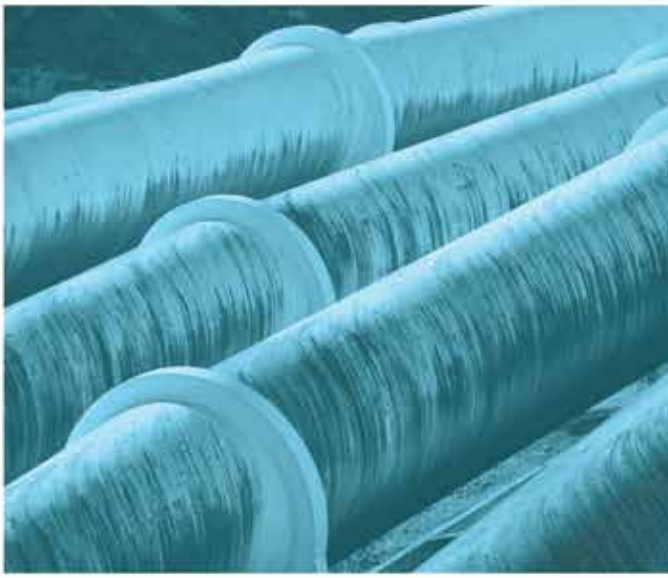



Wongawilli Colliery Modification Report

PA 09_0161 MOD 2 - North West Mains Development
Volume 11 - Appendix L

Prepared for Wollongong Coal Limited
December 2020

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T 02 9339 3184

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Deakin ACT 2600

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Appendix L

Biodiversity development assessment report

North West Mains Development
Biodiversity Development Assessment Report

FINAL REPORT

Prepared for Wollongong Coal Limited

17 November 2020

Biosis offices

NEW SOUTH WALES

Albury
Phone: (02) 6069 9200
Email: albury@biosis.com.au

Newcastle
Phone: (02) 4911 4040
Email: newcastle@biosis.com.au

Sydney
Phone: (02) 9101 8700
Email: sydney@biosis.com.au

Western Sydney
Phone: (02) 9101 8700
Email: sydney@biosis.com.au

Wollongong
Phone: (02) 4201 1090
Email: wollongong@biosis.com.au

VICTORIA

Ballarat
Phone: (03) 5304 4250
Email: ballarat@biosis.com.au

Melbourne
Phone: (03) 8686 4800
Email: melbourne@biosis.com.au

Wangaratta
Phone: (03) 5718 6900
Email: wangaratta@biosis.com.au

Document information

Report to:	Wollongong Coal Limited
Prepared by:	Samantha McCann Paul Price
Accredited Assessor:	Paul Price (BAAS18089)
Biosis project no.:	31606
File name:	31606.NWMains.BDAR.FIN02.20201117
Citation:	Biosis 2020. North West Mains Development BDAR. Report for Wollongong Coal Limited. McCann. S, Price. P. Biosis Pty Ltd. City, NSW. Project no. 31606

Document control

Version	Internal reviewer	Date issued
Draft version 01	Rebecca Dwyer	21/08/2020
Final version 01	Rebecca Dwyer	11/11/2020

Acknowledgements

Biosis acknowledges the contribution of the following people and organisations in undertaking this study:

- Wollongong Coal Limited: Ron Bush, Jason Meredith
- Department of the Environment and Energy for access to the Protected Matters Search Tool of the Australian Government
- NSW Environment, Energy and Science Group for access to the BioNet Atlas of NSW Wildlife.
- BirdLife Australia for access to the New Atlas of Australian Birds 1998-2013.
- NSW Department of Primary Industries for access to indicative mapping of freshwater threatened species and fish populations.

Biosis staff involved in this project were:

- Samantha McCann, Averill Wilson, Byron Dale and Paul Price (assistance in the field)
- Anne Murray (mapping)

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Glossary

BAM	NSW Biodiversity Assessment Method
BC Act	NSW *Biodiversity Conservation Act 2016*
BDAR	Biodiversity Development Assessment Report
Biosecurity Act	NSW *Biosecurity Act 2015*
BOS	Biodiversity Offsets Scheme
CEMP	Construction Environmental Management Plan
CEEC	Critically Endangered Ecological Community
DA	Development Application
DBH	Diameter at Breast Height
DCDB	Digital cadastral database
DAWE	Commonwealth Department of Agriculture, Water and Environment
DPIE	NSW Department of Planning Industry and Environment
DPI	NSW Department of Primary Industries
DTDB	Digital topographic databases
Ecosystem credit species	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a development.
EEC	Endangered Ecological Community
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
GDE	Groundwater Dependent Ecosystem
GIS	Geographic Information System
IBRA	Interim Biogeographic Regionalisation of Australia
LEP	Local Environmental Plan
LGA	Local Government Area
Locality	Area located within 10 kilometres radius from the study area
LPI	NSW Land and Property Information
Matters for further consideration	Impacts that are considered to be complicated or severe that will require further consideration by the consent authority (OEH 2014). The assessment is based on thresholds detailed in Section 9 of the Framework for Biodiversity Assessment. These can also be included as part of the project SEARs.

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Matters of NES	Matters of National Environmental Significance protected by a provision of Part 3 of the EPBC Act
EES	NSW Environment, Energy and Science Group
PCT	Plant Community Type
SALIS	NSW Soil and Land Information System
SEPP	NSW State Environmental Planning Policy
SSD / SSI	State Significant Development / State Significant Infrastructure
study area	The broader area in which the subject site is located, including all direct and indirect impacts. For this project, the study area is defined in Section 1.4.
subject land	The area of direct impact for the proposed works. For this project, the subject land is defined in Section 1.3.
TEC	Threatened Ecological Community
TPZ	Tree Protection Zone
WM Act	NSW *Water Management Act 2000*

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Summary

Wollongong Coal Limited (WCL) proposes to extend the life of its underground coal mine at Wongawilli Colliery by 5 years, to enable WCL to continue development of their previously approved North West Mains Development (NWMD). To date, approximately 500 metres of the NWMD has been developed prior to the Colliery going into care and maintenance in July 2019. Furthermore, the modification largely seeks approval to extend the length of NWMD approximately 2.9 kilometres to access the existing Wongawilli Ventilation Shaft 1, and construction of a new section of coal conveyor system, approximately 60 metres in length, at the Wongawilli Upper Pit Top. The NWMD would continue to be extracted via first workings mining method using two continuous miners. WCL committed in 2019 to no longer undertake mining via longwall extraction methods, as such no longwall mining is proposed as part of this modification application.

As the modification will involve mining activities in areas outside of the previous project approvals, and the project is designated a State Significant Development (SSD), a Biodiversity Development Assessment Report (BDAR) is required in accordance with the NSW Biodiversity Assessment Method (BAM) (OEH 2017a) and the *Biodiversity Conservation Act 2016* (BC Act). The project will be assessed under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). It should be noted that the current assessment falls within the transitional arrangement period of the updated BAM (DPIE 2020a), and has wholly been assessed in accordance with the BAM 2017.

This report addresses the proposed activities that fall outside of the previously approved footprint. This consists of:

- The proposed coal conveyor and associated vegetation removal at the Wongawilli Pit Top.
- The existing mine tunnel entrance at the Wongawilli Pit Top.
- Land occurring above the 28.7 hectares of proposed underground roadways (the Additional Driveage). No direct impacts within the Additional Driveage are proposed, however indirect and prescribed impacts have been addressed.

As direct impacts to native vegetation are only proposed within the Wongawilli Pit Top, this area has been designated the subject land, and makes up 0.04 hectares.

Field investigation at the subject land, undertaken in accordance with the BAM, recorded 0.03 hectares of native vegetation comprising two PCTs, and 0.01 hectares of vegetation also met the listing for the following threatened ecological communities (TECs):

- *Illawarra subtropical rainforest in the Sydney Basin Bioregion* (Endangered Ecological Community (EEC), BC Act)
- *Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion* (Critically Endangered Ecological Community (CEEC), EPBC Act)

No threatened fauna species were recorded at the subject land however the assessment assumes the presence of four species credit species identified by the BAM calculator, due to the presence of appropriate habitat (Appendix 2). These are:

- Pink Robin *Petroica rodinogaster*
- Large-eared Pied Bat *Chalinolobus dwyeri*
- Large Bent-winged Bat *Miniopterus orianae oceanensis*

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- Little Bent-winged Bat *Miniopterus australis*

As vegetation is proposed to be removed from within 100 metres of potential breeding habitat for the three threatened microbats listed above, a significant and irreversible impact (SAII) assessment was prepared for each of these species in accordance with Section 10 of the BAM. A range of mitigation measures will also be undertaken by WCL in order to minimise impacts to these species, and are detailed in Section 6 of this report.

No threatened flora were recorded or assumed to be present within the subject land.

In accordance with Section 10.3 of the BAM, offsets are required to be secured for the proposed works, and the credit requirements are provided in Section 9.

The project is not considered likely to result in a significant impact to species or communities listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and as such a referral to the Minister of the Environment and Energy is not required.

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Stage 1 – Biodiversity assessment

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1 Introduction

Biosis Pty Ltd was commissioned by Wollongong Coal Limited (WCL) to undertake a biodiversity assessment of the proposed modification to the North West Mains Development (NWMD) works at the Wongawilli Colliery (WWC) in the Southern Coalfields, New South Wales (NSW).

The purpose of this assessment was to apply the NSW BAM (OEH 2017a) to the proposed works, and provide WCL with a Biodiversity Development Assessment Report (BDAR). The BDAR is to be submitted to the Department of Planning, Infrastructure and Environment (DPIE) under the *Environmental Planning and Assessment Act 1979* (EP&A Act) as part of a modification to an existing project approval (09-0161) for the proposed works.

1.1 Project background

WWC is an underground coal mine located approximately 14 kilometres south west of Wollongong, NSW. A project approval was initially granted to Gujarat NRE Coking Coal Limited (the previous owners of WWC) on 2 November 2011, for mining operations within the WWC mining lease area until 31 December 2015. The project approval authorised the following activities:

- Mining of six longwall panels in the Nebo Area.
- Continued development and construction of the Western Driveage (now referred to as NWMD).
- Coal processing and transport of coal at a maximum rate of 2 million tonnes per annum of Run of Mine coal per calendar year.
- Continued use of the surface infrastructure at the Wongawilli Pit Top.
- Continued transportation of coal to the Port Kembla Coal Terminal by rail.
- Rehabilitation of the site.

The project approval was granted a modification in 2015, which permitted mining operations to continue until 31 December 2020. WCL proposes a second modification to the existing project approval for extension of mining activities for a further 5 years. The proposed modification also involves a change of footprint for the area originally referred to as the 'Western Driveage' (now NWMD) in the Ecological Assessment undertaken in 2010 (ERM 2010a). The NWMD footprint requires modification in order to connect the Wongawilli Pit Top to an existing colliery ventilation shaft to the east of Lake Avon. If approved, during the completion of the NWMD project WCL would propose to seek approval for a new State Significant Development (SSD) project consisting of mining within the North West and South West Domain utilising the NWMD, with a 30 year mine life. The proposed North West Domain and South West Domain mining operations would use first workings place change mining method, which will have non-perceptible subsidence. The North West Domain and South West Domain would be accessed via the completed NWMD.

Due to the changes in the NWMD footprint, all additional areas that may be subject to impacts by the proposed works need to be assessed for impacts to ecological values.

1.1.1 NWMD footprint

The footprint of the NWMD has been divided into two sections; the Wongawilli Pit Top, and the Additional Driveage.

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Wongawilli Pit Top

The Wongawilli Pit Top is located at the top of a private road north west of Jersey Farm Road, Wongawilli. It is bounded on the west by the Illawarra Escarpment State Conservation Area. Access to the driveage will be via two existing portal entries on the upper most bench of the pit top, with one being used for the transport of people and materials, and one being used to convey coal from the mine. In order to re-utilise the existing infrastructure at the Wongawilli Pit Top, the current coal conveyor will be replaced (covered under current approvals), and an additional conveyor will be installed to connect the conveyor portal to the existing infrastructure. The new conveyor will consist of two 5 x 7 metre driveheads and a 2 x 63 metre conveyor belt held up by pillars. An additional 1 metre of vegetation will be cleared as a buffer around the structure, to allow access and maintenance. The subject land at the Wongawilli Pit Top makes up 0.04 hectares, and the works will require the clearing of approximately 0.03 hectares of vegetation (Figure 1).

Additional Driveage

The proposed driveage will consist of four underground roadways to be developed using first workings mining methods. This will involve the development of four 5.5 metre wide headings, drifts or roadways, and interconnecting cut-throughs with continuous miners. These will provide access to the coal resource, existing colliery ventilation shaft and corridors for personnel and material movement within the seam and coal conveyor network. Works have commenced on the driveage, with approximately 500 metres developed within the Bulli Coal Seam in accordance with WCL's existing approval.

The proposed modification to the driveage footprint is in the north western corner, where an additional 28.7 hectares of underground roadways have been proposed to replace the originally approved western footprint of the driveage.

As the driveage is being developed using the first workings mining method, no impacts (i.e. subsidence) are expected to the ground surface. The first workings method involves parallel tunnels known as 'headings' being driven into the coal seam from the mine entrance using remote controlled coal cutting. These form a series of self-supporting roadways, leaving behind a grid of pillars. The pillars are designed to provide stability to the void in the long term and support the roof strata above the seam. Where the pillars have been designed to be stable, the vertical subsidence is typically less than 20 millimetres. Natural or seasonal variations in surface levels due to wetting and drying of soils are approximately 20 millimetres, and thus subsidence less than this can be considered no more than the variations occurring from natural processes, and should have negligible impacts on both natural and man-made surface infrastructure (CoA 2014, MSEC 2007, Hume Coal 2017).

The geotechnical assessment of the proposed driveage (SCT 2020) confirmed this, with the assessment concluding that there is no potential for any perceptible surface subsidence impacts as a result of the proposed Additional Driveage. The footprint of the Additional Driveage has been included for assessment in the current report, however it is to be noted that no surface impacts are expected.

Biodiversity Development Assessment Report (BDAR)

The NSW BC Act requires that the BAM be applied to all proposals that trigger the BOS, and that a BDAR is required to be submitted to the approval authority. The current project triggers the BOS because it is a State Significant Development.

1.2 Purpose of this assessment

This BDAR will:

- Address the BAM and the BOS.

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- Identify how the proponent proposes to avoid and minimise impacts to biodiversity.
- Identify any potential impact that could be characterised as serious and irreversible.
- Describe the offset obligations required to compensate for any unavoidable biodiversity impacts resulting from the proposed works.
- Consider and assess the proposal in accordance with other relevant legislation such as the Commonwealth EPBC Act.

All biodiversity assessments have been undertaken in accordance with the BAM, and this BDAR has been prepared by Accredited Assessor Paul Price (BAAS18089) and reviewed Accredited Assessor Rebecca Dwyer (BAAS17067).

1.3 The subject land

The subject land is defined as the total area of proposed disturbance, encompassing the proposed works footprint and all areas that could be disturbed during construction. For the current assessment, the subject land is defined as the footprint of the proposed conveyer works at the Wongawilli Pit Top, bounded by the current conveyer to the east and including the existing portal entry to the west (Figure 1). The subject land includes the proposed area for the 2 x 63 metre conveyer belt, and two associated 5 x 7 metre drive heads, with a 1 metre buffer around each of these to account for further vegetation removal for access and maintenance.

The subject land is approximately 0.04 hectares in area, and is located in the north west region of Lot 1 DP 321054. The lot is located at the western end of Wongawilli Road, directly east of the Illawarra Escarpment State Conservation Area, approximately 14 kilometres south west of the Wollongong Central Business District (CBD). The land is located in the Wollongong City Council Local Government Area (LGA) and the South East Local Land Services (LLS) Region and is zoned as RU1 Primary Production under the *Wollongong Local Environmental Plan 2009* (LEP).

The land is currently used for mining activities by WCL with 500 metres of driveage developed within the Bulli Coal Seam in accordance with WCL's existing approval, but is in a care and maintenance period.

1.4 The study area

The study area encompasses the subject land and includes areas outside of the subject land that could be indirectly impacted by the proposal.

For the current assessment, the study area is defined as the combined footprint of both the works at the Wongawilli Pit Top, and the Additional Driveage. Although no direct impacts resulting from subsidence are anticipated to occur (SCT Operations 2020) the Additional Driveage has been included in the study area due to the potential for indirect impacts to the surface as a result of the proposed underground mining, and is further addressed in Section 7.

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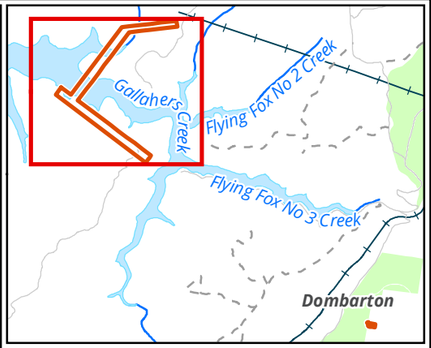

Legend

- Study area
- IBRA Sub-region
- Lot

Destinctive Land Surface

- Cliffline (LPI)
- Cliffline (Biosis 2020)

Strahler stream order (LPI)

- 1
- 2
- 3
- 4

Stream order buffers

- 1
- 2
- 3
- 4

Figure 1.1 Site map

Additional driveage

0 50 100 150 200 250

Metres

N

Scale: 1:6,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 31606,
Date: 17 August 2020,
Checked by: SMM, Drawn by: AEDM, Last edited by: amurray
Location: P:\31600s\31606\Mapping\31606_F1_SiteMap.mxd

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Legend

- Study area
- Subject land
- IBRA Sub-region
- Lot

Acknowledgements: Basemap © Land and Property Information 2016, Imagery NearMap 2019

Figure 1.2 Site map

Wongawilli Pit Top

0 2.5 5 7.5 10 12.5

Metres

N

Scale: 1:300 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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Matter: 31606,
Date: 17 August 2020,
Checked by: SMM, Drawn by: AEDM, Last edited by: amurray
Location: P:\31600s\31606\Mapping\31606_F1_SiteMap.mxd

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1.5 Sources of information

Sources of information used in the assessment included relevant databases, spatial data, literature and previous site reports.

In order to provide a context for the study area, records of flora and fauna from within 5 kilometres (the locality) were collated from the following databases and were reviewed:

- Commonwealth Department of Agriculture, Water and Environment (DAWE) Protected Matters Search Tool for matters protected by the EPBC Act.
- Environment, Energy and Science (EES) BioNet Atlas of NSW Wildlife, for species, populations and ecological communities listed under the BC Act.
- PlantNET (The Royal Botanic Gardens and Domain Trust).
- BirdLife Australia, the New Atlas of Australian Birds 1998-2015.
- Other sources of biodiversity information relevant to the study area were sourced from:
  - The NSW Plant Community Types (PCTs), as held within the BioNet Vegetation Classification database (DPIE 2020b).
  - Relevant vegetation mapping, including *Southeast NSW Native Vegetation Classification and Mapping – SCIVI* (DPIE 2010), *Illawarra Plant Community Type Vegetation Map* (DPIE 2016) and *Native Vegetation of the Illawarra Escarpment and Coastal Plain* (NPWS 2002).

The following reports were also reviewed and relied on to provide additional information:

- *Wongawilli Colliery Modification of Consent – North West Mains Development Scope of Works, Ecology and Aboriginal & European Heritage Technical Specialist Report* (WCL 2020).
- *NRE Wongawilli Colliery Nebo Area Environmental Assessment – Volume 1* (ERM 2010a).
- *Annex M – NRE Wongawilli Colliery Terrestrial Flora and Fauna Assessment – Nebo Area* (ERM 2010b).

Mapping was conducted using hand-held (uncorrected) Global Positioning System (GPS) units (GDA94), mobile tablet computers running Collector for ArcGIS and aerial photo interpretation. The accuracy of this mapping is therefore subject to the accuracy of the GPS units (generally ± 5 metres) and dependent on the limitations of aerial photo rectification and registration.

Basemap data was obtained from NSW Land and property information (LPI) 1:25,000 digital topographic databases (DTDB), with cadastral data obtained from LPI digital cadastral database (DCDB).

The following spatial datasets were utilised during the development of this report:

- Catchment Boundaries of New South Wales dataset.
- Mitchell Landscapes Version 3.0.
- Interim Biogeographic Regionalisation of Australia (IBRA) Version 7.
- Directory of Important Wetlands (DoIW).
- State Environmental Planning Policy (SEPP) Koala Habitat Protection 2019.
- Spatial data associated with Illawarra Plan Community Type Vegetation Map VIS_ID 4678 (DPIE 2016).
- NSW Soil and Land Information System (SALIS).

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- Mapping has been produced using a Geographic Information System (GIS). The following maps and data have been provided:
  - Digital mapping with aerial photography showing 1:1000 or finer.
  - Site map as described in subsection 4.2.1.1 of the BAM.
  - Location Map as described in subsection 4.2.1.2 of the BAM.
  - Landscape map with features including 1500 metre buffer, as described in section 4.2.1.3 of the BAM.

1.6 Legislative requirements

- The project has been assessed against relevant biodiversity legislation and government policy, including:
- *Environment Protection and Biodiversity Conservation Act 1999*
- *Environmental Planning and Assessment Act 1979*
- *Biodiversity Conservation Act 2016*
- *Fisheries Management Act 1994*
- *Biosecurity Act 2015*
- State Environmental Planning Policy Koala Habitat Protection 2019 (Koala SEPP)
- Wollongong City Council LEP 2009

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2 Landscape Context

This chapter describes the landscape and site context of the subject land, describing the landscape features present within the subject land and within a 1500 metre buffer, as required by the BAM (OEH 2017a). Figure 2 shows the location of the subject land and landscape features within the 1500 metre buffer.

