control and suppression activities detailed in the Biodiversity Management Plan. Boral is currently undertaking such activities for their operations. For instance, Boral has undertaken weed control measures such as weed spraying (in particular targeting serrated tussock), aerial spraying, and pest control on their lease holding. Boral would maintain such mitigation measures to ensure that indirect impacts are reduced (as detailed in section 8.4.4) - Potential invasive predators such as the fox are already present within the Project area and immediate surrounds as evident during our field survey sightings. Boral will continue their current pest management to reduce any potential for pests to occur within adjacent foraging habitat.	Unlikely
introduce disease that may cause the species to decline, or	
There are no known documented diseases that are currently contributing to the decline of the species. The Project is not expected to cause an increased risk of any bat diseases.	Unlikely
interfere substantially with the recovery of the species.	
The overall objective of the DERM (2011) National recovery plan for the large-eared pied bat Chalinolobus dwyeri, is to 'ensure the persistence of viable populations of the large-eared pied bat throughout its geographic range'. Management practices that will protect large-eared pied bat populations include: 1. Regulation of underground or open cut mining in the vicinity of known or potential roosts; 2. Management of recreational activities such as bushwalking, caving and abseiling in the vicinity of known or potential roosts; 3. Management practices aimed at reducing the impacts of grazing by sheep, cattle or goats in the vicinity of known or potential roosts; 4. Regulation of vegetation clearing or logging within the vicinity of known or potential roosts; 5. Feral animal control; and 6. Fire management regimes designed to maintain a variety of habitat types within mosaics. Much of the management priority actions listed above are focused around roost sites. The Project will not result in a direct or indirect impact to roost sites. The Project is unlikely to exacerbate indirect impacts (such as feral pest control) or grazing activities that may impact upon adjacent areas of habitat. As per the responses to the questions listed throughout this Assessment of Significance, it seems unlikely that the Project would significantly alter the persistence of the Large-eared Pied Bat through its geographic range. As such, the Project is not conflicting substantially to the recovery of the species.	Unlikely
Conclusion: Impacts from the Project relate to the removal of netential foraging babitat for the Large eared Died Pat. Whilst protection of foraging babitat is	considered

Conclusion: Impacts from the Project relate to the removal of potential foraging habitat for the Large-eared Pied Bat. Whilst protection of foraging habitat is considered important for this species, impacts from the Project are not considered to be significant for the following reasons:



- No roosting or breeding habitat would be impacted by the Project
- The habitat to be removed is not considered to be particularly important foraging habitat in terms of its constitution or size
- Much of the foraging habitat is currently protected within Morton National Park and Bungonia State Conservation Area which occur to the south and east of the Study Area. As such, the foraging habitat protected within these reserves would remain used by the Large-eared Pied Bat population thus unlikely for the species to decline in the locality.
- The Project is unlikely to result in a population being fragmented into two or more populations
- The Project is unlikely to impact the breeding lifecycle of the species.
- The removal of habitat within the Study Area is unlikely to result in a decline of the species.
- Important foraging habitat occurs throughout the locality including within protected areas. Thus the species is not solely reliant upon the Study Area for survival.
- Indirect impacts into adjacent potential foraging habitat are likely to be minimal given the mitigation measures that would be undertaken.



Grey-headed Flying Fox

Grey-headed Flying-fox (Vulnerable)				
Criteria (Vulnerable Species)				Likelihood
An action is likely to have a significant impact on a vulnerable species if there is a real chance or post	sibility that it v	vill:		
lead to a long-term decrease in the size of an important population of a species;				
The field survey and analysis confirmed that no camp/breeding/roosting sites occur within the Study camp site is located in Moss Vale which occurs approximately 30 km north of the Study Area. Given the distance from known camp sites, the Project will not directly or indirectly impact roosting/breed Impacts from the Project constitute impacts to foraging habitat. As discussed in section 8.4.6, foraging broad as the species is a canopy-feeding frugivore and nectarivore, which utilises vegetation communicate open woodlands, Melaleuca swamps and Banksia woodlands. It also feeds on commercial fruit crops primary food source is blossom from Eucalyptus and related genera but in some areas it also utilises. Given relatively broad foraging preferences, all eucalypt dominated vegetation zones within the Study habitat for the species. We have therefore determined that approximately 140.3 ha of foraging habitat vegetation zones occur within the Study Area:	y Area and imm the absence of ling habitat. ng habitat for unities includin s and on introc a wide range dy Area have b itat for the spe	nediate surr f camp sites the Grey-he g rainforest luced tree s of rainforest peen conserv cies, made u	ounds. The closest known within the Study Area, and aded Flying Fox is relatively s, open forests, closed and pecies in urban areas. The t fruits (Eby 1998). vatively considered foraging up of the following	
PCT recorded within Study Area	Vegetation zone condition	Area (ha)		
PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670)	Medium	48.8		
PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670)	Acacia	7.9		Unlikely
PCT 778 Coast Grey Box – stringybark dry woodland on slopes of the Shoalhaven Gorges -Southern Sydney Basin (SR534)	Medium	57.9		
PCT 1150 - Silvertop Ash - Blue-leaved Stringybark shrubby open forest on ridges, north east South Eastern Highlands Bioregion (SR624)	Medium	13.7		
PCT 731 - Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion (SR524)	Medium	12.0		
Total area of habitat for Large-eared Pied Bat		140.3		

The 140.3 ha of potential foraging habitat would be cleared for the Project.

Whilst we have approached this assessment by taking a conservative approach to the area of potential foraging habitat, it is important to note that vegetation communities and preference tree species within the core range of Grey-headed Flying Foxes have been ranked in terms of importance as feeding habitat in Eby and Law (2008). Within the South-eastern region, this includes twenty-six species of plants in the nectar diet of Grey-headed flying foxes occur in the SENSW region including one hybrid). We have completed a review of the feed trees in comparison to the vegetation mapped within and immediately adjacent to the Study Area (section 8.4.6).

We concluded that 6,541 ha of vegetation containing a preference feed trees (as per bionet) occurs within the Study Area.