2.1 Landscape features

2.1.1 Bioregions

The study area occurs within the Sydney Basin IBRA bioregion, and both the Illawarra and Sydney Cataract IBRA subregion. Sydney Basin Bioregion lies on the central east coast of NSW and covers an area of approximately 3,624,008 hectares. It occupies about 4.53 % of NSW and is one of two bioregions contained wholly within the state. The bioregion extends from just north of Batemans Bay to Nelson Bay on the Central Coast, and almost as far west as Mudgee. The bioregion is bordered to the north by the North Coast and Brigalow Belt South bioregions, to the south by the South East Corner Bioregion and to the west by the South Eastern Highlands and South Western Slopes bioregions. The Sydney Basin Bioregion is one of the most species diverse in Australia. This is a result of the variety of rock types, topography and climates in the bioregion (OEH 2016a).

2.1.2 NSW (Mitchell) Landscape

The study area occurs within the Bulli Coastal Escarpment Mitchell Landscape. This landscape is defined by cliffed escarpment and rubble slopes of Triassic horizontally bedded massive quartz sandstone, conglomerate and shale with some areas of layered basalt. Episodic cliff retreat through extensive rockfalls contributes to debris on slopes. Rainfall is high, averaging approximately 2200 millimetres per year. Soils vary from shallow sandy loam on sandstone, texture-contrast profiles on shale and debris slopes, to higher nutrient loam on volcanics and in gully lines where organic matter transfers nutrients. The high rainfall and elevation encourage mesophilic vegetation on richer soils with cool temperate rainforest elements such as, Sassafras (*Doryphora sassafras*), Coachwood (*Ceratopetalum apetalum*), Cabbage-tree Palm (*Livistona australis*), Native Tamarind (*Diploglottis australis*), Cheese Tree (*Glochidion ferdinandi*), Lilly Pilly (*Acmena smithii*), Illawarra Flame Tree (*Brachychiton acerifolius*), with Water Gum (*Tristaniopsis laurina*) and Soft Tree-ferns (*Dicksonia antarctica*) and Rough Tree-ferns (*Cyathea australis*) in the gullies. Sydney Peppermint (*Eucalyptus piperita*), Turpentine (*Syncarpia glomulifera*), Grey Gum (*Eucalyptus punctata*), Smooth-barked Apple (*Angophora costata*) and Christmas Bush (*Ceratopetalum gummiferum*) dominate more exposed ridgelines (Mitchell 2002).

2.1.3 Soil

The study area is within the Illawarra Escarpment 1:100k soil landscape (Hazelton & Tille 1990). This landscape is defined by steep to very steep slopes on Quaternary talus. Large land-slips are common and the landscape is mostly uncleared, consisting of tall open forest and closed rainforest. Soils are deep colluvial soils, with red podzolic and brown podzolic souls on midslopes. Siliceous sands occur along drainage lines. The landscape consists of blocks of sandstone, deep colluvial detritus and soil materials (Hazelton & Tille 1990).

2.1.4 Native vegetation extent

Vegetation within the study area and within the 1500 metre buffer area was assessed using aerial photographic interpretation, field survey results and existing vegetation mapping (Figure 3). Table 1 provides the list of PCTs identified from existing vegetation mapping, and the current assessment, as occurring within the study area and within the 1500 metre buffer. Conservation status of the communities is also provided.

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Table 1 PCTs mapped within the subject land and buffer

PCT – (mapped DPIE 2016 and Biosis 2020)	Conservation status	Location		
		Subject land	Study area	1500 m Buffer
PCT 838 - *Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion*	Endangered (BC Act), Critically Endangered (EPBC Act)	No	No	Yes
PCT 878 - *Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion*	Not listed	No	Yes	Yes
PCT 905 - *Lilly Pilly - Coachwood warm temperate rainforest on moist sheltered slopes and gullies, Sydney Basin Bioregion and South East Corner Bioregion*	Not listed	Yes	No	Yes
PCT 906 - *Lilly Pilly - Sassafras - Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion*	Endangered (BC Act)	No	No	Yes
PCT 1083 - *Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion*	Not listed	No	Yes	Yes
PCT 1127 - *Sandstone cliff-face soak of the Sydney Basin Bioregion*	Not listed	No	Yes	No
PCT 1156 - *Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion*	Not listed	No	No	Yes
PCT 1245 - *Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion*	Not listed	Yes	No	Yes
PCT 1250 - *Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion*	Not listed	No	No	Yes
PCT 1292 - *Water Gum - Coachwood riparian scrub along sandstone streams, Sydney Basin Bioregion*	Not listed	No	Yes	No
PCT 1300 - *Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion*	Endangered (BC Act)	No	No	Yes
PCT 1803 - *Banksia - Needlebush - Tea-tree damp heath swamps on coastal sandstone plateaus of the Sydney basin*	Endangered (BC Act and EPBC Act)	No	No	Yes
PCT 1804 - *Needlebush - Banksia wet heath swamps on coastal sandstone plateaus of the Sydney basin*	Endangered (BC Act and EPBC Act)	No	Yes	Yes
PCT 1824 - *Mallee - Banksia - Tea-tree - Hakea heath-woodland of the coastal sandstone plateaus of the Sydney basin*	Not listed	No	No	Yes

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2.1.1 Cleared areas

Cleared areas within the subject land and buffer make up approximately 95.7 hectares (13.1 %).

2.1.2 Differences between mapped vegetation extent and aerial imagery

There were no significant differences between the mapped vegetation extent, and that visible on aerial imagery.

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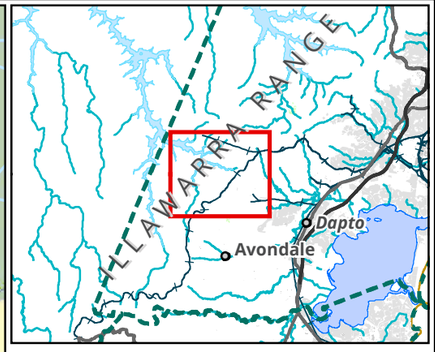

Legend

- Study area
- Subject land
- Subject land 1500m buffer
- IBRA Sub-region
- Biodiversity Values Map (v10)
- Cliffline
- National Park or Reserve
- Riparian buffers - Local wetlands
- Local wetlands

Strahler stream order

- 1
- 2
- 3
- 4

Stream order buffers

- 1
- 2
- 3

Mitchell landscape V3

- Bce - Bulli Coastal Escarpment
- Dap - Dapto - Wollongong Coastal Slopes
- Lap - Lake Illawarra Alluvial Plains
- Wat - Water
- Wpp - Woronora Plateau

Figure 2 Location map

0 200 400 600 800

Metres

N

Scale: 1:20,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 31606,
Date: 18 August 2020,
Checked by: SMM, Drawn by: AEDM, Last edited by: amurray
Location: P:\31600s\31606\Mapping\31606_F2_Location.mxd

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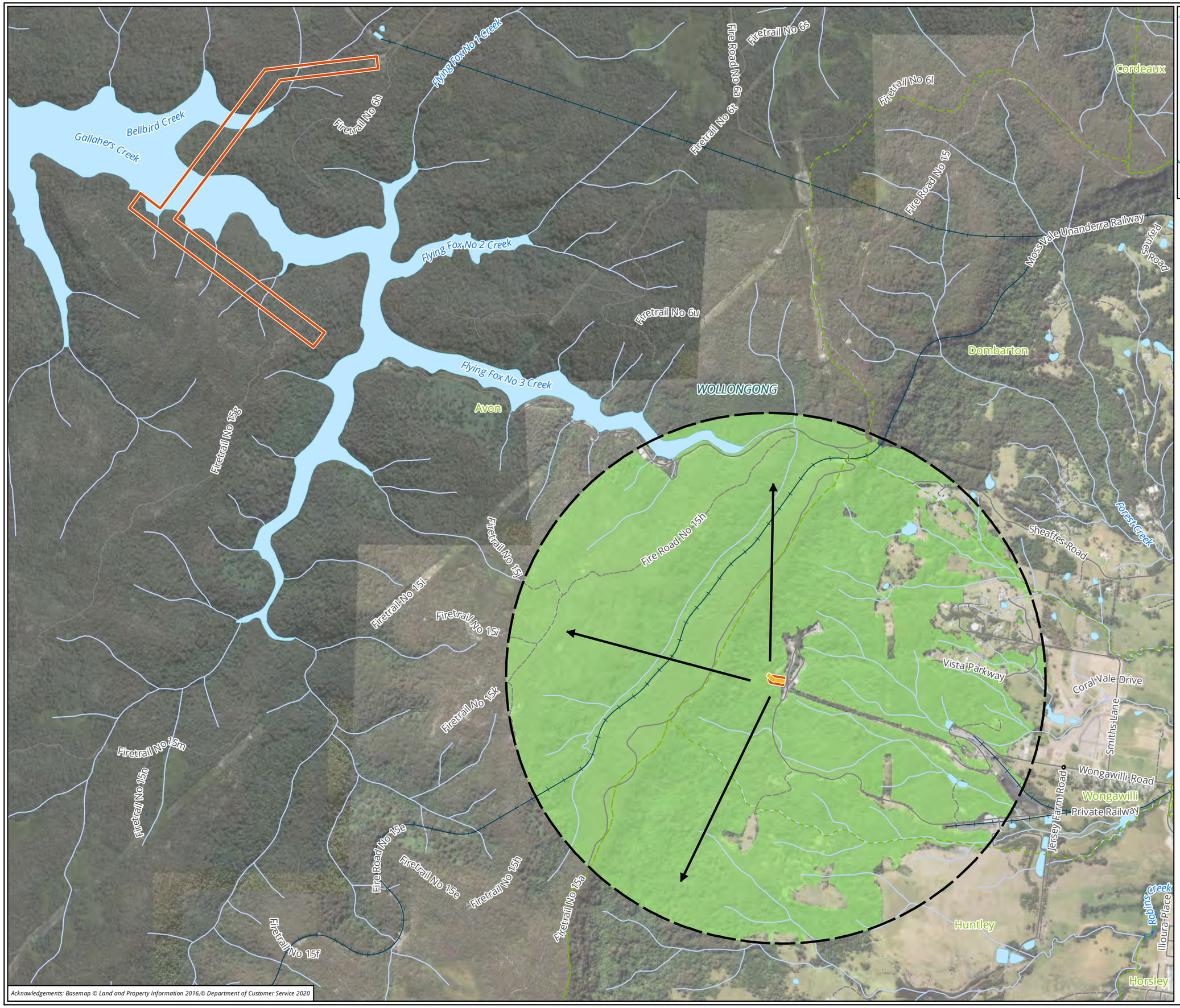
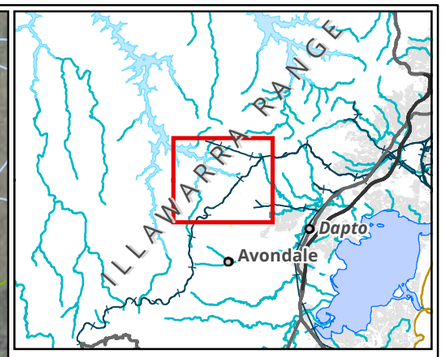
Acknowledgements: Basemap © Land and Property Information 2016





Legend

- Study area
- Subject land
- Subject land 1500m buffer
- Native vegetation
- Habitat connectivity

Figure 3 Native vegetation

0 200 400 600 800

Metres

N

Scale: 1:20,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 31606,
Date: 18 August 2020,
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2.1.4 Rivers and streams

The study area is located within the South East Local Land Services Region and the Hawkesbury Nepean catchment, within the WaterNSW Metropolitan Special Areas. Waterways within the Additional Driveage study area can be placed into two broad groups, the large waterbody of Gallaghers Creek (within the upper influence of Lake Avon dam), and first and second order tributaries of Lake Avon. These are described separately below.

Lake Avon

Lake Avon occurs within Avon Dam and is approximately 11 square kilometres in size, with a total operating capacity of approximately 147 gigalitres and has a catchment area of 142 square kilometres (WaterNSW 2020). The study area intersects with Gallaghers Creek, passing below the lake from the south western to north eastern bank, within the upper extent of dam influence within Lake Avon. The crossing and study are is located downstream of the confluence of the major tributaries of Flying Fox No 1 Creek, Flying Fox No 2 Creek and Flying Fox No 3 Creek with Gallaghers Creek, and upstream of the Bellbird Creek tributary.

Coarse Key Fish Habitat mapping by NSW Department of Primary Industries (DPI) includes Lake Avon within the study area (DPI 2007). Lake Avon would also be considered TYPE 1 highly sensitive key fish habitat and CLASS 1 major key fish habitat, according to the classification system provided in DPI (2013).

Tributaries of Lake Avon

The study area intersects with five mapped first or second order high slope streams on the south western and north eastern banks of Lake Avon, shown as streams one to three, and five to nine in Figure 8 respectively.

The stream network on the north eastern bank appears to be more complex than that mapped, with a number of small waterways and drainage lines additional to those mapped identified during the terrestrial ecological field surveys (Figure 8). These tributaries of Lake Avon are characterised by their relatively high slope, low stream order and substrates dominated by bedrock or large boulders. Within the study area these waterways appear to occur within heath dominated vegetation, with a degree of permanent water held in pool sections. Waterway three is located further downstream within the study area and receives inputs from the other tributaries. As such the waterways is larger, with more elongated pool sections and showing a higher degree of water availability. Within waterway three, flocculant and iron staining were observed coating stream substrates, potentially as a result of historical mining in the area, or otherwise from natural processes. Representative photos of the streams identified within the study area are shown below (Plate 1 and Plate 2).

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Plate 1 Waterway two along the northeastern bank of Lake Avon

Plate 2 Waterway three along the northeastern bank of Lake Avon

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On the south eastern bank, the waterways are of higher slope and are boulder dominated with more limited pool sections. These waterways tend to run in relatively straight paths downslope into Lake Avon as a result of the steeper inclines. The tributaries are shaded and occur within relatively dense coachwood forest. Representative photos of the streams identified within the study area are shown below.

Plate 3 Waterways along the northeastern bank of Lake Avon

A baseline stream health and water quality monitoring report will be prepared by Biosis to specifically address baseline aquatic health within these tributaries. The baseline stream health and water quality monitoring report will include more comprehensive descriptions of individual mapped tributaries within the Additional Driveage study area and will utilise standard stream health monitoring techniques such as AUSRIVAS sampling and analysis to determine baseline water quality levels.

2.1.5 Wetlands

None of the study area is mapped as any wetland included in the DoIW of Australia (DoIW 2004), with Lake Avon mapped as a reservoir on the NSW Wetlands dataset (DPIE 2020).

2.1.6 Connectivity features

The majority of the habitat for flora and fauna mapped within the subject land consists of rainforest and wet sclerophyll forest. As the subject land is located adjacent to the Illawarra Escarpment State Conservation Area and the Water NSW Catchment Special Area, habitat extends far into the surrounding landscape, in a patch larger than 100 hectares. Native vegetation within the subject land is connected to further vegetation to the west, north and south (Figure 3).

2.1.7 Areas of geological significance

There were no recorded karst, caves, crevices, cliffs or other areas of geological significance within the subject land. However, the subject land occurs on a flat bench on the lower slopes of the Illawarra Escarpment. The escarpment rises to the west of the subject land, and is composed of cliff areas often exceeding 10 metres in height.

Within the Additional Driveage, the study area contains two cliff lines recorded during the field investigation (Figure 1). Both cliffs occur above Lake Avon, with steep slopes leading down to the water body. The surrounding

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landscape also contains several cliff lines, typical of the sandstone and claystone geology. No karsts or caves were recorded within the study area, however rocky areas and rock crevices were abundant throughout.

2.1.8 Biodiversity Values Map

There are no areas of outstanding biodiversity or Biodiversity Values mapped within the subject land. There are however areas of outstanding biodiversity value mapped within the Additional Driveage, encompassing riparian vegetation along Lake Avon and its tributaries.

2.1.9 Soil hazard features

No vegetated or cleared parts of the study area are mapped as being Acid Sulphate Soils under the *Wollongong City Council LEP 2009*.

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Legend

- Study area
- Transect
- BAM plot
- Hollow-bearing tree

Vegetation communities

- PCT 1804 - *Needlebush - Banksia wet heath swamps on coastal sandstone plateaus of the Sydney basin* - High
- PCT 1292 - *Water Gum - Coachwood riparian scrub along sandstone streams, Sydney Basin Bioregion* - High
- PCT 1250 - *Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion* - High
- PCT 1127 - *Sandstone cliff-face soak of the Sydney Basin Bioregion* - High
- PCT 1083 - *Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion* - High
- PCT 878 - *Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion* - High

Figure 4.1 Vegetation in the study area

Additional driveage

0 50 100 150 200 250

Metres

N

Scale: 1:6,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 31606,
Date: 21 August 2020,
Checked by: SMM, Drawn by: AEDM, Last edited by: skumar
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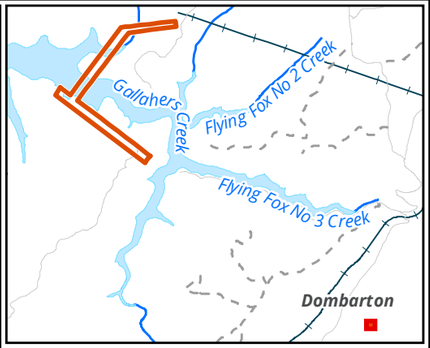

Legend

- Study area
- Subject land
- Transect
- BAM plot
- Hollow-bearing tree
- *Lantana camara* - Lantana

Vegetation communities

- PCT 1245 - *Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion* - Low
- PCT 906 - *Lilly Pilly - Sassafras - Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion* - Moderate

Figure 4.2 Vegetation in the study area

Wongawilli Pit Top

0 2.5 5 7.5 10 12.5

Metres

N

Scale: 1:300 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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Matter: 31606,
Date: 21 August 2020,
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Location: P:\31600s\31606\Mapping\31606_F4_BiosisVeg.mxd

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Acknowledgements: Basemap © Land and Property Information 2016, Imagery NearMap 2019

2.2 Site context

The site context was assessed using a combination of site-based methods implementing the BAM on 17 July 2020 by Biosis ecologists, and desktop assessments utilising GIS. The habitats and vegetation within the study area are a small subset of those in the wider landscape.

2.2.1 Native vegetation cover

Native vegetation cover was assessed using GIS based on the most suitable vegetation mapping, in this case the *Illawarra Plant Community Type Vegetation Map 2016 VIS_ID 4678* (DPIE 2016).

Native vegetation cover within the 1500 metre buffer of the subject land was found to be 86.92 % (Figure 3).

2.2.2 Patch size

Patch size was assessed as per the BAM (OEH 2017a) using a select process in ArcGIS. All intact vegetation that has a gap of less than 100 metres from the next area of moderate to good condition native vegetation is considered to be of the same patch.

Vegetation within the study area meeting this criteria was mapped sequentially and it was found to form part of a relatively large patch of connecting vegetation with a patch size far exceeding 100 hectares.

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3 Native vegetation

The extent of native vegetation, threatened ecological communities and vegetation integrity within the study area was determined using the results of site investigations, previous vegetation mapping (DPIE 2016) and Chapter 5 and Appendix 6 of the BAM (OEH 2017a).

3.1 Methods

3.1.1 Background review

Regional vegetation mapping (DPIE 2016) as well as database searches (See Section 1.5) were reviewed to inform the site investigations. Based on the results of the background review and the requirements of the BAM with respect to this BDAR, appropriate surveys were designed for the study area and impact area.

3.1.2 Field investigation

The flora and fauna assessment across the study area was conducted on 17, 21, 24 and 29 July, and 4 and 24 August 2020 under the terms of Biosis' Scientific Licence issued by the EES under the *National Parks and Wildlife Act 1974* (SL100758, expiry date 31 March 2021). Fauna survey was conducted under approval 11/355 from the NSW Animal Care and Ethics Committee (expiry date 31 January 2021). The BAM Assessment was carried out by Accredited Assessor Paul Price (BAAS18089).

The study area was surveyed in accordance with the BAM (OEH 2017a), which involved:

- The identification and mapping of PCTs according to the structural definitions of Southeast NSW Native Vegetation Classification and Mapping – SCIVI (DPIE 2010).
- Undertaking floristic plots within each vegetation zone in accordance with Section 5 of the BAM (OEH 2017a).
- The identification of native and exotic plant species, according to the Flora of NSW (Harden 1992, 1993, 2000, 2002) with reference to recent taxonomic changes.
- Targeted searches for plant species of conservation significance according to the *Surveying threatened plants and their habitats NSW survey guide for the Biodiversity Assessment Methodology* (DPIE 2020c).
- Incidental observations using the "random meander" method (Cropper 1993).
- Identifying fauna habitats, assessing their condition and assessing their value to threatened fauna species.
- Observations of animal activity and searches for indirect evidence of fauna (such as scats, nests, burrows, hollows, tracks, scratches and diggings).
- An assessment of the natural resilience of the vegetation of the site.
- Identification of previous and current factors threatening the ecological function and survival of native vegetation within and adjacent to the study area.

The conservation significance of plant species and plant communities was determined according to:

- BC Act for significance within NSW.
- EPBC Act for significance within Australia.

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Detailed mapping of PCTs was conducted using hand-held (uncorrected) tablet units (Samsung Galaxy Tab 3) using the ArcGIS Collector application and aerial photo interpretation. Areas of native vegetation for which a PCT could validly be assigned were identified and delineated in the field, and their condition determined. Identification of PCTs within the study area was confirmed with reference to the community profile descriptors (and diagnostic species tests) held within the (2016a) mapping project and NSW BioNet Vegetation Classification database (DPIE 2020b). Locations of floristic plots surveyed are shown on Figure 4.

3.2 Results – subject land

The following section describes the results of the field investigation within the subject land only. The results of survey within the wider study area are discussed further below in Section 3.4.

3.2.1 Vegetation description

The subject land supports 0.03 hectares of native vegetation with varying levels of disturbance (Figure 4).