Our analysis demonstrates that important foraging habitat is not limited to the Study Area, rather is occurs widely throughout the locality. The significance of foraging habitat within the Study Area that would be impacted by the Project is therefore not expected to be high as the expanse of similar foraging habitat within the locality is high as shown on Figure 18. As such, we concluded that whilst the Project would remove 140.3 ha of potential foraging habitat, a relatively large amount would remain within the locality thus it is reasonable to concluded that the Project would not cause a long-term decrease to any population of the species. reduce the area of occupancy of a important population; The Grey-headed Flying Fox forage opportunistically, often at distances up to 30 km from camps, and occasionally up to 60-70 km per night, in response to patchy food resources (Augee and Ford 1999; Tidemann 1999). Given there are no camp sites known within the surrounds of the Study Area, with the closest being in Moss Vale (30 km north of Study Area), it is likely the Grey-headed Flying Fox is travelling at great distance to reach the Study Area. The Study Area may be used on occasion for foraging given the species feeds on a variety of eucalypts, which occur within a wide range vegetation communities. As discussed in section 8.4.6, we have conservatively determined 140.3 ha of potential foraging habitat occurs within the Study Area. Whilst we have approached this assessment by taking a conservative approach to the area of potential foraging habitat, it is important to note that vegetation communities and preference tree species within the core range of Grey-headed Flying Foxes have been identified in terms of importance as feeding habitat in Eby and Law (2008). Within the South-eastern region, this includes 26 species of plants in the nectar diet of Grey-headed flying foxes occur in the South-east NSW region including one hybrid). We have completed a review of the feed trees in comparison to the vegetation mapped within and immediately adjacent to the Study Area (Table 19). Our review has determined that important feed trees (Corymbia gummifera, Eucalyptus amplifolia, E. tereticornis, E. melliodora, E.punctata) are associated within the following PCTs in the Study Area as dominants, or associated canopy species: Unlikely PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland (SR670), •PCT 778 Coast Grey Box – stringybark dry woodland. Based on the 'medium' and 'acacia' condition zones of both PCTs, the area of habitat equates to 114.6 ha. It should be noted however, that in the case of PCT 778 Coast Grey Box – Stringybark dry woodland, the dominant canopy tree present was E. bosistiana, which is not an important feed tree.

In the locality, our review determined that important feed trees (Corymbia gummifera, Eucalyptus amplifolia, E. tereticornis, E. melliodora, E.punctata, Acemena smithii, Syzygium australe) correspond with diagnostic species of the following PCTs (Table 19). The total mapped area of these PCTs within the locality (5km of Study Area) is approximately 6.541 ha.

As shown on Figure 18, the area of potential habitat is not limited to Study Area. In particular, the availability of preference habitat types is scattered throughout the locality.

The reduction of 140.3 ha of potential habitat (including 114.6 ha of vegetation communities containing important feed trees) for the species is relatively minor compared to the availability of habitat across the locality. And furthermore, the proposed development would not restrict the Grey-headed Flying-fox from utilising foraging habitat throughout the locality. We therefore conclude that the Project would not reduce the availability of occupancy for an important population such that any significant disruption to the species would occur.



fragment an existing important population into two or more populations;

The Grev search o resource As discu foraging	y-headed Flying-fox is highly mobile (Menkhorst 1995; Tidemann 1998) and the national population is fluid, moving up and down the east coast in of food. The species may travel at distances up to 30 km from camps, and occasionally up to 60-70 km per night, in response to patchy food es (Augee and Ford 1999; Tidemann 1999). ssed above, the Project would result in the direct clearing of 140.3 ha of native vegetation that we have conservatively assigned as potential habitat.	
Given th The Gree immedia occurs w imposed Given th potentia	The mobile nature of the species, the Grey-Headed Flying Fox would not rely solely on the habitat within the Study Area for its only food source. y-headed Flying Fox may utilise the remaining available habitat throughout the locality as identified in Figure 18. Some of this habit to the ate east, is protected within conservation reserves (Morton National Park, Bungonia Conservation Area), and tracts of Box Gum Woodland that within private property, is to an extent informally protected through the 'Serious and Irreversible Impact Criteria' and 'avoidance measures' in the NSW Biodiversity Conservation Act 2016 (BC Act). The availability of habitat throughout the locality that would not be impacted by the Project, and the mobile nature of the species, the removal of al foraging habitat for the Project would not fragment an important population of the species.	None
adversel	ly affect habitat critical to the survival of a species;	
Habitat (fox. The <u>Critical F</u> DECCW habitat, 1. 2. 3.	critical to the survival of the species has been loosely nominated within DECCW (2009) <i>Draft National Recovery Plan for the Grey-headed Flying</i> - Draft plan contains a definition for critical foraging habitat, and critical roosting habitat which have been addressed below: Roosting Habitat (2009) states that habitat that meets at least one of the following criteria can be explicitly identified as habitat critical to survival, or essential for Grey-headed Flying-foxes. Roosting habitat that: <i>is used as a camp either continuously or seasonally in > 50% of years</i> Response : The Study Area and immediate surrounds are not used as a camp site presently, or historically. The closets known camp site is in Moss Vale, approximately 30km to the north of Study Area. <i>has been used as a camp at least once in 10 years (beginning in 1995) and is known to have contained > 10 000 individuals, unless such habitat has been used only as a temporary refuge, and the use has been of limited duration (<i>i.e. in the order of days rather than weeks or months</i>) Response: As discussed above, the Study Area and immediate surrounds are not used as a camp site presently, or historically. The closets known camp site is in Moss Vale, approximately 30km to the north of Study Area. <i>has been used as a camp at least once in 10 years (beginning in 1995) and is known to have contained > 2500 individuals, including reproductive females during the final stages of pregnancy, during lactation, or during the period of conception (<i>i.e.</i>. September to May). Response: As above - The Study Area and immediate surrounds are not used as a camp site presently, or historically. The closets known camp site is in Moss Vale, approximately 30km to the north of Study Area.</i></i>	Unlikely
Critical F	Foraging Habitat	



None

DECCW (2009) states that foraging habitat that meets at least one of the following criteria can be explicitly identified as habitat critical to survival, or essential habitat, for Grey-headed Flying Foxes. Natural foraging habitat that is:

1. productive during winter and spring, when food bottlenecks have been identified (ParryJones and Augee 1991, Eby et al. 1999):

Response: The DECCW (2009) do not provide guidance around what constitutes a 'productive' natural foraging habitat, nor a 'food bottleneck'. As previously discussed, the Study Area may be used on occasion for foraging given the species feeds on a variety of eucalypts, which occur within a wide range vegetation communities. As discussed in section 8.4.6, we have conservatively determined 140.3 ha of potential foraging habitat occurs within the Study Area. Of this foraging habitat we have determined that PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland (SR670), and PCT 778 Coast Grey Box – stringybark dry woodland, is likely to be favourable given the presence of important feed trees: *Eucalyptus melliodora* and *E. tereticornis.* However, both tree species alone would not support the Grey-headed Flying Fox during both winter and spring given the flowering times of both eucalypts.

Similar potential foraging habitat is relatively available throughout the locality which contain important feed trees, including *E. melliodora, E. tereticornis, E.punctata, Pittosporum undulatum* and *Syzygium smithii,* and are shown in Figure 18. As indicated by the Figure, the foraging habitat to the immediate east are likely to be in a better condition to that of the Study Area, given historic vegetation clearing and grazing has not occurred. As such, whilst the site does contain potential foraging habitat, it is unlikely to be of significantly productive during both winter and spring to an extent that it is critical foraging habitat for the species.

- known to support populations of > 30 000 individuals within an area of 50 km radius (the maximum foraging distance of an adult)
 Response: The Study Area does not support a population of >30,000 individuals. It is highly likely that if the Study Area did provide such habitat, records of the species would have turned up during the field surveys (spotlighting), and greater records would be known from the locality.
- productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (September to May)
 Response: No, the Study Area is highly unlikely to be productive for the species given absence of roost sites and the distance from known camps. As discussed above, the locality contains important feed trees and foraging habitat that is not impacted by the Project.
- 4. productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes (months vary between regions)

Response: No, the Study Area is highly unlikely to be productive for the species given absence of roost sites and the distance from known camps. No commercial crops or important commercial fruit trees would be impacted by the Project.

5. known to support a continuously occupied camp

Response: No camp site occur within the Study Area. No known camp sites occur within the locality (within 5km of the Study Area). It should be noted that our survey involved traversing into Bungonia Gorge, Barbers Creek and parts of the Shoalhaven River, which confirmed camp sites do not occur.

disrupt the breeding cycle of an important population

The Project is unlikely to disrupt the breeding cycle of the species as breeding events for this species primarily take place within camps, none of which would be adversely impacted by the Project. There are no known camps mapped within 20km of the Study Area.



modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;			
The Grey-headed Flying Fox forage opportunistically, often at distances up to 30 km from camps, and occasionally up to 60-70 km per night, in response to patchy food resources (Augee and Ford 1999; Tidemann 1999).			
Given there are no camp sites known within the surrounds of the Study Area, with the closest being in Moss Vale (30 km north of Study Area), it is likely the Grey-headed Flying Fox is travelling at great distance to reach the Study Area.			
As discussed in section 8.4.6, we have conservatively determined 140.3 ha of potential foraging habitat occurs within the Study Area. Of this foraging habitat we have determined that that PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland (SR670), and PCT 778 Coast Grey Box – stringybark dry woodland, are likely to be favourable given the presence of important feed trees: <i>Eucalyptus melliodora</i> and <i>E. tereticornis</i> .			
As detailed in section 8.4.6, in order to determine the availability of habitat within the locality (which we have conservatively assigned to a 5km radius of the Study Area for this assessment), we have compared the important feed trees detailed in Eby (2008), to that of regional vegetation mapping.			
As shown on Figure 18, the area of potential habitat is not limited to Study Area. In particular, the availability of preference habitat types is scattered throughout the locality.	Unlikely		
Given the mobile nature of the species, the Grey-Headed Flying Fox would not rely solely on the habitat within the Study Area for its only food source. The Grey-headed Flying Fox may utilise the remaining available habitat throughout the locality as identified in Figure 18. Some of this habit to the immediate east, is protected within conservation reserves (Morton National Park, Bungonia Conservation Area), and tracts of Box Gum Woodland that occurs within private property, is to an extent informally protected through the 'Serious and Irreversible Impact Criteria' and 'avoidance measures' imposed in the NSW Biodiversity Conservation Act 2016 (BC Act).			
The reduction of 140.3 ha of potential foraging habitat for the species is relatively minor compared to the availability of habitat across the locality. And furthermore, the proposed development would not restrict the Grey-headed Flying-fox from utilising foraging habitat throughout the locality. We therefore conclude that the Project would not modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.			
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;			
 The Project is unlikely to increase invasive species being established in adjacent areas that would impact upon the Grey-Headed Flying Fox, due to the following: It is unlikely that invasive weeds would spread into adjacent areas given Boral would implement weed control and suppression activities detailed in the Biodiversity Management Plan. Boral is currently undertaking such activities for their operations. For instance, Boral has undertaken weed control measures such as weed spraying (in particular targeting serrated tussock), aerial spraying, and pest control on their lease holding. Boral would maintain such mitigation measures to ensure that indirect impacts are reduced (as detailed in section 8.4.4) Potential invasive predators such as the fox are already present within the Project area and immediate surrounds as evident during our field survey sightings. Boral will continue their current pest management to reduce any potential for pests to occur within adjacent foraging habitat. 	Unlikely		
introduce disease that may cause the species to decline, or			



There are no known documented diseases that are currently contributing to the decline of the species. The Project in not expected to cause an increased risk of any bat diseases.	Unlikely
interfere substantially with the recovery of the species.	
The Project does not directly or substantially interfere with any of the specific recovery objectives under the National Recovery Plan (DECCW 2009). A general objective is to lessen the currently operating threats to the species which includes the removal of foraging habitat. The Project is therefore not consistent with this general objective. However the level and type of foraging habitat removal is not considered to constitute substantial interference with the recovery of the species. Furthermore, as discussed above, the Project would not result in an impact to critical roosting habitat or critical foraging habitat as defined in DECCW (2009).	Unlikely
 Conclusion: Impacts from the Project relate to the removal of potential foraging habitat for the Grey-headed Flying-fox. Whilst protection of foraging habitat important for this species, impacts from the Project are not considered to be significant for the following reasons: No roosting habitat would be impacted by the Project No critical foraging habitat would be impacted by the Project The habitat to be removed is not considered to be particularly important foraging habitat in terms of its constitution or size Similarly important foraging habitat occurs throughout the locality including within protected areas Indirect impacts into adjacent potential foraging habitat are likely to be minimal given the mitigation measures that would be undertaken. 	t is considered