The native vegetation condition varied across the study area with areas of heavy weed infestation and good core areas of native vegetation. The native vegetation contained areas of closed vegetation and open vegetation, and majority of areas contained three distinct stratum. The south-western portion of the study area contained a large infestation of Lantana *Lantana camara* which was also depauperate and lacked canopy species. Areas adjacent to the vehicle track in the north west area of the study area were primarily underscrubbed and lacked native understorey, whilst maintaining canopy cover from White Topped Box *Eucalyptus quadrangulata.*

Parts of the study area with no native over storey or mid storey cover and less than 50 % cover of native groundcover met the definition of cleared land and were not mapped as native vegetation.

3.2.2 Native vegetation extent

Figure 4.1 and 4.2 provide a map of the native vegetation extent recorded within the study area and subject land proposed to be impacted, as assessed during field investigations undertaken in July 2020. The figures include all areas of native vegetation (native ground cover and areas with canopy). Areas not shown as native vegetation cover within the Wongawilli Pit Top (Figure 4.2), and which do not provide habitat for threatened species, are not included for further assessment in accordance with Section 5.1.1.5 of the BAM (OEH 2017a).

3.2.3 Plant community types

The following PCTs were assessed as present within the within the study area:

- PCT 906 - Lilly Pilly - Sassafras - Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion (Table 2).
- PCT 1245 - *Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion* (Table 3).

Table 2 and Table 3 provide detailed descriptions of the two PCTs recorded within the study area. PCTs recorded within the study area are shown on Figure 4.

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Table 2 PCT 906 – moderate condition

PCT 906: Lilly Pilly - Sassafras - Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion	
Common name	Illawarra Escarpment Subtropical Rainforest
Vegetation formation	Rainforests
Vegetation class	Subtropical Rainforests
Extent within subject land	0.01 ha
Condition	The vegetation community was recorded in a moderate condition with native species represented within all strata with weed ingress in the understorey and areas of high Lantana infestation.
Description	PCT 906 was primarily located in the upper portion of the study area. Native species recorded in the upper stratum included a codominant canopy of Coachwood *Ceratopetalum apetalum,* Sweet Pittosporum *Pittosporum undulatum* with occasional representations of Red Cedar *Toona ciliata* .The open mid storey stratum was represented diverse representation of mesic rainforest species such as Lilly Pilly *Acmena smithii,* Giant Stinging Tree *Dendrocnide excelsa, Elaeodendron australe,* Sandpaper Fig *Ficus coronata,* Cabbage Tree Palm *Livistona australis* support by a range of vines including Water Vine *Cissus antarctica* and Sweet Morinda *Gynochthodes jasminoides.* The understorey, whilst limited consisted primarily of Giant Maidenhair *Adiantum formosum* and *Oplismenus imbecillis.* Exotic species were recorded in moderate densities with opportunistic herbaceous perennial species being observed throughout the vegetation type, with heavier weed density observed along the boundaries with cleared and disturbed areas to the east and west. A heavy infestation of Lantana *Lantana camara* was observed in the south-west corner of the patch. Other weed species recorded included Lantana *Lantana camara*, Crofton Weed *Ageratina adenophora*, Cape Ivy *Delairea odorata,* Lantana, Pellitory *Parietaria judaica* and Madeira Winter Cherry *Solanum pseudocapsicum*.
Survey effort	One BAM plot/transect (OEH 2017a) (Figure 4).
Justification of PCT	Species recorded in the canopy, ground and mid stratum are consistent with the subtropical rainforest community in a moderate condition. Floristic diagnostic tree species included Giant Stinging Tree, Red Cedar but as a result of the modified nature of the vegetation type, both tree species richness (7) percentage tree cover (50 %) did not meet to that of the PCT benchmark of 14 % and 90 % respectively. The modified nature of the community was also evident within the recorded shrub growth form, with both species richness (5) and percentage cover (36 %) to be recorded below benchmark conditions with the floristic composition limited to *Elaeodendron australe*, Sandpaper Fig, Hairy-leaved Doughwood *Melicope micrococca*, Sweet Pittosporum and Scrub Beefwood *Stenocarpus salignus*. Grass and Grass like species richness provided a score of 2, with a percentage cover of 6% for which exceeded that of the PCT benchmarks of 1 % and 0 % respectively. Forb species richness (2) was recorded to be lower than PCT benchmark conditions (3), yet recorded to exceed (2 %) that of the percentage cover benchmark (0 %) Both fern and 'other' growth forms failed to reach PCT benchmark conditions with the collated fern data providing a species richness score of 1 and

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PCT 906: Lilly Pilly - Sassafras - Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion	
	a percentage cover of 25 %. Other BAM attribute species (9) were represented primarily by scramblers and climbing flora species. Species such as Gum Vine *Aphanopetalum resinosum* and Water Vine *Cissus antarctica* providing a percentage cover of 21 % and a failure to reach PCT benchmark conditions. Additional supporting information in the justification of the PCT include : • The floristic composition soil type and landscape position (approx. 280 metre a.s.l) align with the final determination (NSW Scientific Committee 2008). • The BioNet PCT Identification tool identified PCT 906 from the species recorded at the subject land.
TEC Status	PCT 906 currently meets the listing for *Illawarra Subtropical Rainforest in the Sydney Basin Bioregion* (Endangered Ecological Community (EEC), BC Act) in accordance with the final determination (NSW Scientific Committee 2008) for *Illawarra subtropical rainforest in the Sydney Basin Bioregion - endangered ecological community listing*. PCT 906 in its current condition meets the Commonwealth listing for *Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion* Critically Endangered Ecological Community (CEEC) under the EPBC Act, as a Regenerating rainforest –Category D, as it meets the following criteria in the Conservation Advice (Department of Environment and Energy 2019): • An area of least at least 0.1 ha. • At least 30 % canopy cover. • A minimum of 15 native plant species from Table A1 per 0.04 ha sample plot on average for the patch. • Evidence of regeneration (e.g. seedlings, saplings or other sub-mature stages of rainforest tree species).
Estimate of percent cleared value of PCT	50 % (OEH 2017b).
PCT 906 – moderate condition	

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Table 3 PCT 1245 – low condition

PCT 1245: Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	
Common name	Illawarra Escarpment Blue Gum Wet Forest
Vegetation formation	Wet Sclerophyll Forests (Shrubby sub-formation)
Vegetation class	North Coast Wet Sclerophyll Forests
Extent within subject land	0.02 ha
Condition	The vegetation community was recorded in a low condition as result of the reduced species diversity recorded within all documented stratums. This is supported by the historical evidence of tree removal, vegetation clearing and maintenance under scrubbing of mid storey vegetation resulting in the high incidence of exotic flora.
Description	PCT 1245 was recorded to consist of a dominant canopy layer of White Topped Box *Eucalyptus quadrangulata* supported by a reduced mid-storey of Sweet Pittosporum and Cabbage Tree Palm *Livistona australis*. The understorey was observed to be heavily modified where recorded native flora species were limited to occurrences of Bracken Fern *Pteridium esculentum*, Giant Maidenhair Fern and Rainbow Fern *Calochlaena dubia* intermixed dense infestations of exotic species such as Cockspur Flower *Plectranthus ecklonii*, Cape Ivy and Madeira Winter Cherry. As a result of the exposed nature of the vegetation type, a number of opportunistic rainforest species such Red Cedar and Giant Stinging Tree were observed within the vegetation type.
Survey effort	One BAM plot/transect (OEH 2017a) (Figure 4).
Justification of PCT	Species recorded in the canopy, ground and mid stratum are consistent with a heavily degraded the Wet Sclerophyll Forests community in a low condition. Floristic diagnostic canopy species included White Topped Box only, but as result of heavily modified nature of the vegetation type, opportunistic rainforest species such as Red Cedar and Giant Stinging Tree were recorded. As such, the recorded tree species richness (4) and percentage tree cover (17 %) did not meet to that of the PCT benchmark of 9 % and 69 % respectively. The heavily modified nature of the community was also mimicked within the recorded shrub and growth forms, with both species richness (3) and percentage cover (23 %) to be recorded below benchmark conditions. Flora species recorded were limited, Sandpaper Fig, Sweet Pittosporum and Native Elderberry *Sambucus australasica* only. Grass and Grass like species richness provided a score of 2, with a percentage cover of 4 % for which again failed to meet that the PCT benchmarks of 6 % and 7 %. Likewise was recorded for Forb species richness with a single entity being recorded, Stinging Nettle *Urtica incisa* for which provided a percentage cover of 5 %. As such this growth form failed to be meet the required PCT benchmark parameters. Both fern and 'other' growth forms failed to reach PCT benchmark conditions with the collated fern data providing a species richness score of 2 and a percentage cover of 20 %. Other BAM attribute species (2) were represented primarily by larger fern and palm species such as Rainbow Fern *Calochlaena dubia* and Cabbage Palm providing a percentage cover of 15 % and a failure to reach PCT benchmark.
TEC Status	Not listed under State or Commonwealth legislation.
Estimate of percent cleared value of PCT	43 % (OEH 2017b).

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PCT 1245: Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	
PCT 1245 – low condition	

3.2.4 Threatened ecological communities

Illawarra Subtropical Rainforest in the Sydney Basin Bioregion is listed as an EEC under the BC Act, which is synonymous with the Commonwealth listed CEEC *Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion* (Figure 5.2).

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3.3 Vegetation integrity assessment

3.3.1 Vegetation zones

PCTs within the impact area were assessed and stratified, based on broad condition state, into vegetation zones. This resulted in two vegetation zones identified within the impact area. Table 4 describes each of the zones.

Table 4 Vegetation zones mapped within the impact area

Vegetation zone	Vegetation type	Condition	Area (ha)	Plots surveyed
1	PCT 906 - Illawarra Escarpment Subtropical Rainforest	Moderate	0.01 ha	1 plot
2	PCT 1245 - Illawarra Escarpment Blue Gum Wet Forest	Low	0.02 ha	1 plot

3.3.2 Vegetation integrity

Vegetation integrity was assessed using data obtained from undertaking BAM plots, as per the methodology outlined in Section 5.3.4 of the BAM (OEH 2017a). Plot data was collected via:

- A 20 metre x 50 metre quadrat and 50 metre transect for assessment of site attributes and function.
- A 20 metre x 20 metre quadrat, nested within the larger quadrat for full floristic survey to determine composition and structure of the PCT.

The minimum number of BAM plots per vegetation zone was determined using Table 6 of the BAM (OEH 2017a). A total of two BAM plots were completed within the subject land. An assessment of vegetation integrity was undertaken using benchmark data collected as outlined in Subsection 5.3.3 of the BAM.

No additional local data was used for this assessment.

A list of flora species was compiled, and records of all flora species will be submitted to EES for incorporation into the Atlas of NSW Wildlife, and is included in Appendix 3.

3.3.3 Vegetation integrity score

Plot data were entered into the BAM calculator to determine vegetation integrity score. Plot data are presented in Appendix 2. Vegetation integrity scores for the vegetation zones are provided in Table 5.

Table 5 Vegetation zone integrity scores

PCT (No)	Vegetation zone	Composition condition score	Structure condition score	Function condition score	Vegetation integrity score
906	1	59.5	77.8	58.7	64.8
1245	2	19.8	44.3	74.1	40.2

As outlined in Section 10.3.1 of the BAM, an offset is required for impacts on native vegetation where the vegetation integrity score is:

- ≥15 where the PCT is representative of an endangered or critically endangered ecological community.

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- ≥17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community.
- ≥20 where the PCT is not representative of a TEC or associated with threatened species habitat.

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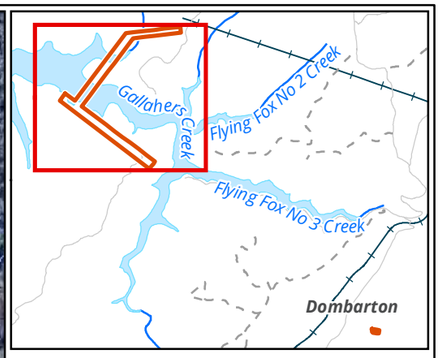

Legend

Study area

Threatened Ecological Communities

Coastal Upland Swamp in the Sydney Basin Bioregion (Endangered, BC Act and EPBC Act)

Figure 5.1 TECs in the study area

0 50 100 150 200 250

Metres

N

Scale: 1:6,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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Matter: 31606,
Date: 18 August 2020,
Checked by: SMM, Drawn by: AEDM, Last edited by: amurray
Location: P:\31600s\31606\Mapping\31606_F5_TECs.mxd

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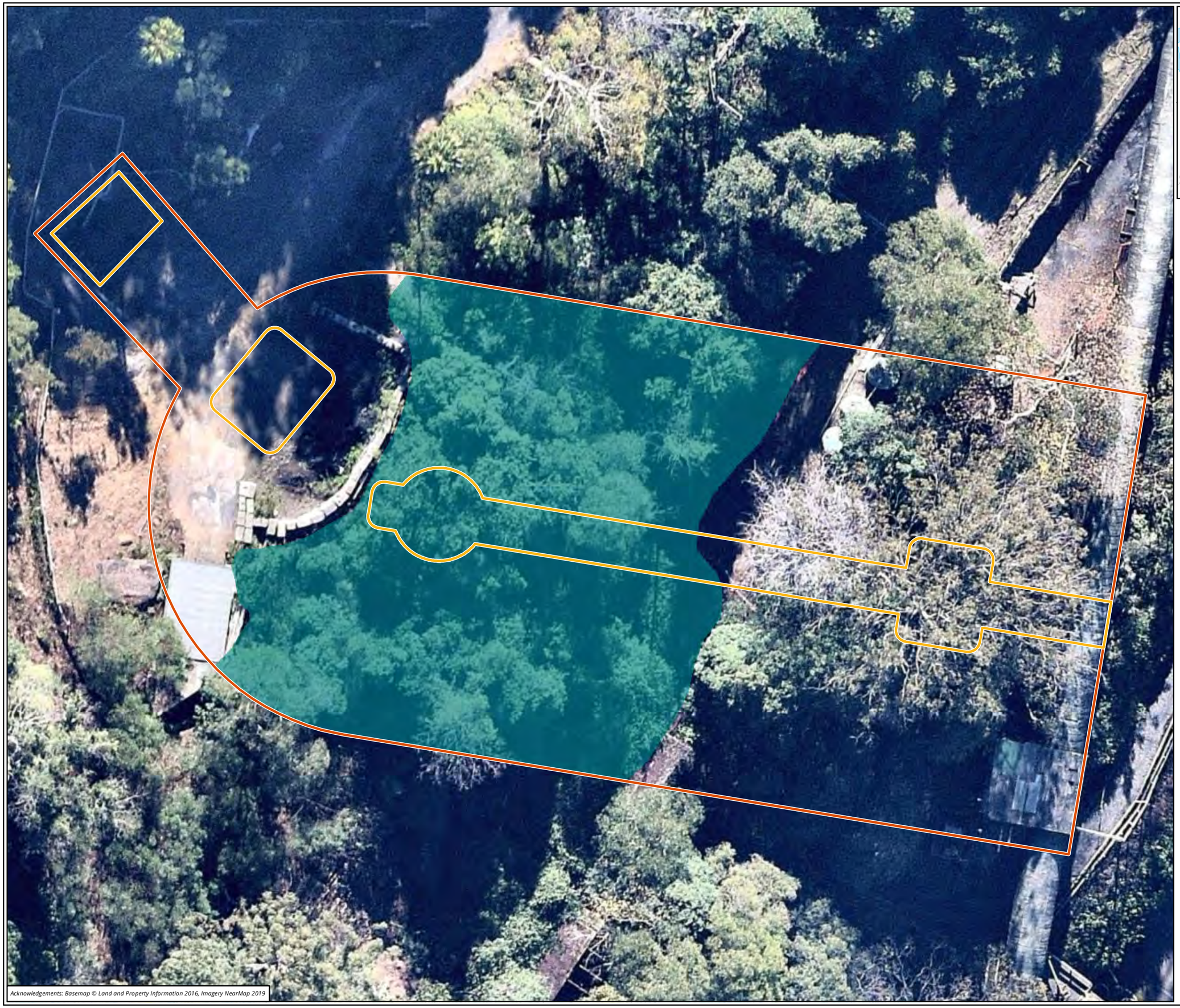
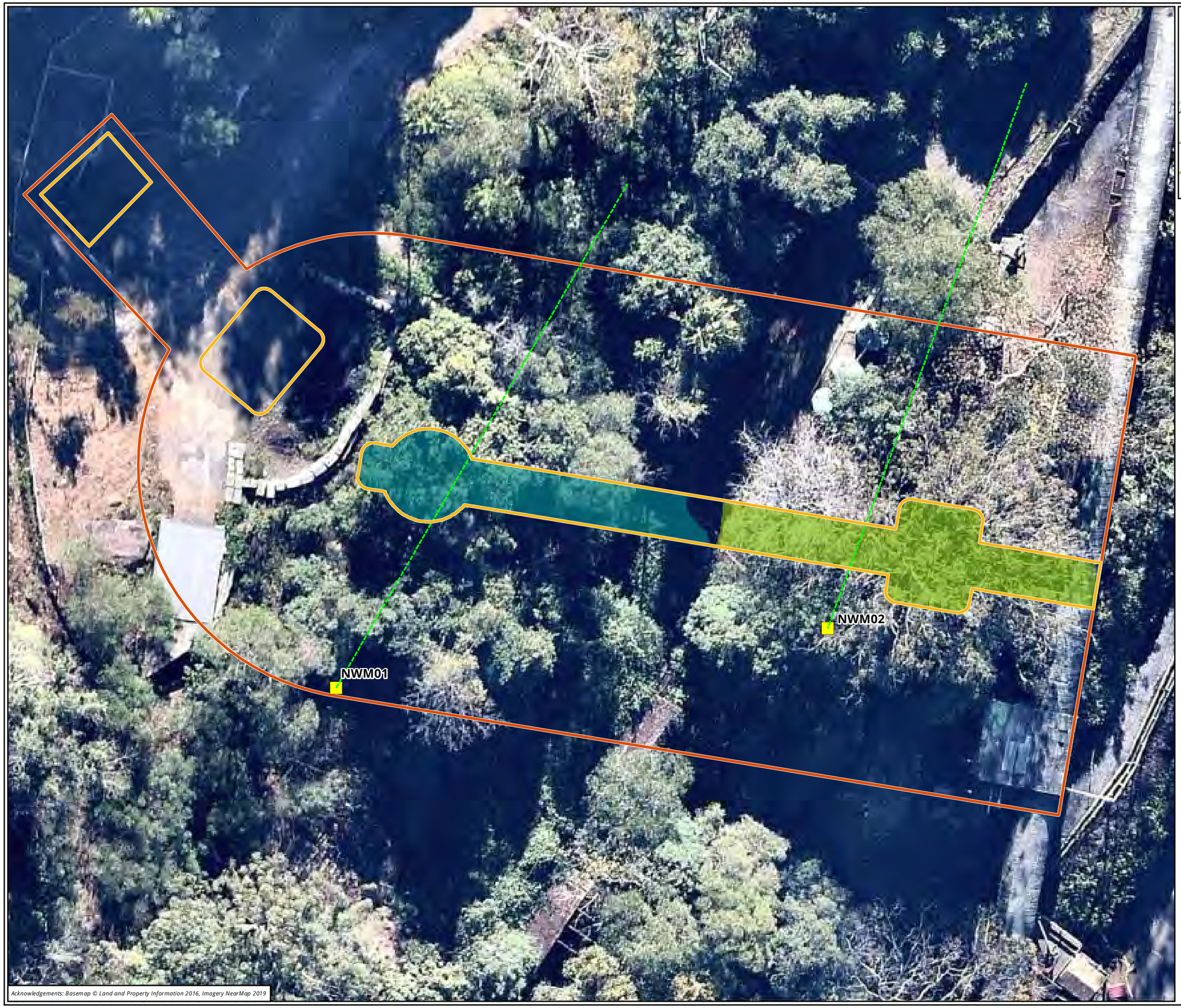
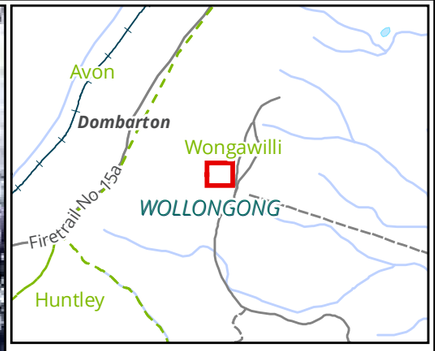


Figure 5.2 TECs in the study area





Legend

- Study area
- Subject land
- Transcript
- BAM plot

Vegetation zones

- VZ1 - PCT 906 - Moderate
- VZ2 - PCT 1245 - Low

Figure 6 Vegetation zones

0 2 4 6 8 10

Metres

N

Scale: 1:300 @ A3

Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 31606,
Date: 21 August 2020,
Checked by: SMM, Drawn by: AEDM, Last edited by: skumar
Location: P:\31600s\31606\Mapping\31606_F6_VegZones.mxd

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Acknowledgements: Basemap © Land and Property Information 2016, Imagery NearMap 2019

3.4 Results – Additional Driveage

3.4.1 Vegetation description

As previously stated, a geotechnical report provided by SCT Operations Pty Ltd concluded that there is no potential for any perceptible surface subsidence impacts as a result of the proposed Additional Driveage.

The field investigation within the Additional Driveage included the assessment of floristic plots within each vegetation zone in accordance with Section 5 of the BAM (OEH 2017a). This information was recorded so that any potential indirect that might occur as a result of the proposed development could be assessed.

The following PCTs were assessed as present within the within the Additional Driveage and are shown in Figure 4:

- PCT 878 - *Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion* (high condition).
- PCT 1083 - *Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion* (high condition).
- PCT 1127 - *Sandstone cliff-face soak of the Sydney Basin Bioregion* (high condition).
- PCT 1250 - *Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion* (high condition).
- PCT 1292 - *Water Gum - Coachwood riparian scrub along sandstone streams, Sydney Basin Bioregion* (high condition).
- PCT 1804 - *Needlebush - Banksia wet heath swamps on coastal sandstone plateaus of the Sydney basin* (high condition).