Regent Honeyeater

Regent Honeyeater	
Criteria (Critically Endangered Species)	Likelihood
An action is likely to have a significant impact on a Critical Endangered species if there is a real chance or possibility that it will:	
lead to a long-term decrease in the size of an important population of a species;	
The Regent Honeyeater is endemic to mainland south-east Australia, and has a patchy distribution which extends from south-east Queensland, through	
New South Wales (NSW) and the Australian Capital Territory (ACT), to central Victoria. The Study Area is within the distribution range of the species. It	
does not occur within the four known key breeding areas where the species is regularly recorded. These are the Bundarra-Barraba, Capertee Valley and	
Hunter Valley districts in New South Wales, and the Chiltern area in north-east Victoria.	
The species is highly mobile, occurring only irregularly in most sites, and in variable numbers, often with long periods with few observations anywhere. This	
presents an obstacle when confirming presence/absence or likely usage of the site, and thus we have approached this assessment by completing a field	
survey, and analysing previous consultant surveys at the mine, and historic surveys of the site and surrounds.	
During our analysis, we did not record the species, nor any historic records within the Study Area and immediate surrounds. Only three historical records	
have been made since 1983 within 12 km of the Study Area as per below:	
- Approximately 4.8 km south of the Study Area near Lockdown Road, Bungonia. This record was in made in 2005 within a gully environment near Bungonia	
Creek weir.	
- Approximately 5 km south of the Study Area near the Bungonia State Conservation Area office. This record was made in 1998.	Unlikely
- Approximately 11.9 km south of the Study Area within private property. This record was made in 1983.	
Given Bungonia State Conservation Area and Morton National Park are relatively popular for bird watchers, if the Regent Honeyeater were to frequent the	
area, it seems reasonable to suggest that the records would be greater than three records within 36 years.	
The species is known to be most commonly associated with box-ironbark eucalynt woodland and dry scleronbyll forest, but also inhabits riparian vegetation	
and lowland coastal forest. In addition it can be found in a range of other habitats including remnant trees in farmland, roadside reserves and travelling	
stock routes, and in planted vegetation in parks and gardens. Principally a canopy bird, it is reliant on select species of eucalypt and mistletoe which provide	
rich nectar flows.	
The Study Area did not contain a Ironbark-Box association, however the Study Area did contain Eucalyptus melliodora (Yellow Box). The soils across the	
Study Area are not fertile rich given the sandstone influence, and the landscape position of the Yellow Box dominated communities (PCT1334) are located	
away from riparian areas which the species prefers. As such, the habitat present is different in some respects to common habitat where the species is found.	



Regardless, given the species can utilise a range of habitat types (plantings, gardens, dry sclerophyll forest) on occasion we have conservatively estimated 140.3 ha of foraging habitat occurs in the Study Area. This is made up of the following vegetation zones:

PCT recorded within Study Area	Vegetation zone condition	Area (ha)
PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670)	Medium	48.8
PCT 1334 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (SR670)	Acacia	7.9
PCT 778 Coast Grey Box – stringybark dry woodland on slopes of the Shoalhaven Gorges -Southern Sydney Basin (SR534)	Medium	57.9
PCT 1150 - Silvertop Ash - Blue-leaved Stringybark shrubby open forest on ridges, north east South Eastern Highlands Bioregion (SR624)	Medium	13.7
PCT 731 - Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion (SR524)	Medium	12.0
Total area of habitat for Large-eared Pied Bat		140.3

Any population of the Regent Honeyeater should be regarded as an important population given the status of the species is Critically Endangered. A longterm population decrease due to the removal of the habitat within the Study Area seems unlikely given the habitat present is not favourable when compared to the descriptions provided in the Recovery Plan.

Within the locality of the Study Area (attributed to a 5 km radius of the Study Area), we have attempted to map the area of foraging habitat for the species using existing vegetation mapping. We have used the Tozer et al (2006) mapping Project, and corresponded the vegetation communities to PCTs that are associated with the Regent Honeyeater as per Bionet. The mapping determined that 9,672 ha of potential habitat occurs within the locality, including 1,798 ha of Box-Ironbark PCTs for which the species prefers as per the habitat descriptions for the species on bionet (Figure 19).

The Project would impact 1.5% of foraging habitat within the locality, and 7.8% of favourable habitat (Box-Ironbark PCTs) noting that a large portion is protected within conservation areas. As such, it seems unlikely that the removal of potential foraging habitat in the Study Area would be such that the population would decline in the long-term due to decline in habitat in the locality.

reduce the area of occupancy of an important population;

The Regent Honeyeater is not known to occupy the Study Area, and the cryptic nature of its movement patters presents a great difficulty in understanding its use across its distribution range. As stated in 8.4.8, it is noted that the species is highly mobile, occurring only irregularly in most sites, and in variable numbers, often with long periods with few observations. The species has not been recorded within the Bungonia region for over 36 years (section 8.4.8), which tends to indicate it must be a highly irregular for the species to utilise the area during migration.

Conservatively, we have assigned 140.3 ha of potential habitat as within the Study Area that would be directly impacted by the Project. As previously Unlikely discussed, this amount represents 1.5% of foraging habitat within the locality, and 7.8% of favourable habitat (Box-Ironbark PCTs) within the locality, and thus seems unlikely that the Project would significantly reduce the ability for the species to occupy the locality. Furthermore, given the availability of habitat in the locality, it seems unlikely that the species would have limited foraging resources, and the species migration patterns would be altered. We therefore conclude that it is unlikely that the Project would reduce the area of occupancy of the Regent Honeyeater.

fragment an existing important population into two or more populations;



The Regent Honeyeater comprises a single population, with some exchange of individuals between regularly used areas (Garnett et al., 2011). No population is known to occur within the Study Area or the Bungonia region on regular basis, which is reflective of the lack of records over the past 36 years. Given Bungonia is a popular birding spot, it seems likely that regular usage of the wider area by the species would result in greater records. The Project through clearing of potential foraging habitat is unlikely to increase fragmentation for any population of the species. The Regent Honeyeater is a mobile species and would still have movement within the surrounding areas of potential habitat as shown in Figure 19. In particular, Morton National Unlikely Park and Bungonia State Conservation Area present a protected intact vegetated movement and shelter corridor should the species were to move through the Bungonia area. As such, it seems unlikely that any movement patterns would be obstructed such that a population would be split in two or more. Furthermore, the Project would not impact any known breeding sites. We therefore conclude that it is highly unlikely the Project would result in the fragmentation of a population into two or more populations. adversely affect habitat critical to the survival of a species; The National Recovery Plan for the Regent Honeyeater (Anthochaera phrygia) identifies the following as habitat critical to the survival of the regent honeyeater: 1. 'Any breeding or foraging areas where the species is likely to occur. 2. Any newly discovered breeding or foraging locations.' Any breeding or foraging areas where the species is likely to occur No breeding habitat occurs within the Study Area. Within its current distribution there are four known key breeding areas where the species is regularly recorded. These are the Bundarra-Barraba, Capertee Valley and Hunter Valley districts in New South Wales, and the Chiltern area in north-east Victoria. Breeding has also been regularly recorded in the Cement Mills-Durakai area west of Warwick, southern Queensland and in the Australian Capital Territory. No breeding areas would be impacted. Unlikely In terms of foraging habitat, is it not possible to exclude any area of native vegetation with absolute certainty within the movement corridors of the species given the Regent Honeyeater can utilise a wide range of habitat types including that of orchards and urban gardens. However, the likelihood for the Regent Honeyeater to have foraging habitat with the Study Area and use it on a regular or intermittent basis seems relatively low given the species was not detected during field surveys, and the sparse records for the species with the locality over the past 30 years. Based on this, it is unlikely that the habitat within the Study Area supports foraging habitat where the species is likely to occur on a regular/permanent basis. Any newly discovered breeding or foraging locations As discussed above, the Study Area would not impact upon any breeding habitat. The potential foraging habitat within the Study Area is unlikely to be

Based on the above response, it seems unlikely that critical habitat as described in the National Recovery Plan would be impacted by the Project.

utilised on a permanent, or semi-permanent basis given the absence of records.



disrupt the breeding cycle of an important population

Within its current distribution there are four known key breeding areas where the species is regularly recorded. These are the Bundarra-Barraba, Capertee Valley and Hunter Valley districts in New South Wales, and the Chiltern area in north-east Victoria. Breeding has also been regularly recorded in the Cement Mills-Durakai area west of Warwick, southern Queensland and in the Australian Capital Territory. None of these breeding areas would be impacted by the Project.

There appears to be regular movements by the species but there is also a high level of variability in the timing and pattern of movements between years, with seasonal patterns of abundance and breeding related to regional patterns in the flowering of key species (Franklin et al., 1989; Ley et al., 1996; Menkhorst 1997). Accumulated evidence from banded birds has shown that individuals may return to the same area in successive breeding seasons (Ley et al., 1996; Geering & French 1998). Conversely, some birds also change breeding sites from one season to another. Given the absence of records within the bungonia region for over 36 years, it seems unlikely that the removal of potential habitat within the Study Area would result in a change in flight movement resulting in a decline in breeding patterns for species.

modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

Most records of regent honeyeaters come from box-ironbark eucalypt associations, where the species seems to prefer more fertile sites with higher soil water content, including creek flats, broad river valleys and lower slopes. Other forest types regularly utilised by regent honeyeaters include wet lowland coastal forest dominated by swamp mahogany (Eucalyptus robusta), spotted gum-ironbark associations and riverine (Menkhorst, 1997; Geering & French, 1998; Oliver et al., 1998; Oliver et al., 1999).

This riparian habitat is also selected as breeding habitat in some years (Geering and French, 1998; Oliver et al., 1998; Oliver et al., 1999). Often this is adjacent to box-ironbark woodland. Remnant stands of timber, roadside reserves, travelling stock routes and street trees also provide important habitat for regent honeyeaters at certain times (Franklin et al., 1987, 1989; Ley & Williams, 1992; Webster & Menkhorst, 1992; Oliver, 1998).

Like other species of honeyeater, the regent honeyeater utilises a variety of food resources. Its diet primarily consists of nectar, but also includes invertebrates (mostly insects) and their exudates (e.g. lerps and honeydew), and occasionally fruit. Nectar is obtained chiefly from eucalypts and mistletoe, and regent honeyeaters appear reliant on select species which provide reliable nectar flows. Regent honeyeaters prefer taller and larger diameter trees for foraging, as these typically produce more nectar (Franklin et al., 1989; Webster & Menkhorst 1992; Menkhorst et al., 1999; Oliver 2000).

Unlikely

The habitat types within the Study Area does not neatly match up with the preferred habitat for the Regent Honeyeater. For instance, the Study Area:

- The Study Area is typically not located within high fertile soils with high water content which the species tends to prefer.
- The potential habitat within the Study Area is located away from riparian areas.
- The Study Area does not contain a Box-Ironbark eucalypt combination which the species prefers
- The Study area lacks taller and larger diameter trees which the species prefers.

Furthermore, no population is known to occur within the Study Area or the Bungonia region on regular basis, which is reflective of the lack of records over the past 36 years. Given Bungonia is a popular birding spot, it seems likely that regular usage of the wider area by the species would result in greater records. This could indicate that the use of the Study Area by the Regent Honeyeater on a permanent, semi-permanent or even an intermittent basis for foraging, is unlikely.



However, we acknowledge the species can utilise a range of habitat types (plantings, gardens, dry sclerophyll forest), and may only visit an area intermittently over decades. Therefore, it not possible to exclude habitat from being used, and have conservatively estimated 140.3 ha of foraging habitat occurs in the Study Area.

The 140.3 ha would be directly impacted for the Project via unavoidable vegetation clearing. The habitat to be cleared has already been impacted by historic clearing events and high levels of weed and pest occurrence (eg. goats) (section 4.4 and 4.4.1).

Within the locality of the Study Area (attributed to a 5 km radius of the Study Area), we have attempted to map the area of foraging habitat for the species using existing vegetation mapping. We have used the Tozer et al (2006) mapping Project, and corresponded the vegetation communities to PCTs that are associated with the Regent Honeyeater as per Bionet. The mapping determined that 9,672 ha of potential habitat occurs within the locality, including 1,798 ha of Box-Ironbark PCTs for which the species prefers as per the habitat descriptions for the species on bionet (Figure 19).