The BAM plot data collected within the Additional Driveage is included in Appendix 3.

3.4.2 Threatened ecological communities

PCT 1804 recorded within the Additional Driveage meets the listing for the TEC *Coastal Upland Swamp in the Sydney Basin Bioregion,* which is listed as Endangered under both the BC Act and the EPBC Act (Figure 5).

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4 Threatened species

4.1 Predicted species

A list of predicted species (ecosystem credit species) expected to occur within the subject land was generated as per Section 6 of the BAM. Impacts to these species require assessment, however targeted survey is not required as these species are assumed to occur, based on the occurrence of PCT 906 and PCT 1245 within patches larger than 100 hectares. Table 6 lists the ecosystem credit species that could not be discounted from occurring within the study area.

These species were considered when prescribing management and mitigation measures for the proposal.

Table 6 Threatened ecosystem credit species (predicted species) with potential to occur

Common name	Species name
Broad-headed Snake	*Hoplocephalus bungaroides*
Dusky Woodswallow	*Artamus cyanopterus cyanopterus*
Eastern Coastal Free-tailed Bat	*Micronomus norfolkensis*
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*
Gang-gang Cockatoo	*Callocephalon fimbriatum*
Glossy Black-Cockatoo	*Calyptorhynchus lathami*
Golden-tipped Bat	*Phoniscus papuensis*
Greater Broad-nosed Bat	*Scoteanax rueppellii*
Grey-headed Flying-fox	*Pteropus poliocephalus*
Koala	*Phascolarctos cinereus*
Large Bent-winged Bat	*Miniopterus orianae oceanensis*
Little Bent-winged Bat	*Miniopterus australis*
Little Eagle	*Hieraaetus morphnoides*
Little Lorikeet	*Glossopsitta pusilla*
Masked Owl	*Tyto novaehollandiae*
Olive Whistler	*Pachycephala olivacea*
Powerful Owl	*Ninox strenua*
Regent Honeyeater	*Anthochaera phrygia*
Rose-crowned Fruit-Dove	*Ptilinopus regina*
Sooty Owl	*Tyto tenebricosa*
Spotted-tailed Quoll	*Dasyurus maculatus*
Square-tailed Kite	*Lophoictinia isura*

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Superb Fruit-Dove	*Ptilinopus superbus*
Swift Parrot	*Lathamus discolor*
Varied Sittella	*Daphoenositta chrysoptera*
Yellow-bellied Glider	*Petaurus australis*
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*

4.2 Species credit species

Appendix 2 provides the lists of species credit species predicted to occur within the subject land based on the presence of PCT 906 and PCT 1245, both within a patch greater than 100 hectares. The potential for a species to occur within the subject land was assessed in accordance with Sections 6.3 and 6.4 of the BAM and species with geographical or habitat constraints present within the subject land were not required to be surveyed. An assessment of potential occurrence, and potential for impact, for all species credit species is also provided in Appendix 2. Species credit species with moderate likelihood of occurrence or higher were either assumed present, or targeted surveys were undertaken to confirm presence/absence within the subject land.

The subject land contains rainforest vegetation with areas of dense understorey that could provide potential foraging habitat for Pink Robin (Vulnerable, BC Act). This species inhabits rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies (OEH 2017c). The species uses the perch-and-pounce method of foraging, often from the ground or understorey vegetation. As this species is highly mobile, there is a possibility that it could occur within the subject land, and thus the species has been assumed present.

Two human-made structures that could provide potential roosting or breeding habitat for threatened microbat species were recorded within 100 metres of the proposed works. These are the old gantry and tumbler house, and the existing mine tunnel entrance (Figure 7). Neither structure is currently in use by WCL, and both are connected to each other and a network of other adits through an underground tunnel system. Several microbat species have previously been recorded utilising these structures, including the threatened Large Bent-winged Bat (Vulnerable, BC Act) (BioNet 2020). The structures may also provide breeding and roosting habitat for Large-eared Pied Bat (Vulnerable, BC Act and EPBC Act) and Little Bent-winged Bat (Vulnerable, BC Act). These three species have been assumed present within the subject land.

All of the 0.03 hectares of vegetation to be impacted by the Wongawilli Top Pit proposed works was considered habitat for each species credit species assumed present, these species are listed in Table 7.

Table 7 Threatened species credit species (candidate species) assumed present

Species name	Common name
Fauna	
Chalinolobus dwyeri	Large-eared Pied Bat
Miniopterus australis	Little Bent-winged Bat
Miniopterus orianae oceanensis	Large Bent-winged Bat
Petroica rodinogaster	Pink Robin

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4.2.1 Biodiversity risk weighting

Table 6 outlines the Biodiversity Risk Weighting for threatened species potentially impacted by the proposed works.

Table 8 Threatened species Biodiversity Risk Weighting

Scientific name	Common name	Biodiversity Risk Weighting
Fauna		
Chalinolobus dwyeri	Large-eared Pied Bat	3.0
Miniopterus australis	Little Bent-winged Bat	3.0
Miniopterus orianae oceanensis	Large Bent-winged Bat	3.0
Petroica rodinogaster	Pink Robin	2.0

4.3 Threatened species surveys

Targeted threatened flora species surveys of the study area were undertaken on 17 July 2020. Weather observations for the survey date are shown in Table 9.

Table 9 Weather observations during flora survey (Albion Park, NSW)

Survey undertaken	Survey date	Temperature (°C)		Rain (mm)
		Min.	Max.	
Targeted threatened flora survey	17 July 2020	11.3	15.5	0

Information from the Australia Government Bureau of Meteorology website.

4.3.1 Threatened flora habitat and survey

Threatened flora habitat occurs within areas of the Subtropical Rainforest and Wet Sclerophyll forest communities located on the lower extent of the Illawarra Escarpment.

An assessment of habitat requirements for threatened flora species likely to occur within the subject land was undertaken and is described further in Appendix 2.

Four species assessed to have a moderate likelihood of occurring within the subject land are known to prefer rainforest communities and have local occurrences, including the vegetation type within the subject land described in Table 2 and Table 3. Targeted surveys were undertaken for *Gossia acmenoides,* Illawarra Irene *Irenepharsus trypherus,* Scrub Turpentine *Rhodamnia rubescens* and *Solanum celatum*. These species were thoroughly searched for using targeted meanders in areas of potential habitat. Due to the small size of the subject land, it was not practical to undertake targeted transects. The approved survey period in accordance with the BAM for the above listed species fell within the time of survey for *Gossia acmenoides* and Scrub Turpentine. Although the survey was undertaken outside of time of survey for Illawarra Irene and *Solanum celatum* given the small size of the subject land and conspicuous nature of these species, survey effort is considered comprehensive to adequately assess for presence of these species.

No threatened flora species were recorded during the field survey as detailed above.

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4.3.2 Fauna habitat assessment and field investigation

A fauna habitat assessment was undertaken to determine whether the vegetation to be impacted by the proposed works at the Wongawilli Pit Top contained microhabitats suitable to support the threatened fauna species outlined in Appendix 2. The habitat assessments focused on the presence of the following features within the study area:

- Habitat trees including large hollow-bearing trees, availability of flowering shrubs and feed tree species.
- Condition of native vegetation and the presence of exotic species.
- Quantity of ground litter and logs.
- Searches for indirect evidence of fauna presence.
- Presence of caves, tunnels or culverts.
- General degradation of the site as a result of past industrial land management practices and lack of maintenance.

During the field investigation, only one hollow-bearing tree was recorded within the subject land, containing a hollow of medium size (Figure 4). The subject land lacked large hollows that would be suitable habitat for roosting owls such as Powerful Owl *Ninox strenua*, or larger mammals such as Spotted-tailed Quoll *Dasyurus maculatus*. No aquatic habitat was recorded within the subject land, and thus presence of threatened frog species such as Littlejohn's Tree Frog *Litoria littlejohni* or Red-crowned Toadlet *Pseudophryne australis* was considered unlikely. No banksias, bottlebrushes or other high quality feed species were recorded within the subject land that might provide foraging habitat for mammals such as Eastern Pygmy-possum *Cercartetus nanus*. A comprehensive assessment of the likelihood of occurrence for each potential species credit species is provided in Appendix 2.

No threatened fauna species were recorded during the field survey, and no further threatened fauna were considered likely to occur within the subject land in addition to those assumed present (Pink Robin, Large-eared Pied Bat, Large Bent-winged Bat and Little Bent-winged Bat). Thus, no targeted threatened fauna surveys were required.

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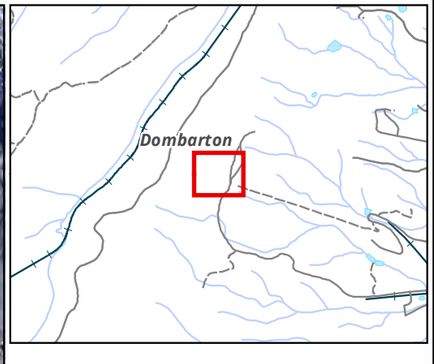

Legend

- Study area
- Subject land

Threatened microbat breeding habitat (Large-eared Pied Bat, Large Bent-winged Bat, Little Bent-winged Bat)

- Existing mine tunnel entrance
- Old gantry and tumbler house
- Microbat breeding habitat (100m buffer)

Figure 7 Threatened microbat breeding habitat

0 10 20 30 40

Metres

N

Scale: 1:1,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 31606,
Date: 12 August 2020,
Checked by: SMM, Drawn by: AEDM, Last edited by: amurray
Location: P:\31600s\31606\Mapping\31606_F7_MicrobatHabitat.mxd

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Acknowledgements: Basemap © Land and Property Information 2016, Imagery NearMap 2019

5 Aquatic habitats

The following section addresses the likelihood of occurrence of threatened aquatic species within the Additional Driveage. Waterbodies within the study area are described in Section 2.1.4. The project groundwater assessment concluded that there is no potential for any surface water or groundwater impacts as a result of the proposed Additional Driveage (SLR 2020), while the project geotechnical report similarly concluded that there is no potential for any perceptible surface subsidence impacts as a result of the proposed Additional Driveage (SCT 2020). This following information was recorded so that any potential indirect impacts that might occur as a result of the proposed development could be assessed.

Lake Avon

Within the study area and broader arm of Gallaghers Creek (upper extent of the Lake Avon dam influence), the Fish Community status has been classified by NSW DPI as very poor (DPIE 2020d). The NSW DPI has mapped indicative distribution for Macquarie Perch within the lower extent of Lake Avon, commencing approximately 6 kilometres downstream of the study area and continuing downstream along the Avon River (DPIE 2020d). Macquarie Perch have the potential to occur within the study area along Gallaghers Creek given the level of connectivity within Lake Avon.

There is a paucity of published literature or documentation regarding the fish community composition within Lake Avon. Several threatened fish species populations are known to occur within Lake Cataract which is located north of Lake Avon, which are believed to have been introduced via translocation (Table 10). There is the potential for similar translocations to have occurred within Lake Avon and the presence of these species within Lake Avon and the study area is therefore possible, but unknown.

Table 10 Threatened aquatic species believed to be translocated into Cataract Dam

Common name	Species name	FM Act	EPBC Act
Macquarie Perch	*Macquaria australasica*	Endangered	Endangered
Murray Cod	*Maccullochella peelii*	-	Vulnerable
Silver Perch	*Bidyanus bidyanus*	Vulnerable	Critically Endangered
Trout Cod	*Maccullochella macquariensis*	Endangered	Endangered

The project groundwater assessment concluded that there is no potential for any surface water or groundwater impacts as a result of the proposed Additional Driveage (SLR 2020), while the project geotechnical report similarly concluded that there is no potential for any perceptible surface subsidence impacts as a result of the proposed Additional Driveage (SCT 2020). It also concluded that inflows from Lake Avon into the proposed underground roadways is unlikely, although recommendations are provided if this was to occur.

Mapped tributaries of Lake Avon

No fish community status mapping or indicative threatened fish species mapping is located along the mapped tributaries of Lake Avon within the Additional Driveage study area. These streams are not considered to support suitable habitats for the threatened species listed above given their high slope, small size and more limited connectivity. These tributaries do however support habitats for non-threatened aquatic species such as Mountain Galaxias *Galaxias olidus* and Spiny Crayfish *Euastacus* spp.

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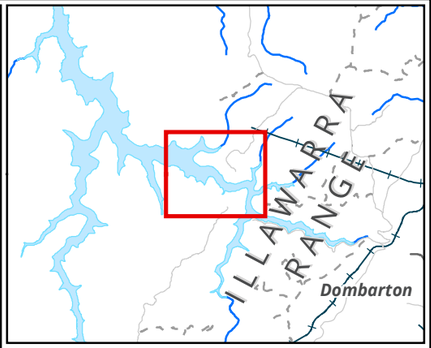

Legend

- Study area
- Waterway/drainage line (Biosis 2020)

Strahler stream order

- 1
- 2
- 3
- 4

Figure 8 Aquatic features

0 50 100 150 200 250

Metres

N

Scale: 1:6,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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Matter: 31606,
Date: 17 August 2020,
Checked by: SMM, Drawn by: AEDM, Last edited by: amurray
Location: P:\31600s\31606\Mapping\31606_F8_AquaticFeatures.mxd

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Stage 2 – Impact assessment (biodiversity values)

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6 Avoid and minimise impacts

This section identifies the potential impacts of the proposed work on the biodiversity values of the study area and subject land, and includes measures taken to date and additional recommendations to assist the final design of the development to further avoid and minimise impacts on biodiversity within and surrounding the subject land and study area. For clarity, avoidance and minimisation of impacts has been assessed separately for the Wongawilli Pit Top and the Additional Driveage.

6.1 Wongawilli Pit Top

6.1.1 Actions to avoid/minimise project impacts

The principal means to reduce impacts on biodiversity values within the study area is to avoid and/or minimise the removal of native vegetation and fauna habitat. Additional recommendations include measures to mitigate residual impacts after all measures to avoid and minimise impacts have been considered.

Steps undertaken to avoid and minimise impacts to biodiversity are broken down into site selection and planning, construction and operation. Further steps undertaken to minimise impacts to threatened microbats are included further below in Table 11 and Table 12.

Site selection and planning

The location of the proposed conveyor to be installed is necessary to connect the conveyor portal to the existing infrastructure at the Wongawilli Colliery. The reutilisation of infrastructure at the Wongawilli Colliery minimises impacts to native vegetation and flora and fauna habitats present within the broader study area, by avoiding construction of completely new infrastructure.

Construction

Mitigation measures recommended to avoid and minimise further indirect impacts to vegetation and habitat during the construction phase of the proposed works include:

- Installation of appropriate exclusion fencing around trees and vegetation to be retained in the study area.
- Installation of appropriate signage such as 'No Go Zone' or 'Environmental Protection Area'.
- Identification the location of any 'No Go Zones' in site inductions and a Construction Environmental Management Plan (CEMP).
- All material stockpiles, vehicle parking and machinery storage will be located within cleared areas or areas proposed for clearing, and not in areas of native vegetation that are to be retained.
- The proposed hollow-bearing tree to be removed should be placed in the area of retained vegetation to provide additional fauna habitat.
- Removal of the hollow-bearing tree should be supervised by a qualified ecologist.
- Where appropriate native vegetation cleared from the subject land should be mulched for re-use on the site, to stabilise bare ground.
- Wet down areas to reduce dust generation during construction.

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- Implementation of temporary stormwater controls during construction and to ensure that discharges to the drainage channels are consistent with existing conditions.
- Sediment and erosion control measures should be implemented prior to construction works commencing (e.g. silt fences, sediment traps), to protect current drainage channels. These should conform to relevant guidelines, should be maintained throughout the construction period and should be carefully removed following the completion of works.

The following mitigation measures will be undertaken by WCL in order to minimise any impact to potential threatened microbats utilising the old gantry and tumbler house (Table 11) or the existing mine tunnel entrance (Table 12) as a result of the proposed works.

Table 11 Impact management and mitigation strategies for the old gantry and tumbler house structures

Impact	Environmental management measure	Timing	Responsibility
Construction of coal conveyor adjacent to a potential roosting and breeding structures for threatened microbats	A microbat survey is to be undertaken during the day prior to the commencement of construction of the proposed conveyor. All potential habitat is to be inspected to confirm if microbats are present.	Pre-construction	Project Ecologist, Environmental Manager
	A detailed schedule of management, monitoring and mitigation measures specific to the construction phase of the project will be implemented in the CEMP.	Pre-construction	Project Ecologist, Environmental Manager
	Appropriate noise barriers are to be installed between the proposed conveyor and the old gantry and tumbler house before the start of construction, ensuring not to impede movement of microbats in and out of the structure.	Pre-construction	Environmental Manager, Contractors
	It will be ensured that any staff that are required to undertake works within the vicinity of the structure are briefed on the importance of minimising disturbance to the structure and any potential resident microbats.	Pre-construction	Environmental Manager, Site Foreman, Contractors
	Any necessary lighting required for the proposed works will be directed away from the structures, and designed such that light spill does not occur within retained vegetation.	Construction	Environmental Manager, Contractors
	WCL will maintain appropriate exclusion zones around the structures, and manage any night works by ensuring noise and light pollution is kept to a minimum, particularly through the breeding and lactation period (October and March) in the vicinity of the identified microbat habitat.	Construction, operation	Environmental Manager, contractors
	If it is identified that bats are present in torpor within the structure, fortnightly winter monitoring should be conducted during any upgrades or maintenance works to ensure that over-wintering roosting colonies are not being adversely impacted.	Construction, operation	Project Ecologist

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Impact	Environmental management measure	Timing	Responsibility
	Unexpected finds and stop works procedures are to be implemented if microbats are observed exiting the structure during construction.	Construction	Environmental Manager and Site Foreman
	Any permanent lighting required for operation of the proposed conveyor will be designed to be directed away from, and avoid light spill into, the structure and any retained vegetation.	Operation	Environmental Manager
	Permanent noise barriers will be constructed between the conveyor and the microbat structure, to minimise noise or vibration disturbance to resident microbats.	Operation	Environmental Manager
	The structure will be designated as a permanent no-go-zone to avoid disturbance to microbats from increased foot traffic in the vicinity.	Operation	Environmental Manager

Table 12 Impact management and mitigation strategies for the existing mine tunnel entrance

Impact	Environmental management measure	Timing	Responsibility
Reutilisation of the existing mine tunnel entrance that provides potential roosting and breeding habitat for threatened microbats	A pre-clearance survey is to be undertaken during the day in September or October, when individuals from all microbat species concerned would have returned to their breeding habitat prior to the breeding season. All areas with the potential to support microbat habitat within the existing mine tunnel entrance will be inspected.	Pre-construction	Project Ecologist, Environmental Manager
	If threatened microbats are not located during preclearance		
	All potential habitat found not to support microbats during pre-clearance surveys and considered likely to be impacted by the proposed works is to have temporary exclusion measures installed to prevent microbats from moving in before works begin. These measures are to be installed immediately following the pre-clearance survey, to ensure microbats do not move into the habitat overnight. Exclusion measures may include: • Thick tape (such as bitumen tape) or plywood installed over habitat. • Expanding foam to remove cracks and gaps that may be utilised by microbats. • Sealing of all side entrances that connect the existing tunnel to other inactive sections of the adit system, including the old gantry and tumbler house. Sealing off of these entrances will ensure that microbats are able to continue	Pre-construction	Project Ecologist, Environmental Manager

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Impact	Environmental management measure	Timing	Responsibility
	utilising inactive adit structures, without exposure to works within the exiting tunnel entrance. Exclusion measures are to be confirmed sufficient and effective by a qualified ecologist prior to works beginning. Any habitat not considered likely to be impacted by the works, for example permanently unused sections within the adit system are to remain available to any displaced microbats. This will include the installation of bat-friendly gates at any entrances to the system available to microbats. A detailed schedule of management, monitoring and mitigation measures specific to the construction phase of the project will be implemented in the CEMP.		
	If non-breeding threatened microbats are located during preclearance		
	If microbats are found to be present in the existing tunnel entrance during the pre-clearance inspection, but are not likely to be utilising the structure as a maternity roost (i.e. no evidence of pregnant or lactating females) then temporary exclusion measures are to be installed overnight once the bats have left the roost to forage. Planned roost exclusion can only be conducted outside the breeding season (October – March) and over wintering time (mid-May to August) under the supervision of a qualified ecologist to ensure all microbats have vacated the roost. The following safeguards must be considered to minimise potential impacts to displaced bats: • Ensure that this procedure is not conducted during an extensive dry period (drought) as this could be detrimental and lead to mortality, if there is no nearby suitable habitat. • Avoid conducting this procedure during windy, full-moon, cold or rainy nights (i.e. >20 mm in 24 hours), as there is a low likelihood of roost exodus. The most beneficial timing for planned roost exclusion is in autumn (mid-April – early May) and the start of spring (September). This would avoid both the breeding and overwintering period for microbats. If works and exclusion of roosting bats are required during the overwintering months (mid-May to August), when many culvert roosting bats enter torpor (hibernation state), the following additional safeguards must be adhered to: • Nocturnal monitoring of roost activity is to be undertaken by a qualified ecologist, and bats must be confirmed as leaving the roost to forage on at least two separate occasions prior to installation of exclusion measures.		