The Project would impact 1.5% of foraging habitat within the locality, and 7.8% of favourable habitat (Box-Ironbark PCTs) noting that a large portion is protected within conservation areas. As such, it seems unlikely that the removal of potential foraging habitat in the Study Area would be such that the population would decline in the long-term.

No breeding habitat occurs within the Study Area, and no known breeding areas would be directly or indirectly impacted.

Indirect impacts are also unlikely to cause any substantial impacts to potential foraging habitat. The Project is unlikely to increase the likelihood of invasive weeds being established in potential foraging areas resulting in die back of eucalypts and native vegetation. Mitigation measures, such as weed and pest control would be undertaken as a required. Furthermore, the Project is unlikely to increase pest species, such as more aggressive honeyeaters such as the noisy miner, noisy friarbird and the red wattlebirds) and the honeybee (Apis mellifera) (Menkhorst 1997).

No population is known to occur within the Study Area or the Bungonia region on regular basis, which is reflective of the lack of records over the past 36 years. Given Bungonia is a popular birding spot, it seems likely that regular usage of the wider area by the species would result in greater records. This could indicate that the use of the Study Area by the Regent Honeyeater on a permanent, semi-permanent or even an intermittent basis for foraging, is unlikely.

As such, it seems unlikely that the Project would decrease the availability or quality of habitat to the extent that the species is likely to decline.

result in invasive species that are harmful to a Critically Endangered species becoming established in the species' habitat;

The Project is unlikely to increase the likelihood of invasive weeds being established in potential foraging areas resulting in die back of eucalypts and native vegetation. Mitigation measures have been proposed in section 8.4.4 to mitigate potential weed occurrences.

In relation to pest species, it is known that the Regent Honeyeater's reliance on nectar from a few key species predisposes it to competition from other nectivorous birds (such as more aggressive honeyeaters such as the noisy miner, noisy friarbird and the red wattlebirds) and the honeybee (Apis mellifera) (Menkhorst 1997). It is highly unlikely that the Project would result in an increase in such pest species surrounding the Study Area. The bird surveys and general observations undertaken during our field campaigns certainly did not identify such a threat as occurring at the site.

introduce disease that may cause the species to decline, or

There are no known documented diseases that are currently contributing to the decline of the species. The Project in not expected to cause an increased risk of any bird diseases.

interfere substantially with the recovery of the species.



The main objectives in the National Recovery Plan for the Regent Honeyeater (Anthochaera phrygia) are:

- 'Reverse the long-term population trend of decline and increase the numbers of Regent Honeyeaters to a level where there is a viable, wild breeding population, even in poor breeding years; and to
- Enhance the condition of habitat across the regent honeyeaters range to maximise survival and reproductive success, and provide refugia during periods of extreme environmental fluctuation.'

The Recovery Strategies to achieve the objectives include:

- 'Improve the extent and quality of regent honeyeater habitat.'

Unlikely

As previously discussed, the use of the Study Area by the Regent Honeyeater on a permanent, semi-permanent or even an intermittent basis for foraging, seems unlikely. This is supported by the lack of available records within the wider region for over 36 years. And potential habitat for the species within the Study Area is unlikely to disrupt the breeding cycle and movement patterns of the species, and is unlikely to be important to maximise the species survival and reproductive success. As such, the Project is unlikely to conflict with the overall objective of the Recovery Plan.

In reference to the aim of the Recovery Strategy - 'improve the extent and quality of habitat', the Project would not impact upon 'known habitat' for the species. Rather, the Project will impact 'potential habitat' which we have conservatively assigned despite lacking some key characteristic that the species prefers (eg. Ironbarks, mature trees).

Given these reasons, the Project is unlikely to conflict with the objectives of the Recovery Plan.

Conclusion: It is unlikely that a significant impact to the Regent Honeyeater would occur as a result of the Project due to the following:

- Known breeding habitat will not be impacted by the Project.
- The species has only been detected three times in the past 36 years within the Bungonia region suggesting that the species potential usage of the Study Area is likely to be marginal/low.
- The Project will impact upon 'potential foraging habitat' which we have conservatively assessed. It will not impact upon 'known habitat' or 'critical habitat'.
- The Project is unlikely to impact upon any flight movement of the species, or impact upon the life cycle of the species.
- The Project is unlikely to introduce any invasive species becoming established that would impact upon the species.

Migratory Species

Migratory Species Great Egret, Cattle Egret, Rainbow Bee-eater, Black-faced Monarch, Rufous Fantail

Preamble: The above species all have potential habitat within the Study Area that would be impacted from the proposed action. All of the species subject to this assessment are considered to occur within the Project area on an irregular basis and the habitat within the Project area is similar to widespread and common habitat within the locality for these species.

Criteria (Migratory Species)

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species, or

An area of 'important habitat' for a migratory species is:

a. habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or

Response: The Bungonia region does not support an ecologically significant portion of the population for any of the subject migratory species. The Bungonia region is not specifically mentioned in the migratory species profiles and associated documentation available as an important foraging areas for any of the subject migratory species. Furthermore, there is a general lack of records for the species across the locality (within 10km of the Study Area. An ecological significant population would highly likely have more records.

b. habitat that is of critical importance to the species at particular life-cycle stages, and/or

Response: The habitat with the Study Area is not of critical importance for any threatened migratory species at any lifecycle stage. The Study Area only represents marginal habitat that may be utilised on a irregular basis. No breeding habitat associated with any of the migratory species would be impacted. Unlikely

c. habitat utilised by a migratory species which is at the limit of the species range, and/or

Response: The Study area is not at the limit of each of the migratory species range. All the migratory subject species have relatively wide distribution range in NSW. They may only utilise the potential foraging habitat present within the Study Area on a very irregular basis.

d. habitat within an area where the species is declining.