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Impact	Environmental management measure	Timing	Responsibility
	• If bats are not confirmed as leaving the roost to forage (ie. in winter torpor) additional monitoring is to be undertaken until regular foraging has resumed. • Works are not to impact upon the tunnel with bats present in winter torpor. Additional safeguards that must be considered when exclusion devices are installed include: • All roost exclusion should be done after dusk, once individuals have emerged to feed and an ecologist is satisfied no microbat individuals remain within the roost. • Roosting habitat that has been sealed must be regularly monitored to ensure the sealing mechanism remains intact and no microbats are able to utilise the habitat. If it is suspected that the exclusion mechanism has failed then an ecologist must re-inspect the habitat before the seal is reapplied. • Alternative roosting habitat should be made or left available wherever possible when undertaking passive roost exclusion.		
	If breeding threatened microbats are located during preclearance		
	Although unlikely, if threatened microbats are found to be present in the existing tunnel entrance during the preclearance survey, and appear to be in breeding condition (ie. pregnant or lactating females, presence of young), any use of the tunnel will be immediately postponed and appropriately qualified ecologists will be consulted to determine the most appropriate steps to be taken. Appropriate approval authorities would also be notified. Maternity roosts are considered habitat critical to the survival of these species.		
	Reports are to be provided outlining the findings of pre-clearance assessments and detailing the exclusion measures installed and procedure (if required).	All works	Project Ecologist
	Unexpected finds and stop works procedure are to be implemented if microbats are observed within the existing tunnel during works.	Construction, operation	Site Foreman, Environmental Manager and Project Ecologist

Operation

The following recommendations are made to avoid impacts resulting from 'operation' of the proposed works:

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- Any lighting required around the facility should point towards the development and not into surrounding vegetated areas.
- On-going treatment of exotic species from within retained vegetation should be undertaken to assist vegetation resilience and quality.

6.2 Additional Driveage

6.2.1 Actions to avoid/minimise project impacts

WCL proposes to develop the four proposed underground roadways within the Additional Driveage footprint using the bord and pillar first workings methodology. This process is described in Section 1.1.1.

The geotechnical assessment provided by SCT concludes that there is no potential for the proposed roadways development to cause surface ground movement of any consequence. Any surface subsidence is expected to be so small as to be imperceptible for all practical purposes (SCT 2020).

Although this mining methodology is less economically viable than the longwall mining method most often used by WCL, WCL have proposed the first workings methodology to eliminate any direct impacts to surface biodiversity values, and substantially reduce the possibility for indirect impacts as a result of the works.

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7 Assessment of unavoidable impacts

Assessment of direct and indirect impacts unable to be avoided has been undertaken in accordance with the BAM (OEH 2017a). The following direct and indirect impacts are unable to be avoided in progressing the proposed works.

7.1 Direct impacts

7.1.1 Wongawilli Pit Top

Direct impacts arising from the project within the subject land at the Wongawilli Pit Top include:

- Removal of 0.01 hectares of moderate condition PCT 906 Illawarra Escarpment subtropical rainforest consistent with the TEC *Illawarra Subtropical Rainforest in the Sydney Basin Bioregion* (Endangered, BC Act, Critically Endangered, EPBC Act).
- Removal of 0.02 hectares of low condition PCT 1245 Illawarra Escarpment Blue Gum wet forest.
- Removal of 0.03 hectares of vegetation considered to be foraging and breeding habitat for three threatened microbat species, Large-eared Pied Bat, Large Bent-winged Bat and Little Bent-winged Bat.
- Removal of 0.03 hectares of vegetation considered to be foraging habitat for Pink Robin.

These impacts will be permanent and will occur from the outset of the development. Mitigation measures outlined in Section 6.1.1 above and in Sections 7.3.4 and 8.1.1 below will help to minimise the potential impacts to biodiversity values that remain present within the study area.

7.1.2 Additional Driveage

No direct impacts to biodiversity values will occur as a result of the proposed works within the Additional Driveage.

7.2 Indirect impacts

Potential indirect impacts arising from the project are outlined and addressed in Table 13 below.

Table 13 Assessment of indirect impacts

Indirect impact	Assessment / likelihood of occurrence
Inadvertent impacts on adjacent habitat or vegetation.	Potential inadvertent impacts to adjacent vegetation or habitat that may occur as a result of the proposed works include increases in noise, dust, vibration, light and human traffic during construction and operations. These impacts are addressed below, and appropriate mitigation measures are provided in Section 6. Impacts to adjacent vegetation and habitat will also be minimized through the implementation of a CEMP and Operation Environmental Management Plan (OEMP) detailing best practice environmental protection measures. No impacts to habitat or vegetation are predicted as a result of works within the Additional Driveage.

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Indirect impact	Assessment / likelihood of occurrence
Reduced viability of adjacent habitat due to edge effects.	Vegetation within the Wongawilli Pit Top footprint is disturbed, and contains several weed species including Crofton Weed, Cape Ivy, Lantana, Pellitory and Madeira Winter Cherry. The vegetation within the study area is continuous with vegetation outside of the study area to the north and south, but is disrupted to the west by a cleared open area, and to the east by the current conveyor and private road. Edge effects can be seen at the eastern and western edge of the study area through presence of Lantana and absence of canopy species. Due to the removal of 0.03 ha of vegetation in a strip running from the eastern to western edge of the study area, there is potential for reduced viability of the surrounding vegetation due to further edge effects, including weed encroachment and spread. Mitigation measures such as continued weed treatment and monitoring have been provided in Section 6.1.1 in order to minimise this likelihood. No vegetation is proposed to be removed from the Additional Driveage, and thus no edge effects are likely.
Reduced viability of adjacent habitat due to noise, dust or light spill.	The removal of vegetation and construction of a coal conveyer within a larger patch of retained vegetation has the potential to result in reduced viability of habitat adjacent to the proposed works. This may occur as a result of noise, dust or light spill associated with both the construction and continued operation of the proposed conveyor impacting habitat quality for resident fauna such as birds, bats and small mammals. Mitigation measures undertaken to reduce such impacts will include the installation of noise barriers during conveyor construction, the directing of lighting away from adjacent vegetation, and design of lighting structures to avoid light spill into nearby vegetation. Such environmental protection measures will be detailed in the project CEMP. Importantly, as the proposed conveyor will be installed adjacent to the old gantry and tumbler house, which provides potential threatened microbat roosting and breeding habitat, there is potential for reduced viability of this habitat due to noise or light spill, both during construction and operation of the proposed conveyor. While mitigation measures during construction are detailed above, ongoing measures will be required in order to protect the viability of this habitat during ongoing conveyor operation. Mitigation measures will include the installation of permanent noise barriers in between the conveyor and the microbat habitat, ensuring movement of microbats into and out of the structure is not impeded. Any necessary permanent lighting required for operation of the conveyor will also be directed away from the gantry and tumbler house, and light spillage into vegetated areas will be avoided. This should substantially reduce noise and light impacts to potential microbats utilising the old gantry and tumbler house. Similarly, the re-use of the existing mine tunnel entrance may reduce the viability of this structure as habitat for threatened microbats. Proposed mitigation measures include a preclearance survey, exclusion measures and follow up monitoring.

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Indirect impact	Assessment / likelihood of occurrence
	The mitigation measures required for the reduction of impacts to threatened microbat habitat are discussed more comprehensively above, in Section 6.1.1. No such impacts are predicted as a result of works within the Additional Driveage.
Transport of weeds and pathogens from the site to adjacent vegetation.	Weeds occurring within the Wongawilli Pit Top include Crofton Weed, Cape Ivy, Lantana, Pellitory and Madeira Winter Cherry, and are common throughout the subject site, with those also occurring within adjacent vegetation to be retained. As the vegetation to be retained is in similar condition, increased transport of pathogens and weeds is unlikely to occur. Regardless, measures to ensure adequate control of weeds and pathogens will be detailed and managed by biosecurity measures outlined in the CEMP and OEMP. No transport of weeds is predicted as a result of works within the Additional Driveage.
Increased risk of starvation, exposure and loss of shade or shelter.	A single hollow-bearing tree will be removed from the subject land, and the habitat present is considered marginal for most fauna species given the disturbed condition. Removal of 0.03 hectares of vegetation within a patch greater than 100 ha is unlikely to result in increased risk of starvation, exposure or loss of shade or shelter to fauna or flora within the surrounding landscape.
Loss of breeding habitats.	Potential microbat breeding habitat exists within the Wongawilli Pit Top, encompassing the old gantry and tumbler house, and the existing mine tunnel entrance. Due to the removal of vegetation and construction of a coal conveyer adjacent to the old gantry and tumbler house, there is potential for disturbance to this habitat due to noise, light or increased foot traffic. The existing mine tunnel will also be disturbed as it is proposed to be reused for coal transport as a part of the proposed works. The mitigation measures that WCL will employ to reduce the likelihood of impacts to resident microbats have been provided in detail in Section 6.1.1 above, and include installation of noise barriers, redirection of light and under certain circumstances, exclusion of bats from portions of the study area. These mitigation measures are expected to substantially reduce the risk of indirect impacts to microbat breeding habitat. No such impacts are predicted as a result of works within the Additional Driveage.
Trampling of threatened flora species.	No threatened flora species were found, or are considered likely to occur, within the subject land, and thus trampling of threatened flora species is unlikely.
Inhibition of nitrogen fixation and increased soil salinity.	The removal of 0.03 ha of vegetation at Wongawilli Pit Top within a patch greater than 100 ha is unlikely to result in any changes to nitrogen fixation or soil salinity within the locality.

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Indirect impact	Assessment / likelihood of occurrence
Fertiliser drift.	No fertiliser is proposed to be used.
Rubbish dumping.	The proposed works will not increase the exposure of the subject land to the general public, and do not occur on public lands. An increase in rubbish dumping as a result of the proposed works is unlikely. All contractors are to dispose of waste appropriately.
Wood collection.	The proposed works will not increase the exposure of the subject land to the general public, and an increase in wood collection as a result of the proposed works is unlikely.
Bush rock removal and disturbance.	The Wongawilli Pit Top does not support bush rock. The proposed works at the Additional Driveage are underground, and the surface occurs within Water NSW restricted access lands, thus bush rock disturbance is highly unlikely.
Increase in predatory species populations.	Removal of 0.03 ha of vegetation within a patch greater than 100 ha at Wongawilli Pit Top is unlikely to increase predatory species populations within the locality.
Increase in pest animal populations.	The study area and surrounds likely support several pest animal species including Red Fox *Vulpes vulpes*, Feral cats *Felis catus* and several species of deer. The OEMP will detail monitoring and management measures to ensure that the presence of such species does not increase due to the ongoing operation of the proposed conveyor, for example through increases in rubbish that might attract pest species. Overall, the removal of 0.03 ha of vegetation within a patch greater than 100 ha at Wongawilli Pit Top is unlikely to increase the presence of pest animal populations within the locality.
Increased risk of fire.	Removal of 0.03 ha of vegetation within the subject land will involve the use of machinery within vegetation that forms a patch larger than 100 ha. The risk of fire as a result of sparks from machinery during works is unlikely, but could be catastrophic if spread to surrounding bushland. This risk should be managed by implementing appropriate mitigation measures such as spark dampeners, water spraying or the close proximity of fire-fighting gear such as extinguishers. Ongoing operation of the proposed conveyor within the study area after construction may also pose a small fire risk to surrounding bushland if a mechanical issue was to cause a spark. Fire-fighting equipment such as extinguishers should remain in close proximity to the proposed conveyor permanently. This will ensure substantially reduce the fire risk that the proposed works might pose to the study area and surrounds.
Disturbance to specialist breeding and foraging habitat, e.g. Beach nesting for shorebirds.	Vegetation within the Wongawilli Pit Top is disturbed, and does not provide high quality fauna habitat. The subject land lacks large hollows that would be suitable habitat for roosting owls such as Powerful Owl *Ninox strenua*, or larger mammals such as Spotted-tailed Quoll *Dasyurus maculatus*. No aquatic habitat was recorded within the subject land, and thus presence of threatened frog species such as Littlejohn's Tree Frog *Litoria littlejohni* or

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Indirect impact	Assessment / likelihood of occurrence
	Red-crowned Toadlet *Pseudophryne australis* was considered unlikely. No banksias, bottlebrushes or other high quality feed species were recorded within the subject land that might provide foraging habitat for mammals such as Eastern Pygmy-possum *Cercartetus nanus*. A comprehensive assessment of the likelihood of occurrence for each potential species credit species is provided in Appendix 2. Potential microbat breeding habitat does exist within the study area, encompassing the old gantry and tumbler house, and the existing mine tunnel entrance. As discussed above, the removal of vegetation and construction of a coal conveyer adjacent to the old gantry and tumbler house has potential to disturb this habitat due to noise, light or increased foot traffic. The existing mine tunnel will also be disturbed as it is proposed to be reused for coal transport as a part of the proposed works. The mitigation measures that WCL will employ to reduce the likelihood of impacts to resident microbats have been provided in detail in Section 6.1.1 above, and include installation of noise barriers, redirection of light and under certain circumstances, exclusion of bats from portions of the study area. These mitigation measures are expected to substantially reduce the risk of indirect impacts to microbat breeding habitat. No such impacts are predicted as a result of works within the Additional Driveage.
Fragmentation of movement corridors.	Removal of 0.03 ha of vegetation within a patch larger than 100 ha at Wongawilli Pit Top is unlikely to affect movement corridors within the locality.

7.3 Prescribed impacts

7.3.1 Definition of prescribed impacts

Prescribed impacts can be defined generally as impacts on biodiversity values that do not comprise direct clearing of native vegetation that are assessed through credits. Prescribed impacts can be direct impacts (e.g. impacts on species' habitat of a type that is not native vegetation, such as rocks) or indirect impacts (e.g. impacts on species associated with the severing of a habitat corridor). Prescribed impacts comprise impacts on (Clause 6.1, BC Regulation):

- Habitat features for threatened species or TECs including:
  - Karst, caves, crevices, cliffs and other geological features of significance.
  - Rocks.
  - Human-made structures.
  - Non-native vegetation.
- Connectivity of habitat of threatened species that facilitates the movement of those species across their range.

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- Movement of threatened species that maintains their lifecycle.
- Water quality, water bodies and hydrological processes that sustain threatened species and TECs.
- Wind turbine strikes on protected fauna.
- Vehicle strikes on threatened fauna or fauna that is part of a TEC.

The following assessment of prescribed impacts has been undertaken for both the Wongawilli Pit Top and the Additional Driveage. To determine the threatened species and TECs requiring consideration for prescribed impacts within the Additional Driveage, a field investigation was undertaken by Biosis within the Additional Driveage footprint, and BAM plots were used to identify the PCTs present within the footprint (Appendix 3). Habitat features were also identified, and the BAM calculator was used to generate a list of SCS and ECS for the Additional Driveage footprint (Appendix 5). The relevant threatened species and TECs generated in this list are discussed below.

7.3.2 Karsts, caves, crevices and cliffs

List of relevant species and TECs

The list of species associated with karst, caves, crevices and cliffs is shown below in Table 14.

Table 14 Species associated with karst, caves, crevices, cliffs and other geological features

Relevant species	Associated footprint	Use and importance of habitat type
Broad-headed Snake (Endangered, BC Act, Vulnerable, EPBC Act)	Wongawilli Pit Top, Additional Driveage	Broad-headed Snake may use rocky areas and crevices for refuge. Adults shelter in rocky outcrops under flat sandstone rocks on exposed cliff edges during autumn, winter and early spring, then move to adjacent woodland within 500 m of rocky areas during late spring and summer. Pregnant females and juveniles remain in rocky habitat, using cooler, shaded rocks and crevices (DPIE 2017). Appropriate habitat for this species does not occur within the Wongawilli Pit Top, but may occur within the Additional Driveage as rocky outcrops on cliff edges and rock crevices.
Large-eared Pied Bat (Vulnerable, BC Act and EPBC Act)	Wongawilli Pit Top, Additional Driveage	Large-eared Pied Bat roosts in caves (near their entrances), crevices in cliffs and old mine workings. No geological structures suitable as habitat for this species occur at the Wongawilli Pit Top. No caves appropriate for roosting were recording within the Additional Driveage.
Large Bent-winged Bat (Vulnerable, BC Act)	Wongawilli Pit Top, Additional Driveage	Large Bent-winged Bat roosts in caves, derelict mines, storm water tunnels, buildings and other man-made structures. They form discrete populations centred on a maternity cave that is used annually in spring and summer. Maternity caves have very specific temperature and humidity regimes. No geological structures suitable as habitat for this species occur at the Wongawilli Pit Top. No caves appropriate for roosting were recording within the Additional Driveage.
Little Bent-winged Bat (Vulnerable, BC Act)	Wongawilli Pit Top, Additional Driveage	Little Bent-winged Bat roosts in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and buildings. Maternity colonies form in spring and birthing occurs in early summer. Only five maternity colonies are known in Australia.

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Relevant species	Associated footprint	Use and importance of habitat type
		No geological structures suitable as habitat for this species occur at the Wongawilli Pit Top. No caves appropriate for roosting were recording within the Additional Driveage.

Occurrence of habitat or prescribed impact type

The study area is located within the Illawarra Escarpment and Plateau. These areas are comprised of massive beds of durable quartz sandstone. Beneath the cliffs, weaker claystone tends to erode more rapidly and undermine the sandstone causing the cliffs to periodically collapse. The vegetative slopes below the escarpment that sweep down from the cliffs to the coastal plain are made of shales, claystones and coal seams. In many places, erosion-resistant layers of strata protrude from the slopes and form flat benches. The shale and claystones provide the high nutrient levels required to support the lush rainforests that grow below the escarpment (Young 1979).

The Wongawilli Pit Top is located on a flat bench, and does not contain any caves, karsts, cliffs or areas of geological significance.

The Additional Driveage is located on the Illawarra Plateau, and contains two clifflines under which Lake Avon is located (Figure 1). There are also rocky outcrops scattered throughout the footprint, as well rocky areas containing considerable crevices.

Nature, extent and duration of impacts

Impacts to karsts, caves, crevices and cliffs are unlikely to occur as a result of the NWMD development. At the Wongawilli Pit Top, no geological features will be impacted by the proposed works. At the Additional Driveage, geological features may be at risk of impact only if subsidence occurs as a result of mining activities. However, the preliminary subsidence and geotechnical assessment for the project (SCT Operations 2020) confirmed that due to the use of first-workings mining methods, there is no potential for perceptible subsidence impacts as a result of the proposed works.

Overall, there are unlikely to be impacts to threatened species or TECs associated with karst, caves, crevices and cliffs as a result of the proposed works, and thus the consequence of such occurrences is predicted to be nil.

7.3.3 Rocky areas

List of relevant species and TECs

The list of species associated with karst, caves, crevices and cliffs is shown below in Table 15

Table 15 Species associated with rocky areas

Relevant species	Associated footprint	Use and importance of habitat type
Broad-headed Snake (Endangered, BC Act, Vulnerable, EPBC Act)	Wongawilli Pit Top, Additional Driveage	Broad-headed Snake may use rocky areas for refuge. Adults shelter in rocky outcrops under flat sandstone rocks on exposed cliff edges during autumn, winter and early spring, then move to adjacent woodland within 500 m of rocky areas during late spring and summer. Pregnant females and juveniles remain in rocky habitat, using cooler, shaded rocks and crevices (DPIE 2017). Appropriate habitat for this species

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Relevant species	Associated footprint	Use and importance of habitat type
		does not occur within the Wongawilli Pit Top, but may occur within the Additional Driveage as rocky outcrops on cliff edges and rock crevices.
Red-crowned Toadlet (Vulnerable, BC Act)	Wongawilli Pit Top, Additional Driveage	Red-crowned Toadlet may use rocky areas for breeding and refuge, and is largely restricted to the immediate vicinity of these areas. Breeding habitat comprises dense vegetation and debris beside ephemeral creeks and gutters (DPE 2017a). The species deposits eggs in terrestrial nests beneath rocks and logs or in leaf litter (NSW Scientific Committee 2019). Outside the breeding period, the species disperses to refuge areas close to breeding sites, which comprise rocks and masses of dense vegetation or thick piles of leaf litter generally on sandstone ridges (DPE 2017a). No Red-crowned Toadlet habitat occurs within the Wongawilli Pit Top, but may occur within the Additional Driveage due to the presence of rocky outcrops on sandstone ridges, as well as nearby records of the species.

Occurrence of habitat or prescribed impact type

The Wongawilli Pit Top does not contain naturally rocky areas that could be used as habitat for the species above. The Additional Driveage however, contains rocky outcrops scattered throughout the footprint, as well as rocky creeklines and cliff areas.

Nature, extent and duration of impacts

Impacts to rocky areas are unlikely to occur as a result of the NWMD development. At the Wongawilli Pit Top, no rocky areas will be impacted by the proposed works. At the Additional Driveage, rocky areas would only be at risk of impact if substantial subsidence of the ground occurs as a result of mining activities. However, the subsidence and geotechnical assessment for the project (SCT Operations 2020) confirmed that due to the use of first-workings mining methods, there is no potential for perceptible subsidence impacts as a result of the proposed works.

Overall, there are unlikely to be impacts to threatened species or TECs associated with rocky areas as a result of the proposed works, and thus the consequence of such occurrences is predicted to be nil.

7.3.4 Human-made structures

List of relevant species and TECs

The list of species associated with human-made structures is shown below in Table 16.

Table 16 Species associated with human-made structures

Relevant species	Associated footprint	Use and importance of habitat type
Large-eared Pied Bat (Vulnerable, BC Act and EPBC Act)	Wongawilli Pit Top, Additional Driveage	Large-eared Pied Bat roosts in caves (near their entrances), crevices in cliffs and old mine workings. Within the Wongawilli Pit Top two human-made features that could provide potential roosting/breeding habitat for this species occur within 100 m of the proposed works and are discussed below.

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Relevant species	Associated footprint	Use and importance of habitat type
		No man-made structures exist within the Additional Driveage.
Large Bent-winged Bat (Vulnerable, BC Act)	Wongawilli Pit Top, Additional Driveage	Large Bent-winged Bat roosts in caves, derelict mines, storm water tunnels, buildings and other man-made structures. They form discrete populations centred on a maternity cave that is used annually in spring and summer. Maternity caves have very specific temperature and humidity regimes. Within the Wongawilli Pit Top two human-made features that could provide potential roosting/breeding habitat for this species occur within 100 m of the proposed works and are discussed below. No man-made structures exist within the Additional Driveage.
Little Bent-winged Bat (Vulnerable, BC Act)	Wongawilli Pit Top, Additional Driveage	Little Bent-winged Bat roosts in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and buildings. Maternity colonies form in spring and birthing occurs in early summer. Only five maternity colonies are known in Australia. Within the Wongawilli Pit Top two human-made features that could provide potential roosting/breeding habitat for this species occur within 100 m of the proposed works and are discussed below. No man-made structures exist within the Additional Driveage.

Occurrence of habitat or prescribed impact type

Within the Wongawilli Pit Top, two human-made structures that could provide potential roosting or breeding habitat for threatened microbat species occur within 100 metres of the proposed works. These are the old gantry and tumbler house, and the existing tunnel entrance, as seen in Figure 7. Large Bent-wing Bat have previously recorded within the tumbler house by Biosis (Biosis Research 2007, Biosis 2020), and nearby to the study area frequently (Bionet 2020).

No human-made structures occur within the Additional Driveage.

Nature, extent and duration of impacts

The old gantry and tumbler house will not be removed as part of the proposed works. However, vegetation will be removed directly adjacent to the structure, and a coal conveyor will be installed for usage over the next five years. This may cause indirect impacts to threatened microbats using the structure, such as an increase in lighting or noise due to construction activities and conveyor operation, and increased human presence in the area.

The existing mine tunnel entrance is currently not operational, however will be reused for transport of coal as part of the proposed works. This would likely impact any threatened microbats using the tunnel as roosting or breeding habitat, due to disturbance causing displacement of individuals. A recent site inspection undertaken by a Biosis zoologist on 12 August 2020 did not identify microbats within the tunnel entrance. However, no targeted microbat surveys have been undertaken. The tunnel is connected via a side entrance to the old gantry and tumbler house, and movement of bats between these two areas is possible. Therefore, for the purpose of the BAM assessment, Large-eared Pied Bat, Large Bent-winged Bat and Little Bent-winged Bat have been assumed present within the existing mine tunnel.

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Mitigation measures

WCL will commit to undertaking a range of mitigation measures in order to reduce impact to threatened microbats as a result of the proposed works, described in detail in Section 6.1.1 and summarised below.

- Ensuring that no microbats are present within the tunnel entrance, close off and seal the unused side tunnel that connects the main tunnel entrance to the old gantry and tumbler house, in order to confine microbats only to unused portions of the mine tunnel system.
- Install noise barriers or restrictions on noise, to reduce noise impacts to microbats utilising the old gantry and tumbler house.
- Direct lighting away from the gantry and tumbler house, and design lighting to avoid light spill nearby the structure.
- Ensure that the gantry and tumbler house is designated as a no-go-zone, so that human traffic as a result of the proposed works does not disturb roosting microbats.

While the mitigation measures above are designed to reduce the impact of the proposed works on threatened bat species, it is likely that there will still be a long-term negative impact on any potential threatened microbats within the subject land, due to a general increase in disturbance through noise, light and human presence. Potential ongoing consequences may include a reduction in microbats roosting within structures on the subject land, and a reduction in breeding within species utilising such structures.

7.3.5 Non-native vegetation

No threatened species habitat was associated with non-native vegetation within the study area. It has been recommended in Section 6.1.1 that after construction of the proposed works, exotic species within adjacent retained vegetation be treated to avoid spread. This will most likely increases the condition of the TEC *Illawarra Subtropical Rainforest in the Sydney Basin Bioregion* retained within the study area.

7.3.6 Connectivity

Vegetation within the subject land forms part of a very large patch, larger than 100 hectares. Removal of 0.03 hectares of this vegetation, on the eastern edge of the vegetation patch is not likely to result in any changes to connectivity or movement of threatened species.

No vegetation will be removed from the Additional Driveage and thus there will be no changes in connectivity within this footprint.

7.3.7 Movement of threatened species that retains their lifecycle

Within Wongawilli Pit Top the removal of 0.03 hectares of vegetation within a patch large than 100 hectares is unlikely to have an impact on movement of threatened species, including movement that would retain their lifecycle. The old gantry and tumbler house, and the existing mine tunnel entrance provide potential threatened microbat roosting and breeding habitat, and movement of microbats in and out of these structures is essential to their lifecycle. However, the mitigation measures detailed in Section 7.3.4 and further in 8.1.1 will substantially reduce the likelihood that breeding of microbats within the study area will be impacted by the proposed works.

No vegetation will be removed from the Additional Driveage and thus there will be no changes in threatened species movement within this footprint.

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7.3.8 Water quality, water bodies and hydrological processes

List of relevant species and TECs

The list of threatened species associated with water bodies is shown in Table 17. One TEC, *Coastal Upland Swamp in the Sydney Basin Bioregion* (Endangered, BC Act and EPBC Act), associated with waterbodies occur within the study area.

No habitat associated with waterbodies occurs within the Wongawilli Pit Top, and so the below assessment encompasses the Additional Driveage only. As previously stated, the groundwater assessment provided by SLR (2020) for the project concluded that there was no potential for surface water or groundwater impacts as a result of the proposed development. Similarly, the geotechnical assessment provided by SCT Operations (2020) concluded that there is no potential for any perceptible surface subsidence impacts as a result of the proposed works. Thus, the following information is provided only so that any potential indirect impacts, that might occur as a result of the proposed development, are assessed.

Table 17 Species associated with water bodies

Relevant species	Use and importance of habitat type
Eastern Osprey *Pandion cristatus*	Eastern Osprey favours coastal areas, especially the mouths of large rivers, lagoons and lakes. The species feeds on fish over clear, open water. They breed from July to September in NSW, using nests high up in dead trees, usually within one kilometre of the sea (OEH 2018a).
White-bellied Sea Eagle *Haliaeetus leucogaster*	Occurs near large areas of open water including larger rivers, swamps, lakes, and the ocean, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs and saltmarsh. Uses waterbodies for foraging. Feeds mainly on fish and freshwater turtles, but also waterbirds, reptiles, and mammals. Breeding habitat is constrained to living or dead mature trees within forests or tall woodland within 1 km of rivers, lakes, large dams or creeks, wetlands and coastlines (OEH 2019).
Black Bittern *Ixobrychus flavicollis*	Black Bittern inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. Feeds on frogs, reptiles, fish and invertebrates, including snails, dragonflies, shrimps and crayfish. Roosts in trees or on the ground amongst dense reeds. Nests, built in spring are located on a branch overhanging water and consist of a bed of sticks and reeds on a base of larger sticks (OEH 2018b).
Littlejohn's Tree Frog *Litoria littlejohni*	Littlejohn's Tree Frog breeds in the upper reaches of permanent streams and in perched swamps. Breeding is triggered by heavy rain and can potentially occur all year, but is usually from late summer to early spring when conditions are favourable. Males call from low vegetation close to slow flowing pools. Eggs and tadpoles are mostly found in still or slow flowing pools that receive extended exposure to sunlight, but will also use temporary isolated pools (OEH 2017d).
Red-crowned Toadlet *Pseudophryne australis*	Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters. Red-crowned Toadlets have not been recorded breeding in waters that are even mildly polluted or with a pH outside the range 5.5 to 6.5 (DPE 2017a).
Giant Burrowing Frog *Heleioporus australiacus*	Giant Burrowing Frog is found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Breeding habitat of this species is generally soaks or pools within first or second order streams. They are also commonly recorded from 'hanging swamp' seepage lines and where small pools form from the collected water. Eggs are laid in burrows or under vegetation in small pools. After rain, tadpoles are washed into larger pools where they complete their development in ponds or ponded areas of the creekline. Tadpole

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Relevant species	Use and importance of habitat type
	development ranges from around 12 weeks duration to up to 12 months with late developing tadpoles overwintering and completing development when warmer temperatures return (DPIE 2019a).
Southern Myotis ***Myotis macropus***	Southern Myotis 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. The species forages over streams and pools catching insects and small fish by raking their feet across the water surface (DPE 2017b).

The list of species or TECS that require habitat that is associated with hydrological processes is shown in Table 18. These have been grouped based on the potential risk of impacts from changes to hydrological processes associated with the development. No hydrological processes are likely to be impacted at the Wongawilli Pit Top, and so the below assessment encompasses the Additional Driveage only.

Table 18 Species or TECs associated with hydrological processes

Relevant species	Use and importance of habitat type
Higher risk TECs	
• *Coastal Upland Swamp in the Sydney Basin Bioregion*	Higher risk TECs are those that either: • Directly rely on hydrological processes for the maintenance of their floristic assemblages. • Are located in landscape positions where processes such as regular flooding and deposition are key to maintaining the edaphic conditions that support the floristic assemblage. • Are particularly susceptible to erosion, or are considered particularly susceptible to changes in water quality and nutrient load.
Lower risk TECs	
N/A	Lower risk TECs are those that occur in landscape positions where hydrological processes have a lower level of influence on species assemblage or edaphic conditions.
Higher risk threatened flora species	
• Leafless Tongue Orchid *Cryptostylis hunteriana* • Sublime Point Pomaderris *Pomaderris adnata* • Prickly Bush-pea *Pultenaea aristata* • Bauer's Midge Orchid *Genoplesium bauera* • *Hibbertia stricta* subsp. *furcatula*	Higher risk threatened flora species are those that either: • Grow in waterbodies or swampy areas. • Require regular inundation and deposition to maintain edaphic conditions. • Are strongly associated with a higher risk TEC. • Are higher specialised with regards to requirements for soil moisture content and nutrient levels.

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• Thick-leaf Star-hair *Astrotricha crassifolia* • Small Pale Grass-lily *Caesia parviflora* var. *minor* • Thick Lip Spider Orchid *Caladenia tessellate* • *Hygrocybe anomala* var. *ianthinomarginata* • *Epacris purpurascens* var. *purpurascens* • *Hibbertia puberula* • Woronora Beard-heath *Leucopogon exolasius* • Slaty Leek Orchid *Prasophyllum fuscum* • Deane's Paperbark *Melaleuca deanei*	
Lower risk threatened flora species	
• *Helichrysum calvertianum* • Bynoe's Wattle *Acacia bynoeana* • Hairy Geebung *Persoonia hirsuta* • *Grevillea raybrownii*	Lower risk threatened flora species are those that occur in landscape positions where hydrological processes have a lower level of influence on edaphic conditions.
Higher risk threatened fauna species	
• Red-crowned Toadlet *Pseudophryne australis* • Littlejohn's Tree Frog *Litoria littlejohni* • Giant Burrowing Frog *Heleioporus australiacus* • Southern Myotis *Myotis macropus* • Giant Dragonfly *Petalura gigantea*	Higher risk threatened fauna species are those that are reliant on wetlands, lower Strahler order watercourses and riparian areas, or soaks and fringing macrophyte vegetation for key aspects of their lifecycle.
Lower risk threatened fauna species	
• Eastern Osprey *Pandion cristatus* • White-bellied Sea Eagle *Haliaeetus leucogaster* • Bush Stone-curlew *Burhinus grallarius* • Glossy Black-Cockatoo *Calyptorhynchus lathami* • Eastern Pygmy-possum *Cercartetus nanus* • Large-eared Pied Bat *Chalinolobus dwyeri*	Lower risk threatened fauna species are those not directly reliant on waterbodies or wetlands, those associated with riparian areas of higher Strahler watercourses, or those species within limited habitat within the nominated areas (such as waders).

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- Southern Brown Bandicoot *Isoodon obesulus obesulus*
- Swift Parrot *Lathamus discolor*
- Square-tailed Kite *Lophoictinia isura*
- Little Eagle *Hieraaetus morphnoides*
- Little Bent-winged Bat *Miniopterus australis*
- Large Bent-winged Bat *Miniopterus orianae oceanensis*
- Powerful Owl *Ninox strenua*
- Squirrel Glider *Petaurus norfolcensis*
- Koala *Phascolarctos cinereus*
- Grey-headed Flying-fox *Pteropus poliocephalus*
- Masked Owl *Tyto novaehollandiae*
- Regent Honeyeater *Anthochaera phrygia*
- Gang-gang Cockatoo *Callocephalon fimbriatum*
- Broad-headed Snake *Hoplocephalus bungaroides*
- Eastern Bristlebird *Dasyornis brachypterus*
- Eastern Ground Parrot *Pezoporus wallicus wallicus*
- Sooty Owl *Tyto tenebricosa*

Occurrence of habitat or prescribed impact type

There are no habitat features associated with waterbodies or hydrological processes within the Wongawilli Pit Top.

The Additional Driveage contains several waterways including Lake Avon (part of the fourth order Gallaghers Creek), a third order creek in the north, and multiple first order tributaries (Figure 8). Aquatic features and habitat within the study area are described in detail in Section 5. These waterways may provide habitat for several threatened species within the study area, which could be impacted if waterway condition or abundance was to be negatively impacted by the proposed works.

Several of the tributaries in the northern section of the study area provide potential habitat for Littlejohn's Tree Frog, due to the presence of both slow flowing water and pools with low hanging vegetation (OEH 2017d). Tributaries and drainage lines below sandstone ridges may provide habitat for Red-crowned Toadlet within the study area (DPE 2017a), and pools within the multiple first order streams may provide habitat for Giant Burrowing Frog (DPIE 2019a).

Southern Myotis is likely to occur within the study area due to the presence of multiple waterways for foraging as well as abundant hollows and good condition vegetation (DPE 2017b). Other fauna that may use the waterways within the study area for foraging include Eastern Osprey, White-bellied Sea Eagle and Black Bittern.

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While some species rely directly on waterways as habitat for foraging or breeding, many other species rely on aquatic habitat features more indirectly, for example through the presence of groundwater. The species and TECs that have potential to occur within the study area and that are most at risk if groundwater was to be altered due to the proposed works are listed in Table 18. While some of these species rely on groundwater more directly, for example swamp species such as Giant Dragonfly and Slaty Leek Orchid, other species are at a lower but present risk due to the flow-on effects of changes in vegetation that might occur due to changes in groundwater.

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Nature, extent and duration of impacts

Subsidence

The geotechnical assessment provided by SCT (2020) for the proposed works concluded that there is no potential for perceptible surface subsidence impacts as a result of the proposed works within the Additional Driveage. Thus, impacts to vegetation communities due to subsidence is unlikely.

However, in the highly unlikely event that subsidence was to occur as a result of the proposed works within the Additional Driveage, this could substantially change hydrological processes within the study area. There are two general mechanisms by which subsidence movements may cause changes in the hydrology of vegetated areas, and in particular, of upland swamps. Firstly, water can drain into cracks in the bedrock that open beneath or upslope of the swamp as a result of simple tensile strains or complex buckling and shear that enhances connectivity of fractures. Alternately, tilting of the surface can result in the re-distribution of overland flows, loss of water from swamp margins and/or concentration and channelisation of runoff (TSSC 2014). While such hydrological changes can have a negative impact on a range of vegetation types, this is particularly the case for the TEC *Coastal Upland Swamp in the Sydney Basin Bioregion*. The impacts of mine subsidence on this TEC can include gradual or rapid drying of swamp soils, decline of the most groundwater-dependent plant species and consequent changes in vegetation structure, decline of groundwater-dependent fauna including macro-invertebrates and stygofauna, channelisation and consequent erosion of swamp sediments and oxidation of peaty sediments resulting in increased hydrophobicity and flammability (TSSC 2014).

Changes to groundwater

The groundwater assessment for the proposed works provided by SLR (2020) concludes that there is no potential for any surface or groundwater impacts as a result of the proposed Additional Driveage.

Creeks

As previously stated, the groundwater assessment provided by SLR (2020) for the project concluded that there was no potential for surface water or groundwater impacts as a result of the proposed development. Similarly, the geotechnical assessment provided by SCT (2020) concluded that there is no potential for any perceptible surface subsidence impacts as a result of the proposed works. Thus, impacts to creeks are unlikely to occur as a result of the NWMD.

Overall, impacts to threatened species or TECs associated with creeks as a result of the proposed works are unlikely.

Lake Avon

The geotechnical assessment for the project (SCT 2020) states that the potential for inflows from Avon Reservoir into the proposed underground roadways is unlikely but possible, and will need special consideration in consultation with Water NSW, especially in the two areas where four headings are mined directly below the reservoir at between 60 metres and 120 metres overburden depth. It is recommended that Water NSW is consulted to determine the aquatic assessment required to assess the impacts of such inflows on aquatic biodiversity.

7.3.9 Wind turbine strikes

The proposed works does not involve wind turbines, and thus no impact to threatened species or TECs is predicted as a result of wind turbines within the study area.

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7.3.10 Vehicle strikes

The proposed works may result in a small increase in vehicle movement nearby the Wongawilli Pit Top, due to the re-use of the existing mine tunnel and use of the proposed coal conveyor. However, no threatened species or TECs that potentially occur within the Wongawilli Pit Top would be likely to be impacted by vehicle strikes as they do not utilise roadways for movement. The three threatened microbat species (Large-eared Pied Bat, Large Bent-winged Bat and Little Bent-winged Bat) that may potentially occur within the Wongawilli Pit Top are nocturnal, and utilise tunnels or forage within the canopy. Pink Robin forage within the mid and understorey of rainforest areas, and are unlikely to be impacted as a result of vehicle strikes.

There will be no increase in vehicle movement on the surface within the Additional Driveage, and thus no impacts to threatened species or TECs are predicted as a result of an increase in vehicle strikes.

7.4 Impacts to groundwater dependent ecosystems

The study area at the Wongawilli Pit Top is partially mapped as supporting Groundwater Dependant Ecosystems (GDEs) on the Groundwater Dependent Ecosystem Atlas (GDEA) (BOM 2019) due to the presence of Subtropical Complex Rainforest (recorded as PCT 906 during the field investigation). However, no changes to groundwater are predicted as a result of the proposed works at the Wongawilli Pit Top.

The study area within the Additional Driveage is partially mapped as supporting GDEs on the GDEA due to the predicted presence of PCT 1250 - *Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion* (Coastal Sandstone Gully Forest) within the vegetated peninsula in the centre of the study area (BOM 2019). However, the field investigation undertaken by Biosis confirmed that the vegetation in this area was not Coastal Sandstone Gully Forest but was instead PCT 1083 - *Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion* and PCT 878 - *Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion* (Figure 4).

Due to the inconsistency between GDEA mapping and the vegetation mapped during the field investigation, the presence of GDEs was instead determined using the *Risk assessment guidelines for groundwater dependent ecosystems – Appendix 4: inferring groundwater dependency* (DPI 2012). Using this document it was determined that all PCTs mapped as present within the Additional Driveage are groundwater dependent, with the exception of PCT 1083.

In particular, in the north east portion of the Additional Driveage, PCT 1804 - *Needlebush - Banksia wet heath swamps on coastal sandstone plateaus of the Sydney basin* was recorded, and is consistent with the TEC *Coastal Upland Swamp in the Sydney Basin Bioregion* (Endangered, BC Act and EPBC Act). This PCT is considered to be particularly groundwater dependent.

The groundwater assessment for the project undertaken by SLR (2020) predicts negligible impacts to surface or groundwater as a result of the proposed Additional Driveage. Hence, impacts to ecosystems that rely on groundwater are unlikely.

7.5 Adaptive management strategy

The proposed works within the Wongawilli Pit Top will not result in impacts relating to karst, caves, crevices, cliffs and other geological features of significance, subsidence and upsidence, wind turbine strikes or vehicle strikes and as such as an Adaptive Management Strategy is not considered necessary.

The proposed works within the Additional Driveage is also not predicted to result in impacts relating to karst, caves, crevices, cliffs and other geological features of significance, subsidence and upsidence, wind turbine

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strikes or vehicle strikes. However, due to the unpredictable nature of indirect mining impacts, and the substantial effect that unexpected subsidence could have on habitat within the study area, comprehensive baseline vegetation and aquatic data have been collected by Biosis throughout the study area, which can be referred to if an adaptive management strategy is later required.

In accordance with the mitigation measures outlined in Section 6.1.1, surveys for threatened microbats will be undertaken within potential habitat in the study area prior to works being undertaken, so that any changes to microbat abundance can be monitored. If impacts to microbat numbers are observed after construction or operation of the proposed conveyor, an adaptive management strategy will be developed in consultation with a qualified ecologist.

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8 Impact summary

8.1 Thresholds for assessment and offsetting

This section outlines the thresholds for assessment and offsetting in accordance with Section 10 of the BAM.

8.1.1 Serious and irreversible impacts

Four SAIIs have been identified as having potential to occur as a result of the proposed works. These are:

- Removal of 0.01 hectares of *Illawarra Subtropical Rainforest in the Sydney Basin Bioregion* (Endangered, BC Act, Critically Endangered EPBC Act).
- Removal of 0.03 hectares of breeding habitat for Large-eared Pied Bat.
- Removal of 0.03 hectares of breeding habitat for Large Bent-winged Bat.
- Removal of 0.03 hectares of breeding habitat for Little Bent-winged Bat.

SAII assessments have been prepared for each of these entities, and are provided Appendix 6.

8.1.2 Impacts to native vegetation (ecosystem credits)

As outlined in Section 10.3.1 of the BAM, the accredited assessor is required to determine an offset for all impacts of the proposed works on PCTs with a vegetation integrity score:

- ≥15 where the PCT is representative of an endangered or critically endangered ecological community
- ≥17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community
- ≥20 where the PCT is not representative of a TEC or associated with threatened species habitat.

On this basis, offsets are required for vegetation zone (VZ) 1 as it has a vegetation integrity score greater than 15, and for vegetation zone 2 as it has a vegetation score greater than 20.

The offset requirement for the proposal was calculated using the BAM Calculator. Table 19 provide a summary of the ecosystem credit offsets required for impacts from proposed works at the subject land.