Response: According to each of the species profiles, the Bungonia region is not specifically mentioned as an area where any of the migratory species is declining. The Study Area only represents potential foraging habitat for each of the migratory subject species, which are unlikely to utilise the site on a regular basis.

result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or



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Likelihood



No invasive species of particular significance to the identified migratory species are expected to be established as a result of the proposed action. The Study Area is already affected by invasive plants including some noxious weeds and introduced fauna such as the fox and goat. Indirect impact, such as weed incursion and feral pests will be specifically targeted via mitigation measures (pest and weed control) in order to prevent decline of habitat within adjacent areas. Through the successful application of mitigation measures, it seem highly unlikely that the Project would result in an increase in invasive species being established in adjacent areas result in a decline in potential habitat.		
seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.		
 The Project is unlikely to seriously disrupt an ecologically significant proportion of any migratory population due to the following: The Bungonia region is not known to support a significant portion of the migratory species populations. The Study Area only contained potential foraging habitat for each of the migratory species. Each of the migratory species has a fairly broad habitat preferences (appendix 1) such that the habitat features of the Study Area cannot be ruled out. It is highly unlikely that the Study Area supports a significant proportion of the migratory species. The Project will not impact upon breeding migration or resting behaviour of any migratory species. 	Unlikely	
 Conclusion: Conclusion: It is unlikely that a significant impact to any migratory species would occur as a result of the Project due to the following: The Study Area and immediate surrounds are not known to support a significant proportion of the migratory species The Study Area is only considered potential foraging habitat due to the broad habitat preferences for each migratory species The potential foraging habitat within the Study Area is not limiting The Project will not impact upon roosting, feeding, breeding or resting behaviour of the migratory species. No critical habitat would be impacted. 		

🖄 Australian Government



Department of the Environment and Energy

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about <u>Environment Assessments</u> and the EPBC Act including significance guidelines, forms and application process details.

Report created: 17/04/20 14:25:58

Summary Details Matters of NES Other Matters Protected by the EPBC Act Extra Information Caveat

<u>Acknowledgements</u>



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates Buffer: 10.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the <u>Administrative Guidelines on Significance</u>.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	5
Listed Threatened Species:	46
Listed Migratory Species:	14

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A <u>permit</u> may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	3
Commonwealth Heritage Places:	None
Listed Marine Species:	21
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	4
Regional Forest Agreements:	1
Invasive Species:	43
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities

[Resource Information]

likely to occur within area

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Illawarra and south coast lowland forest and woodland ecological community	Critically Endangered	Community may occur within area
Natural Temperate Grassland of the South Eastern Highlands	Critically Endangered	Community likely to occur
Southern Highlands Shale Forest and Woodland in the	Critically Endangered	Community likely to occur
Sydney Basin Bioregion Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	Endangered	within area Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area
Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Anthochaera phrygia		
Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus		
Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Grantiella picta		
Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Hirundapus caudacutus		
White-throated Needletail [682]	Vulnerable	Species or species habitat

Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Fish		
<u>Macquaria australasica</u> Macquarie Perch [66632]	Endangered	Species or species

Name	Status	Type of Presence
		habitat may occur within area
Australian Grayling [26179]	Vulnerable	Species or species habitat may occur within area
Frogs		
Heleioporus australiacus		
Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat may occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat may occur within area
Litoria littlejohni Littlejohn's Tree Frog, Heath Frog [64733]	Vulnerable	Species or species habitat may occur within area
Insects		
Synemon plana		
Golden Sun Moth [25234]	Critically Endangered	Species or species habitat likely to occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat known to occur within area
Dasyurus maculatus maculatus (SE mainland population	<u>on)</u>	
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Petauroides volans		
Greater Glider [254]	Vulnerable	Species or species habitat known to occur within area
Petrogale penicillata		
Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat known to occur within area
Phascolarctos cinereus (combined populations of Qld, N	<u>NSW and the ACT)</u>	
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Long-nosed Potoroo (SE Mainland) [66645]	Vulnerable	Species or species habitat may occur within area
<u>Pseudomys novaehollandiae</u> New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat may occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Plants		
<u>Acacia bynoeana</u> Bynoe's Wattle, Tiny Wattle [8575]	Vulnerable	Species or species habitat may occur within area
Caladenia tessellata Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat may occur within area
Commersonia prostrata		
Dwarf Kerrawang [87152]	Endangered	Species or species habitat likely to occur within area
Cryptostylis hunteriana		_
Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Eucalyptus aggregata		
Black Gum [20890]	Vulnerable	Species or species habitat known to occur within area
Eucalyptus aquatica		
Mountain Swamp Gum, Broad-leaved Sallee, Broad- leaved Sally [56173]	Vulnerable	Species or species habitat may occur within area
Eucalyptus macarthurii		
Camden Woollybutt, Paddys River Box [7827]	Endangered	Species or species habitat known to occur within area
Genoplesium baueri		
Yellow Gnat-orchid [7528]	Endangered	Species or species habitat may occur within area
<u>Genoplesium plumosum</u>		
Plumed Midge-orchid, Tallong Midge Orchid [32180]	Endangered	Species or species habitat likely to occur within area
Haloragis exalata subsp. exalata		
Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat known to occur within area
Kunzea cambagei		
[11420]	Vulnerable	Species or species habitat likely to occur within area
Lepidium hyssopifolium		
Basalt Pepper-cress, Peppercress, Rubble Pepper- cress, Pepperweed [16542]	Endangered	Species or species habitat may occur within area
Leucochrysum albicans var. tricolor		
Hoary Sunray, Grassland Paper-daisy [56204]	Endangered	Species or species habitat known to occur within area
Persicaria elatior		
Knotweed, Tall Knotweed [5831]	Vulnerable	Species or species habitat may occur within area
Phyllota humifusa		
Dwarf Phyllota [10133]	Vulnerable	Species or species habitat known to occur within area

Pimelea axiflora subsp. pubescens

Bungonia Rice-flower [21981]

Species or species habitat Endangered known to occur within area Pomaderris cotoneaster Cotoneaster Pomaderris [2043] Endangered Species or species habitat known to occur within area Pomaderris delicata [67208] **Critically Endangered** Species or species habitat likely to occur within area Pomaderris pallida Pale Pomaderris [13684] Vulnerable Species or species habitat known to occur within area Rutidosis leptorrhynchoides Button Wrinklewort [7384] Endangered Species or species habitat may occur within area Thelymitra kangaloonica Kangaloon Sun Orchid [81861] Critically Endangered Species or species habitat may occur within area Thesium australe Austral Toadflax, Toadflax [15202] Vulnerable