Table 19 Offsets required for the proposed works (ecosystem credits)

Vegetation zone	Vegetation	Area (ha)	Impact	Vegetation integrity score	Offset required?	Credit requirement
VZ1	PCT 906 - moderate	0.01	Clearance	64.8	Yes	1
VZ2	PCT 1245 - low	0.02	Clearance	40.2	Yes	1

8.1.3 Impacts to threatened species (species credits)

As outlined in Section 10.3.2 of the BAM an offset is also required for the potential threatened species impacted by the development that require species credits, those being (following assumed presence in Section 4.3):

- Large-eared Pied Bat
- Large Bent-winged Bat

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- Little Bent-winged Bat
- Pink Robin

The offset requirement for the proposal was calculated using the BAM Calculator. Table 20 provide a summary of the species credit offsets required for impacts from proposed works at the subject land.

Table 20 Offsets required for the proposed works (species credits)

Vegetation zone	Species	Habitat condition (vegetation integrity score) loss	Area (ha)	Biodiversity risk weighting	Credit requirement
VZ1	Large-eared Pied Bat	64.8	0.01	3	0
	Large Bent-winged Bat	64.8	0.01	3	0
	Little Bent-winged Bat	64.8	0.01	3	0
	Pink Robin	64.8	0.01	2	0
VZ2	Large-eared Pied Bat	40.2	0.02	3	1
	Large Bent-winged Bat	40.2	0.02	3	1
	Little Bent-winged Bat	40.2	0.02	3	1
	Pink Robin	40.2	0.02	2	0

Species polygons for the above four species credit species impacted by the project are illustrated in Figure 9 below.

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Legend

- Study area
- Subject land

Impacts requiring offset

- PCT 906 - Moderate
- PCT 1245 - Low
- Threatened fauna habitat:
  - Large-eared Pied Bat
  - Large Bent-winged Bat
  - Little Bent-winged Bat
  - Pink Robin

Acknowledgements: Basemap © Land and Property Information 2016, Imagery NearMap 2019

Figure 9 Impacts requiring offsets

0 2.5 5 7.5 10 12.5

Metres

N

Scale: 1:300 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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Matter: 31606,
Date: 17 August 2020,
Checked by: SMM, Drawn by: AEDM, Last edited by: amurray
Location: P:\31600s\31606\Mapping\31606_F9_Offsets.mxd

00

9 Biodiversity credits

Offsetting through the transfer and retirement of biodiversity credits, or paying into the BCT Offset Fund, is required for the current assessment for impacts to one vegetation zone at the subject land. A biodiversity credit report and credit payment report are provided on the following pages.

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10 Assessment against biodiversity legislation

10.1 Environment Protection and Biodiversity Conservation Act 1999

An assessment of the impacts of the proposed works on Matters of National Environmental Significance (MNES), against heads of consideration outlined in Commonwealth of Australia (2013) was prepared to determine whether referral of the proposed works to the Commonwealth Minister for the Environment is required. MNES relevant to the proposed works are summarised in Table 21.

Table 21 Assessment of the proposed works against the EPBC Act

Matter of NES	Project specifics	Potential for significant impact
Threatened species	EPBC listed threatened species previously recorded within the locality of the subject land include 5 flora species and 8 fauna species. With the exception of the species listed in Appendix 2, these threatened species were considered to have a low likelihood of occurrence. Large-eared Pied Bat is listed as Vulnerable under the EPBC Act, and is considered to have a moderate likelihood of occurrence within the subject land (Appendix 2). The project will remove 0.03 hectares of potential foraging and breeding habitat for Large-eared Pied Bat and as such a Significant Impact Criteria (SIC) assessment has been completed and is provided in Appendix 4.	The project is unlikely to result in a significant impact to any species listed as threatened under the EPBC Act.
Threatened ecological communities	One TEC *Illawarra Subtropical Rainforest in the Sydney Basin Bioregion* listed as Critically Endangered under the EPBC Act is present within the subject land. The project will result in the removal of 0.01 ha of this community, and as such a SIC has been completed and is provided in Appendix 4.	The project is unlikely to result in a significant impact to any TECs listed under the EPBC Act.
Migratory species	Migratory species are considered to have the potential to occur within the subject land on a transient basis. Vegetation outside the study area provides higher quality foraging and breeding habitat for these species.	No impact is expected to any Migratory listed species.
National Heritage Place	The study area is not located within a National Heritage Place.	The proposed works will not result in the real possibility that any values associated with a National Heritage Place will be lost, degraded, damaged, notably altered, modified, obscured or diminished.
Wetlands of international importance (Ramsar sites)	The closest wetland of international importance is Towra Point Nature Reserve which is approximately 65 kilometres north-east of the subject land.	No potential for impact.

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On this basis, the EPBC Act is unlikely to be triggered and referral of the proposed works to the Australian Government Minister for the Environment will not be required.

10.2 Environmental Planning and Assessment Act 1979

10.2.1 Wollongong LEP 2009

The study area at the Wongawilli Pit Top is zoned RU1 Primary Production under the Wollongong LEP 2009. The study area within the Additional Driveage is zoned E2 Environmental Conservation, except for Lake Avon which is zoned SP2 Infrastructure.

Developments proposed on land zoned RU1 under the Wollongong LEP can be granted consent if for the purpose of extractive industries. Thus, the proposed works at Wongawilli Pit Top are not exempt from approval under the LEP.

Mining is prohibited in both zones SP2 and E2 under the Wollongong LEP. However, the State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 permits the proposed works.

Illawarra Escarpment area conservation

Part 7 Clause 7.8 of the Wollongong LEP aims to provide specific controls to protect, conserve and enhance the Illawarra Escarpment. The study area at the Wongawilli Pit Top falls within the Illawarra Escarpment map to which this clause applies. However, the State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 prevails over the Wollongong LEP, and thus permits the proposed works.

10.2.2 SEPP Koala Habitat Protection 2019

As the proposed works is considered an SSD, the SEPP Koala Habitat Protection does not apply (DPIE 2020e).

10.3 *Biosecurity Act 2015*

The Biosecurity Act provides for the identification, classification and control of priority weeds with the purpose of determining if a biosecurity risk is likely to occur. A biosecurity risk is defined as the risk of a biosecurity impact occurring, which for weeds includes the introduction, presence, spread or increase of a pest into or within the State or any part of the State. A pest plant has the potential to; harm or reduce biodiversity or out-compete other organisms for resources, including food, water, nutrients, habitat and sunlight.

One priority weed listed for the Greater Sydney Local Land Services (LLS) region, which includes the Wollongong Council LGA, was recorded in the study area at the Wongawilli Pit Top. This was Lantana (Figure 4). The associated Duty for this species is:

- Prohibition on dealings - must not be imported into the State or sold.
- Regional Recommended Measure - land managers should mitigate the risk of new weeds being introduced to their land, and reduce impacts from the plant on priority assets.

As such to prevent the above listed biosecurity impacts from occurring as a result of the presence of the above listed priority weeds within the study area, all practical steps should be taken to control and eradicated the weeds from the study area prior to or during vegetation removal.

10.4 Water Management Act 2000

As the proposed works is considered an SSD, a controlled activity permit under the WM Act is not required.

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11 Conclusion

Avoidance of impacts to native vegetation, threatened ecological communities and fauna habitat have been undertaken to restrict proposed direct impacts associated with the project to the removal of 0.01 hectares of PCT 906 (*Illawarra Subtropical Rainforest in the Sydney Basin Bioregion* (Endangered, BC Act, Critically Endangered, EPBC Act)) and 0.02 hectares of PCT 1245, and the habitat it supports from the subject land.

The vegetation integrity scores for vegetation at the subject land are such that a total of two ecosystem credits are required to offset impacts to the two vegetation zones identified within the subject land.

No threatened fauna species were recorded at the subject land however this assessment assumes the presence of four species credit species identified by the BAM calculator (Appendix 2). These are Pink Robin, Large-eared Pied Bat, Large Bent-winged Bat and Little Bent-winged Bat. Based on the impact area and biodiversity risk weighting (Table 8) attributed to these species, four species credits are required to offset impacts to fauna habitat. Mitigation measures to avoid direct impacts and mitigate potential indirect impacts to native fauna are provided in Section 6 of this report.

There were no threatened flora species recorded or assumed to be present within the subject land.

Matters of National Environmental Significance are not likely to be significantly impacted by the proposed works and as such, a referral of the project to the Commonwealth is not required.

If the mitigation measures provided in this report are implemented, there should be no further impacts to biodiversity values as a result of the proposed works, and the project can proceed as planned.

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Appendices

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Appendix 1 Survey methods

Appendix 1.1 Nomenclature

The flora taxonomy (classification) used in this report follows the most recent Flora of NSW (Harden 1992, Harden 1993, Harden 2002). All doubtful species names were verified with the on-line Australian Plant Name Index (Australian National Botanic Gardens 2007). Flora species, including threatened species and introduced flora species, are referred to by both their common and then scientific names when first mentioned. Subsequent references to flora species cite the common names only, unless there is no common name, for which scientific name will be used. Common names, where available, have been included in threatened species tables and the complete flora list in Appendix 3.

Names of vertebrates follow the Census of Australian Vertebrates (CAVs) maintained by the DEE (Commonwealth of Australia 2009). In the body of this report vertebrates are referred to by both their common and scientific names when first mentioned. Subsequent references to these species cite the common name only.

Appendix 1.2 Permits and licences

The flora and fauna assessment was conducted under the terms of Biosis' Scientific Licence issued by EES (SL100758, expiry date 31 March 2020). The BAM Assessment and quality review of the BDAR was carried out by Accredited Assessor Paul Price (BAAS18089).

Appendix 1.3 Limitations

Field surveys were undertaken in accordance with the BAM. Ecological surveys provide a sampling of flora and fauna at a given time and season. Factors influencing detectability of species during survey include species dormancy, seasonal conditions, ephemeral status of waterbodies, and migration and breeding behaviours of some fauna. In many cases, these factors do not present a significant limitation to assessing the overall biodiversity values of a site.

The field survey was conducted in winter during cooler weather, which is not a suitable time to determine the presence of most threatened species. However, any potential threatened fauna species that were considered moderately likely (or above) to occur within the study area were assumed present. Due to the small size of the study area and the conspicuous nature of the threatened flora species with potential to occur within the study area, the field assessment was considered comprehensive in determining the presence/absence of such species.

Surveys undertaken, combined with habitat assessments and desktop analysis are considered sufficient to reach the conclusions herein in regards to this and all other species' likelihood of occurrence within the study area.

Database searches, and associated conclusions on the likelihood of species to occur within the study area, are reliant upon external data sources and information managed by third parties.

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Appendix 2 BAM Candidate species assessment

Table A. 1 Threatened flora species assessment

Species	Conservation status		BAM Predicted SCS	Potential occurrence in subject land	Survey required/ undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
***Cynanchum elegans* White-flowered Wax Plant**	E	E1	No	Low	Yes	Low	No	Habitat not present within the study area with no littoral or dry rainforest present. No targeted survey undertaken.	The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree *Leptospermum laevigatum* – Coastal Banksia *Banksia integrifolia* subsp. *integrifolia* coastal scrub; Forest Red Gum *Eucalyptus tereticornis* aligned open forest and woodland; Spotted Gum *Corymbia maculata* aligned open forest and woodland; and Bracelet Honeymyrtle *Melaleuca armillaris* scrub to open scrub.
***Daphnandra johnsonii* Illawarra Socketwood**	E	E1	Yes	Low	No	Low	No	Species assessed as having a low likelihood of occurrence within the study area and therefore no targeted surveys were required.	Occupies the rocky hillsides and gullies of the Illawarra lowlands, occasionally extending onto the upper escarpment slopes. Associated vegetation includes rainforest and moist

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									eucalypt forest. Associated soils are loams and clay loams derived from volcanic and fertile sedimentary rocks.
***Gossia acmenoides* - endangered population *Gossia acmenoides* population in the Sydney Basin Bioregion south of the Georges River**	-	E2	Yes	Moderate	Yes	Low	No	Targeted surveys undertaken within the study area and subject land in accordance with approved survey timetable for the species. Targeted survey for the species occurred in July 2020. Approved survey periods for the species is all year. The survey was completed in accordance with the BAM (OEH 2017a) *NSW Guide to Surveying Threatened Plants* (OEH 2016b). The species was not recorded.	Found in subtropical and dry rainforest on the ranges and coastal plain of eastern Australia. It is estimated there are less than 100 mature plants, through approximately 30 sites. Occurring often as a single individual or small group.
***Irenepharsus trypherus* Illawarra Irene**	E	E1	Yes	Moderate	Yes	Low	No	The study area provides potential habitat for the species. A targeted survey was undertaken, however it was undertaken outside of flowering time of the species. As the species is conspicuous in nature, and given the extended survey effort in the relatively small study area, it is unlikely to occur within the subject land. The survey was completed in accordance with the BAM (OEH 2017a) *NSW*	The species has been recorded from 18 sites within the local government areas of Kiama, Shellharbour, Shoalhaven, Tallaganda, Wingecarribee, and Wollongong. Typically inhabits steep rocky slopes near cliff lines and ridge tops. The species is less typically found growing out of rock crevices or on narrow benches along cliff lines. The vast majority of sites are recorded from the

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								Guide to Surveying Threatened Plants (OEH 2016b).	upper slopes of the ridge systems that extend south and east of the Illawarra escarpment.
***Rhodamnia rubescens* Scrub Turpentine**	-	E4A	Yes	Moderate	Yes	Low	No	Targeted surveys undertaken within the study area and subject land in accordance with approved survey timetable for the species. Targeted survey for the species occurred in July 2020. Approved survey periods for the species is all year. The survey was completed in accordance with the BAM (OEH 2017a) *NSW Guide to Surveying Threatened Plants* (OEH 2016b). The species was not recorded.	Occurs in coastal districts north from Batemans Bay in New South Wales, approximately 280 km south of Sydney, to areas inland of Bundaberg in Queensland. Populations typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 m above sea level in areas with rainfall of 1,000-1,600 mm. Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils.
Solanum celatum	-	E1	Yes	Moderate	Yes	Low	No	The study area provides potential habitat for the species. A targeted survey was undertaken, however it was undertaken outside of flowering time of the species. As the species is conspicuous in nature, and given the extended survey effort in the relatively small study area, it is unlikely to occur within the	Restricted to an area from Wollongong to just south of Nowra, and west to Bungonia. Majority of records are prior to 1960 and the majority of populations are likely to have been lost to clearing. Grows in rainforest clearings, or in wet sclerophyll forests.

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								subject land. The survey was completed in accordance with the BAM (OEH 2017a) *NSW Guide to Surveying Threatened Plants* (OEH 2016b)	
Syzygium paniculatum **Magenta Lilly Pilly**	V	E1	Yes	Low	No	Low	No	The study area does not provide habitat as it does not contain Littoral Rainforest and occurs approximately 13 kms from the coast. No targeted surveys were undertaken	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest.
Zieria granulata **Illawarra Zieria**	E	E1	Yes	Low	No	Low	No	Habitat does not occur within the study area, with no associated vegetation overlying soils were the species is seen less frequently.	Restricted to the Illawarra region where it is recorded from a number of sites. The species primarily occupies the coastal lowlands between Oak Flats and Toolijooa, in the local government areas of Shellharbour and Kiama. The typical habitat is dry ridge tops and rocky outcrops on shallow volcanic soils, usually on Bumbo Latite. Less frequently found on the moist slopes of the Illawarra escarpment and in low-lying areas on Quaternary sediments. Associated vegetation includes Bracelet

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									Honey-myrtle *Melaleuca armillaris* scrub, Forest Red Gum *Eucalyptus tereticornis* woodland and rainforest margins, although the species has been recorded from a number of other vegetation types.

Table A. 2 Threatened fauna species assessment

Species	Conservation status		BAM Predicted SCS	Potential occurrence in subject land	Survey required/ undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
***Anthochaera phrygia* Regent Honeyeater**	CE	E4A	Yes	Low	No	Low	No	There are no records of this species within 5 km. This species breeds in a small number of known locations. The study area provides marginal foraging habitat only. The study area is outside of mapped 'Important areas' for this species.	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak.
***Callocephalon fimbriatum* Gang-gang Cockatoo**	-	V	Yes	Low	No	Nil	No	No suitable breeding habitat (hollows > 9 cm) was present within the study area.	Found in tall mountain forests and woodlands in summer and spring, and moves into drier more open eucalypt forest in autumn and winter. Favours old growth forest and

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									woodland for nesting and roosting, using hollows 10 cm or larger in diameter and at least 9 m off the ground.
***Calyptorhynchus lathami* Glossy Black-Cockatoo**	-	V	Yes	Low	No	Nil	No	No foraging habitat (She-oak) exists within the subject land. Breeding habitat (hollows > 15 cm) does not exist within the subject land.	Found in open forests and woodlands where stands of She-oak occur.
***Cercartetus nanus* Eastern Pygmy-possum**	-	V	Yes	Low	No	Low	No	The vegetation within the subject land is highly disturbed, and is lacking native mid-storey. No banksias or bottlebrushes are present. The habitat is not considered suitable for Eastern Pygmy-possum.	Prefers woodlands and heath, but can inhabit a broad range of habitats including rainforest and sclerophyll forest. Feeds largely on nectar collected from banksias, eucalypts and bottlebrushes. Shelters in tree hollows, stumps, bird nests and thickets.
***Chalinolobus dwyeri* Large-eared Pied Bat**	V	V	Yes	Moderate	No	Low	Yes	The subject land occurs within 100 m of two structures that may support breeding habitat for the species (Figure 7). As per the BAM, an SAII has been prepared for this species.	Found in well-timbered areas containing gullies. Roosts in caves, mines, tunnels, crevices and cliffs.
***Dasyurus maculatus* Spotted-tailed Quoll**	E1	V	No	Low	No	Nil	No	The vegetation of the study area is highly disturbed, and does not contain appropriate den sites such as caves or large hollows. The lack of medium and large hollows means that	Found in a range of habitats including rainforest, open forest, woodland, coastal heath and inland riparian forest. Den sites include hollow-bearing trees, fallen

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								there is unlikely to be an abundance of prey for the species such as possums or gliders. There is only one previous record in the locality, from 2004.	logs, caves, rock outcrops and rocky cliff faces.
***Heleioporus australiacus* Giant Burrowing Frog**	V	V	Yes	Nil	No	Nil	No	This species does not generally occur in rainforest or wet sclerophyll forest. There is no appropriate habitat for this species present within the subject land.	Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based.
***Hieraaetus morphnoides* Little Eagle**	-	V	Yes	Low	No	Low	No	There is no suitable breeding habitat (tall living trees within a remnant patch) within the subject land. Large trees are limited within the subject land, and vegetation is highly disturbed. Much more appropriate habitat occurs elsewhere within the locality.	Found in eucalypt forest, woodland or open woodland. Nests in tall living trees within a remnant patch.
***Hoplocephalus bungaroides* Broad-headed Snake**	V	E	Yes	Low	No	Low	No	No exposed cliff edges are present within the subject land. Although some rock crevices are present, the subject land is highly disturbed and unlikely to provide appropriate shelter habitat.	Largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast. Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in crevices or hollows in large trees within

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									500 m of escarpments in summer.
***Lathamus discolor* Swift Parrot**	CE	E1	Yes	Low	No	Low	No	No breeding habitat exists within the mainland of Australia. The study area is outside of mapped 'Important areas' for this species. Few eucalypts are present within the subject land, and the area is highly disturbed.	Found where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations.
***Litoria aurea* Green and Golden Bell Frog**	V	E1	Yes	Low	No	Nil	No	No suitable habitat exists within the subject land for this species. The closest wet area is a creek line situated approximately 120 m to the south east of the subject land, however no records of this species occur within 5 km.	Inhabits mostly unshaded marshes, dams and stream-sides, particularly those containing bullrushes or spikerushes.
***Litoria littlejohni* Littlejohn's Tree Frog**	V	B	No	Nil	No	Nil	No	No suitable streams, swamps or heath-based forest exists within the subject land.	This species breeds in the upper reaches of permanent streams and in perched swamps. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground.
***Lophoictinia isura* Square-tailed Kite**	-	V	Yes	Low	No	Nil	No	This species does not generally occur in rainforest or wet-sclerophyll forest. No large trees appropriate for nesting	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference

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								are located within the subject land. There is more appropriate habitat located outside of the subject land, within the locality.	for timbered watercourses.
***Miniopterus australis* Little Bent-winged Bat**	-	V	Yes	Moderate	No	Low	Yes	The subject land occurs within 100 m of two structures that may support breeding habitat for the species (Figure 7). As per the BAM, an SAII has been prepared for this species.	Inhabits eucalypt forest, rainforest, vine thicket, sclerophyll forests, melaleuca swamps, dense coastal forests and banksia scrub. Found in well-timbered areas. Roosts in caves, tunnels, mines, tree hollows, culverts and bridges. Large maternity colonies form in spring, and only five nursery sites/ maternity colonies are known in Australia.
***Miniopterus orianae oceanensis* Large Bent-winged Bat**	-	V	Yes	Moderate	No	Low	Yes	The subject land occurs within 100 m of two structures that may support breeding habitat for the species (Figure 7). The species has previously been recorded adjacent to the subject land. As per the BAM, an SAII has been prepared for this species.	Primarily roosts within caves and man-made structures such as tunnels, mines and buildings. Forms discrete populations centred on a maternity roost that is used annually. Hunts in forested areas.
***Mixophyes balbus* Stuttering Frog**	V	E1	Yes	Low	No	Low	No	There are no records of this species within 5 km. Although the subject land contains rainforest and is on the Illawarra Escarpment, it is highly disturbed and has	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in

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								minimal leaf litter for sheltering. No breeding habitat (rock shelves or shallow riffles in small flowing streams) is present within the subject land.	deep leaf litter and thick understorey vegetation on the forest floor. Eggs are laid on rock shelves or shallow riffles in small, flowing streams.
Myotis macropus **Southern Myotis**	-	V	Yes	Low	No	Low	No	There are no waterbodies present within the subject land. There is only one hollow bearing tree present within the subject land, and although this tree is nearby a mine tunnel and approximately 130 m from a watercourse, vegetation nearby by outside of the study area is much more intact with more roosting opportunities. It is unlikely that this species would utilise the subject land.	Roosts close to hollow-bearing trees, caves, mineshafts, buildings or bridges. Forages over streams and pools.
Ninox strenua **Powerful Owl**	-	V	Yes	Low	No	Nil	No	No suitable breeding habitat (hollows > 20 cm) are located within the subject land.	Found in a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. It roosts by day in dense vegetation. It nests in large tree hollows at least 0.5m deep in trees at least 150 years old.
Petauroides volans **Greater Glider**	V	-	No	Low	No	Low	No	The subject land is highly disturbed and does not contain any large hollows. Most records of the species within the locality occur on the western side of	Typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows. Favours

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								the escarpment, where vegetation is older and much less disturbed. The subject land also contains very few eucalypt species, and it is unlikely that Greater Glider would use the site for foraging.	forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species. During the day it shelters in tree hollows, with a particular selection for large hollows in large, old trees.
Petrogale penicillata **Brush-tailed Rock-wallaby**	V	E1	Yes	Nil	No	Nil	No	There are no records of this species within 5 km. The closest records to the subject land are from more than 50 years ago. The subject land does not contain complex fissures, caves or ledges, and does not face in a northwards direction. The subject land does not contain crevices large enough for this species to shelter inside. Vegetation is also highly disturbed, and fruits of shrubs and trees are limited.	Occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Shelters or basks during the day in rock crevices, caves and overhangs. Browses on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.
Petroica rodinogaster **Pink Robin**	-	V	Yes	Low	No (assumed presence)	Low	Yes	The subject land contains rainforest vegetation, with often dense understorey which could be used for perching for this species. The groundcover is open in areas, providing opportunities for foraging. As this species is highly mobile, there is a possibility that it could occur within the subject land.	Inhabits rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies. Uses the perch-and-pounce of foraging, often from the ground.