Species or species habitat likely to occur within area

Name	Status	Type of Presence
Reptiles		
Aprasia parapulchella		.
Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat likely to occur within area
		-
Delma impar		
Striped Legless Lizard, Striped Snake-lizard [1649]	Vulnerable	Species or species habitat likely to occur within area
Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the	he EPBC Act - Threatened	Species list.
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat
		likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus		
White-throated Needletail [682]	Vulnerable	Species or species habitat
		likely to occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat
		known to occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat
		may occur within area
Mujegra eveneleuse		
<u>Nylagra cyanoleuca</u> Satia Elvastabar [612]		Spaciae er opeciae hebitet
Salin Flycalcher [612]		known to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat
		Known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat

Calidris acuminata

Species or species habitat may occur within area

Sharp-tailed Sandpiper [874]

Calidris ferruginea Curlew Sandpiper [856]

Calidris melanotos Pectoral Sandpiper [858]

Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]

Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]

Pandion haliaetus Osprey [952]

Tringa nebularia Common Greenshank, Greenshank [832] Species or species habitat may occur within area

Critically Endangered Sp

Species or species habitat may occur within area

Species or species habitat may occur within area

Species or species habitat may occur within area

Critically Endangered

Species or species habitat may occur within area

Species or species habitat likely to occur within area

Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land		[Resource Information]
The Commonwealth area listed below may in the unreliability of the data source, all propose Commonwealth area, before making a definit department for further information.	ndicate the presence of Commonwea sals should be checked as to whethe tive decision. Contact the State or Te	alth land in this vicinity. Due to r it impacts on a erritory government land
Name		
Commonwealth Land - Airservices Australia Commonwealth Land - Australian Telecomm Commonwealth Land - Telstra Corporation L	unications Corporation imited	
Listed Marine Species		[Resource Information]
* Species is listed under a different scientific	name on the EPBC Act - Threatene	d Species list.
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat

Pectoral Sandpiper [858]

Chrysococcyx osculans

Black-eared Cuckoo [705]

Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]

Haliaeetus leucogaster White-bellied Sea-Eagle [943]

Hirundapus caudacutus White-throated Needletail [682]

Lathamus discolor Swift Parrot [744]

Merops ornatus Rainbow Bee-eater [670]

Monarcha melanopsis Black-faced Monarch [609]

Species or species habitat likely to occur within area

may occur within area

Species or species habitat may occur within area

Species or species habitat known to occur within area

Vulnerable

Species or species habitat likely to occur within area

Critically Endangered

Species or species habitat likely to occur within area

Species or species habitat may occur within area

Species or species

Name	Threatened	Type of Presence
Motocillo flovo		habitat known to occur within area
Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
<u>Rhipidura rufifrons</u> Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area
Extra Information		
State and Territory Reserves		[Resource Information]
Name		State
Bungonia		NSW
Bungonia		NSW
Forestry Management Areas in Moss Vale (FMZ2) Morton		NSW NSW
Regional Forest Agreements		[Resource Information]
Note that all areas with completed RFAs have been in	ncluded.	
Name		State

Invasive Species

Southern RFA

New South Wales

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

		- (5
Name	Status	Type of Presence
Birds		
Acridotheres tristis		
Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis		
Skylark [656]		Species or species habitat likely to occur within area
Anas platvrhvnchos		
Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis		
European Goldfinch [403]		Species or species habitat likely to occur within area
Carduelis chloris		
European Greenfinch [404]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within
Columba livia		area
Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus		
House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus		
Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Pycnonotus jocosus		
Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis		
Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris		
Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula		
Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus		
Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris		
Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus		
Goat [2]		Species or species habitat likely to occur within area

Equus caballus Horse [5]

Species or species habitat likely to occur within area

Felis catus Cat, House Cat, Domestic Cat [19]

Feral deer Feral deer species in Australia [85733]

Lepus capensis Brown Hare [127]

Mus musculus House Mouse [120]

Oryctolagus cuniculus Rabbit, European Rabbit [128]

Rattus norvegicus Brown Rat, Norway Rat [83]

Rattus rattus Black Rat, Ship Rat [84]

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Sus scrota		
Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes		
Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides		
Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus scandens		
Asparagus Fern, Climbing Asparagus Fern [23255]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera		
Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Cytisus scoparius		
Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Eichhornia crassipes		
Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista monspessulana		
Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana		
Broom [67538]		Species or species habitat may occur within area
Lycium ferocissimum		
African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Nassella neesiana Chilean Needle grass [67699]

Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]

Opuntia spp. Prickly Pears [82753]

Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]

Rubus fruticosus aggregate Blackberry, European Blackberry [68406]

Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]

Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]

Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss,

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species habitat may occur within area

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species

Name	Status	Type of Presence
Kariba Weed [13665]		habitat likely to occur within area
Senecio madagascariensis		
Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Ulex europaeus		
Gorse, Furze [7693]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-34.748185 150.026387,-34.745081 150.032224,-34.745081 150.03394,-34.759186 150.044583,-34.793308 150.027417,-34.778927 150.002698,-34.752134 150.015744,-34.748185 150.026387

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-Office of Environment and Heritage, New South Wales -Department of Environment and Primary Industries, Victoria -Department of Primary Industries, Parks, Water and Environment, Tasmania -Department of Environment, Water and Natural Resources, South Australia -Department of Land and Resource Management, Northern Territory -Department of Environmental and Heritage Protection, Queensland -Department of Parks and Wildlife, Western Australia -Environment and Planning Directorate, ACT -Birdlife Australia -Australian Bird and Bat Banding Scheme -Australian National Wildlife Collection -Natural history museums of Australia -Museum Victoria -Australian Museum -South Australian Museum -Queensland Museum -Online Zoological Collections of Australian Museums -Queensland Herbarium -National Herbarium of NSW -Royal Botanic Gardens and National Herbarium of Victoria -Tasmanian Herbarium -State Herbarium of South Australia -Northern Territory Herbarium -Western Australian Herbarium -Australian National Herbarium, Canberra -University of New England -Ocean Biogeographic Information System -Australian Government, Department of Defence Forestry Corporation, NSW -Geoscience Australia -CSIRO -Australian Tropical Herbarium, Cairns -eBird Australia -Australian Government – Australian Antarctic Data Centre -Museum and Art Gallery of the Northern Territory -Australian Government National Environmental Science Program

-Australian Institute of Marine Science

-Reef Life Survey Australia

-American Museum of Natural History

-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania

-Tasmanian Museum and Art Gallery, Hobart, Tasmania

-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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