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***Phascolarctos cinereus* Koala**	V	V	Yes	Low	No	Low	No	One Koala feed tree species (White-topped Box) listed in the Koala Habitat Protection SEPP 2019 for the Central Coast Koala Management Area is present within the subject land. However, this tree species is limited to a few individuals. Much more suitable Koala habitat is located to the west of the subject land, within the Illawarra Escarpment State Conservation Area, and the Water NSW Catchment Special Area, in patches larger than 100 ha. Most records within the locality occur in these areas, on the western side of the escarpment.	Found in eucalypt woodlands and forests containing specific feed tree species as listed in the Koala Habitat Protection SEPP 2019.
Potorous tridactylus Long-nosed Potoroo	V	V	Yes	Low	No	Low	No	The closest record of this species is approximately 6.5 km from the subject land. While there is marginal habitat present within the study area, the understorey is weedy and highly disturbed. Much more appropriate habitat for this species occurs to the south west of the subject land, nearby Macquarie's Pass, where most records fall within the locality. It is unlikely that this species would utilise the subject land.	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.

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Pseudophryne australis Red-crowned Toadlet	-	V	Yes	Low	No	Low	No	The subject land is highly disturbed due to presence of mining activities in the vicinity. Any water run-off entering the site would be passing through cleared areas containing mining materials, making water quality unsuitable for this species. No drainage lines occur within the subject land, and the subject land is not located nearby to suitable breeding habitat for this species. It is unlikely that this species would occur within the subject land.	Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter. Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters. Red-crowned Toadlets have not been recorded breeding in waters that are even mildly polluted or with a pH outside the range 5.5 to 6.5. Red-crowned Toadlets are quite a localised species that appear to be largely restricted to the immediate vicinity of suitable breeding habitat.
Pteropus poliocephalus Grey-headed Flying-fox	V	V	Yes	Low	No	Low	No	The closest known camp for this species is located approximately 5 km from the subject land. There was no evidence of roosting individuals observed within the subject land during the field investigation. The vegetation within the subject land is highly disturbed, and does not	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in

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								provide high quality foraging resources for this species. While the species may occasionally use the subject land for foraging, it is not considered good quality habitat.	gullies, close to water, in vegetation with a dense canopy.
Tyto novaehollandiae Masked Owl	-	V	Yes	Low	No	Nil	No	No suitable breeding habitat (hollows > 20 cm) are located within the subject land.	Found in dry eucalypt forests and woodlands up to 1100 m. Hunts along edges of forests and roadsides. Breeds in large hollows within moist eucalypt forested gullies.
Tyto tenebricosa Sooty Owl	-	V	Yes	Low	No	Low	No	No suitable breeding habitat (caves, or hollows > 20 cm) are located within the subject land.	Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Roosts by day in the hollow of a tall forest tree or in heavy vegetation; hunts by night for small ground mammals or tree-dwelling mammals. Breeds in caves or large hollows.

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Appendix 3 Flora BAM data

Appendix 3.1 BAM plot field data

Table A. 3 Flora species recorded in the Wongawilli Pit Top from BAM plots

Family	Scientific name	Common name	NWM01				NWM02			
			N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum
Sapindaceae	*Acer pseudoplatanus*	Sycamore Maple					E	2	1	
Myrtaceae	*Acmena smithii*	Lilly Pilly	N	10	20	Tree				
Adiantaceae	*Adiantum formosum*	Giant Maidenhair	N	40	200	Fern and fern allies	N	5	200	Fern and fern allies
Asteraceae	*Ageratina riparia*	Mistflower	N	1	10					
Aphanopetalaceae	*Aphanopetalum resinosum*	Gum Vine	N	2	10	Vine				
Blechnaceae	*Blechnum camfieldii*		N	2	20	Fern and fern allies				
Dicksoniaceae	*Calochlaena dubia*	Rainbow Fern					N	10	200	Tree fern
Convolvulaceae	*Calystegia sepium* subsp. *roseata*		N	1	1	Vine				
Cunoniaceae	*Ceratopetalum apetalum*	Coachwood	N	20	30	Tree	N	5	10	Tree
Vitaceae	*Cissus antarctica*	Water Vine	N	2	10	Vine				
Asteraceae	*Delairea odorata*	Cape Ivy	HTE	3	50		HTE	5	200	
Urticaceae	*Dendrocnide excelsa*	Giant Stinging Tree	N	1	3	Tree	N	5	20	Tree
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	HTE	1	30		HTE	3	200	
Celastraceae	*Elaeodendron australe*		N	10	20	Shrub				
Myrtaceae	*Eucalyptus quadrangulata*	White Topped Box					N	5	1	Tree

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Family	Scientific name	Common name	NWM01				NWM02			
			N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry	N	1	2	Vine				
Moraceae	*Ficus coronata*	Creek Sandpaper Fig	N	5	5	Shrub	N	2	5	Shrub
Fabaceae (Faboideae)	*Glycine tabacina*	Variable Glycine	N	1	1	Vine				
Sapindaceae	*Guioa semiglauca*	Guioa	N	2	10	Tree				
Araceae	*Gymnostachys anceps*	Settler's Twine	N	1	5	Forb				
Rubiaceae	*Gynochthodes jasminoides*	Sweet Morinda	N	1	5	Vine				
Monimiaceae	*Hedycarya angustifolia*	Native Mulberry	N	1	5	Tree				
Juncaceae	*Juncus usitatus*		N	3	100	Rush	N	1	1	Rush
Verbenaceae	*Lantana camara*	Lantana	HTE	20	20					
Arecaceae	*Livistona australis*	Cabbage Palm	N	5	4	Palm and palmlike	N	5	5	Palm and palmlike
Meliaceae	*Melia azedarach*	White Cedar	N	1	2	Tree				
Rutaceae	*Melicope micrococca*	Hairy-leaved Doughwood	N	5	20	Shrub				
Rutaceae	*Murraya paniculata*	Murrya					E	2	2	
Asteraceae	*Onopordum spp.*		E	1	1					
Poaceae	*Oplismenus imbecillis*		N	3	50	Other grass	N	2	50	Other grass
Urticaceae	*Parietaria judaica*	Pellitory	E	3	100		E	5	200	
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum	N	5	5	Shrub	N	20	29	Shrub
Lamiaceae	*Plectranthus ecklonii*	Cockspur Flower	E	5	20		E	10	200	
Dennstaedtiaceae	*Pteridium esculentum*	Bracken Fern					N	15	200	Fern and fern allies
Adoxaceae	*Sambucus australasica*	Shrub					N	1	2	Shrub
Smilacaceae	*Smilax glyciphylla*	Sweet Sarsparilla	N	5	20	Vine				
Solanaceae	*Solanum pseudocapsicum*	Madeira Winter Cherry	E	5	200		E	5	100	

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Family	Scientific name	Common name	NWM01				NWM02			
			N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum
Caryophyllaceae	*Stellaria media*	Common Chickweed	E	1	20					
Proteaceae	*Stenocarpus salignus*	Scrub Beefwood	N	1	5	Shrub				
Menispermaceae	*Stephania japonica*	Snake vine	N	2	5	Vine	N	2	5	Vine
Meliaceae	*Toona ciliata*	Red Cedar	N	5	2	Tree	N	2	1	Tree
Urticaceae	*Urtica incisa*	Stinging Nettle	N	2	5	Forb	N	5	200	Forb
Monimiaceae	*Wilkiea huegeliana*	Veiny Wilkiea	N	1	1	Shrub				
Poaceae	*Zea mays*	Maize					E	2	6	

Table A. 4 Flora species recorded in the Additional Driveage from BAM plots (NWM03)

Family	Scientific name	Common name	NWM03			
			N. E or HTE	Cover	Abundance	Stratum
Fabaceae	*Acacia binervata*	Two-veined Hickory	N	10	100	Tree
Fabaceae	*Acacia longifolia*		N	0.1	1	Shrub
Orchidaceae	*Acianthus* spp.	Mosquito Orchid	N	0.1	10	Forb
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry	N	0.1	10	Other
Blechnaceae	*Blechnum cartilagineum*	Gristle Fern	N	5	50	Fern
Orchidaceae	*Chiloglottis* spp.		N	0.1	5	Forb
Vitaceae	*Cissus hypoglauca*	Giant Water Vine	N	0.1	1	Other
Ranunculaceae	*Clematis aristata*	Old Man's Beard	N	0.1	2	Other
Rubiaceae	*Coprosma quadrifida*	Prickly Currant Bush	N	0.1	5	Shrub
Asteraceae	*Coronidium elatum*		N	0.1	1	Shrub
Fabaceae	*Desmodium gunnii*	Slender Tick-trefoil	N	0.1	2	Forb
Phormiaceae	*Dianella caerulea* var. *producta*		N	0.1	5	Forb
Elaeocarpaceae	*Elaeocarpus reticulatus*	Blueberry Ash	N	15	100	Shrub
Poaceae	*Entolasia stricta*	Wiry Panic	N	0.1	10	Grass &

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Family	Scientific name	Common name	NWM03			
			N. E or HTE	Cover	Abundance	Stratum
						grasslike
Myrtaceae	*Eucalyptus muelleriana*	Yellow Stringybark	N	2	2	Tree
Myrtaceae	*Eucalyptus piperita*	Sydney Peppermint	N	45	1	Tree
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry	N	0.1	1	Other
Rubiaceae	*Galium binifolium*		N	0.1	5	Forb
Fabaceae	*Glycine microphylla*	Small-leaf Glycine	N	0.1	2	Other
Haloragaceae	*Gonocarpus teucrioides*	Germander Raspwort	N	0.1	10	Forb
Dilleniaceae	*Hibbertia dentata*	Twining Guinea Flower	N	1	100	Other
Araliaceae	*Hydrocotyle sibthorpioides*		N	0.1	1	Forb
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge	N	0.1	20	Grass & grasslike
Santalaceae	*Leptomeria acida*	Sour Currant Bush	N	0.1	1	Shrub
Ericaceae	*Leucopogon lanceolatus*		N	0.1	1	Shrub
Proteaceae	*Lomatia silaifolia*	Crinkle Bush	N	0.1	1	Shrub
Poaceae	*Microlaena stipoides*	Weeping Grass	N	0.1	1	Grass & grasslike
Oleaceae	*Notelaea longifolia*	Large Mock-olive	N	0.1	1	Tree
Oleaceae	*Notelaea ovata*		N	0.1	1	Shrub
Poaceae	*Oplismenus imbecillis*		N	0.1	50	Grass & grasslike
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung	N	0.1	1	Shrub
Poaceae	*Poa affinis*		N	0.1	1	Grass & grasslike
Phyllanthaceae	*Poranthera microphylla*	Small Poranthera	N	0.1	10	Forb
Campanulaceae	*Pratia purpurascens*	Whiteroot	N	0.1	10	Forb
Dennstaedtiaceae	*Pteridium esculentum*	Bracken	N	0.1	2	Fern
Uvulariaceae	*Schelhammera undulata*		N	0.1	5	Forb
Smilacaceae	*Smilax australis*	Lawyer Vine	N	0.1	1	Other

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Family	Scientific name	Common name	NWM03			
			N. E or HTE	Cover	Abundance	Stratum
Myrtaceae	*Tristaniopsis collina*	Mountain Water Gum	N	0.2	10	Tree
Apocynaceae	*Tylophora barbata*	Bearded Tylophora	N	0.1	30	Other
Violaceae	*Viola banksii*		N	0.1	10	Forb

Table A. 5 Flora species recorded in the Additional Driveage from BAM plots (NWM04)

Family	Scientific name	Common name	NWM04			
			N. E or HTE	Cover	Abundance	Stratum
Myrtaceae	*Baeckea linifolia*	Weeping Baeckea	N	0.1	1	Shrub
Proteaceae	*Banksia ericifolia*	Heath-leaved Banksia	N	0.1	1	Shrub
Proteaceae	*Banksia serrata*	Old-man Banksia	N	0.1	1	Tree
Cunoniaceae	*Bauera rubioides*	River Rose	N	1	100	Shrub
Cyperaceae	*Caustis flexuosa*	Curly Wig	N	0.1	2	Grass & grasslike
Cunoniaceae	*Ceratopetalum apetalum*	Coachwood	N	20	30	Tree
Proteaceae	*Conospermum tenuifolium*	Sprawling Smoke-bush	N	0.1	1	Shrub
Phormiaceae	*Dianella caerulea* var. *caerulea*		N	0.1	10	Forb
Poaceae	*Entolasia marginata*	Bordered Panic	N	0.1	10	Grass & grasslike
Ericaceae	*Epacris pulchella*	Wallum Heath	N	0.1	1	Shrub
Myrtaceae	*Eucalyptus sieberi*	Silvertop Ash	N	0.1	1	Tree
Cyperaceae	*Gahnia sieberiana*	Red-fruit Saw	N	0.2	5	Grass & grasslike
Gleicheniaceae	*Gleichenia microphylla*	Scrambling Coral Fern	N	0.5	100	Fern
Haloragaceae	*Gonocarpus teucrioides*	Germander Raspwort	N	0.1	10	Forb
Polypodiaceae	*Grammitis billardierei*	Finger Fern	N	0.1	1	Fern

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Family	Scientific name	Common name	NWM04			
			N. E or HTE	Cover	Abundance	Stratum
Proteaceae	*Hakea dactyloides*	Finger Hakea	N	0.1	1	Shrub
Proteaceae	*Hakea teretifolia*	Needlebush	N	0.1	1	Shrub
Proteaceae	*Lambertia formosa*	Mountain Devil	N	0.1	1	Shrub
Ericaceae	*Leucopogon lanceolatus*		N	0.1	1	Shrub
Lindsaeaceae	*Lindsaea microphylla*	Lacy Wedge Fern	N	0.1	1	Fern
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat	N	0.1	10	Grass & grasslike
Proteaceae	*Lomatia myricoides*	River Lomatia	N	1	20	Shrub
Myrtaceae	*Melaleuca squamea*	Swamp Honey-myrtle	N	0.1	1	Shrub
Proteaceae	*Persoonia mollis* subsp. *mollis*		N	0.5	5	Shrub
Dennstaedtiaceae	*Pteridium esculentum*	Bracken	N	0.1	1	Fern
Orchidaceae	*Pterostylis* spp.	Greenhood	N	0.1	1	Forb
Paracryphiaceae	*Quintinia sieberi*	Possumwood	N	0.1	5	Tree
Orchidaceae	*Sarcochilus* spp.		N	0.1	1	Other
Cyperaceae	*Schoenus melanostachys*		N	2	30	Grass & grasslike
Smilacaceae	*Smilax glyciphylla*	Sweet Sarsparilla	N	0.1	1	Other
Gleicheniaceae	*Sticherus flabellatus*	Umbrella Fern	N	35	1000	
Proteaceae	*Symphionema montanum*		N	0.1	1	Shrub
Poaceae	*Tetrarrhena turfosa*		N	0.1	1	Grass & grasslike
Osmundaceae	*Todea barbara*	King Fern	N	1	20	Other
Osmundaceae	*Tristaniopsis laurina*	Kanooka	N	40	100	Tree

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Table A. 6 Flora species recorded in the Additional Driveage from BAM plots (NWM05)

Family	Scientific name	Common name	NWM05			
			N. E or HTE	Cover	Abundance	Stratum
Fabaceae	*Acacia longifolia*		N	0.1	1	Shrub
Fabaceae	*Acacia terminalis* subsp. *angustifolia*		N	0.1	2	Shrub
Fabaceae	*Acacia ulicifolia*	Prickly Moses	N	0.1	10	Shrub
Apiaceae	*Actinotus minor*	Lesser Flannel Flower	N	0.1	2	Forb
Proteaceae	*Banksia ericifolia* var. *ericifolia*		N	60	1000	Shrub
Proteaceae	*Banksia serrata*	Old-man Banksia	N	5	10	Tree
Cunoniaceae	*Bauera rubioides*	River Rose	N	40	100	Shrub
Cyperaceae	*Baumea articulata*	Jointed Twig-rush	N	0.1	1	Grass & grasslike
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry	N	0.1	1	Other
Fabaceae	*Bossiaea obcordata*	Spiny Bossiaea	N	0.1	10	Shrub
Myrtaceae	*Callistemon citrinus*	Crimson Bottlebrush	N	0.1	10	Shrub
Cyperaceae	*Caustis flexuosa*	Curly Wig	N	0.1	1	Grass & grasslike
Proteaceae	*Conospermum tenuifolium*	Sprawling Smoke-bush	N	0.5	500	Shrub
Cyperaceae	*Cyperus* spp.		N	0.1	1	Grass & grasslike
Cyperaceae	*Dillwynia floribunda*		N	0.1	5	Shrub
Restionaceae	*Empodisma minus*		N	5	1000	Grass & grasslike
Poaceae	*Entolasia stricta*	Wiry Panic	N	0.1	50	Grass & grasslike
Ericaceae	*Epacris pulchella*	Wallum Heath	N	0.1	10	Shrub
Rutaceae	*Eriostemon australasius*		N	0.1	1	Shrub
Myrtaceae	*Eucalyptus haemastoma*	Broad-leaved Scribbly Gum	N	0.1	1	Tree
Myrtaceae	*Eucalyptus piperita*	Sydney Peppermint	N	0.1	1	Tree

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Family	Scientific name	Common name	NWM05			
			N. E or HTE	Cover	Abundance	Stratum
Myrtaceae	*Eucalyptus sieberi*	Silvertop Ash	N	0.1	1	Tree
Restionaceae	*Eurychorda complanata*		N	0.1	5	Grass & grasslike
Cyperaceae	*Gahnia sieberiana*	Red-fruit Saw-sedge	N	5	10	Grass & grasslike
Rubiaceae	*Galium gaudichaudii*	Rough Bedstraw	N	0.1	10	Forb
Gleicheniaceae	*Gleichenia microphylla*	Scrambling Coral Fern	N	30	1000	Fern
Haloragaceae	*Gonocarpus teucrioides*	Germander Raspwort	N	0.1	10	Forb
Cyperaceae	*Gymnoschoenus sphaerocephalus*	Button Grass	N	0.1	5	Grass & grasslike
Proteaceae	*Hakea dactyloides*	Finger Hakea	N	0.2	30	Shrub
Proteaceae	*Hakea sericea*	Needlebush	N	0.1	1	Shrub
Proteaceae	*Hakea teretifolia*	Needlebush	N	10	30	Shrub
Proteaceae	*Isopogon anemonifolius*	Broad-leaf Drumsticks	N	0.1	50	Shrub
Restionaceae	*Leptocarpus tenax*		N	0.1	100	Grass & grasslike
Santalaceae	*Leptomeria acida*	Sour Currant Bush	N	0.1	2	Shrub
Myrtaceae	*Leptospermum trinervium*	Slender Tea-tree	N	5	50	Shrub
Restionaceae	*Lepyrodia scariosa*		N	0.1	20	Grass & grasslike
Lomandraceae	*Lomandra cylindrica*		N	0.1	100	Grass & grasslike
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	N	0.5	30	Grass & grasslike
Lomandraceae	*Lomandra multiflora*	Many-flowered Mat-rush	N	0.1	10	
Lomandraceae	*Lomandra obliqua*		N	0.1	50	Grass & grasslike
Myrtaceae	*Melaleuca squarrosa*	Scented Paperbark	N	15	500	Shrub

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Family	Scientific name	Common name	NWM05			
			N. E or HTE	Cover	Abundance	Stratum
Ericaceae	*Monotoca scoparia*		N	0.1	10	Shrub
Iridaceae	*Patersonia longifolia*		N	0.1	1	Forb
Iridaceae	*Patersonia sericea*	Silky Purple-Flag	N	0.1	2	Forb
Proteaceae	*Persoonia levis*	Broad-leaved Geebung	N	0.1	2	Shrub
Proteaceae	*Persoonia mollis* subsp. *mollis*		N	0.1	1	Shrub
Proteaceae	*Petrophile pulchella*	Conesticks	N	0.2	30	Shrub
Phyllanthaceae	*Phyllanthus hirtellus*	Thyme Spurge	N	0.1	1	Shrub
Thymelaeaceae	*Pimelea linifolia*	Slender Rice Flower	N	0.1	1	Shrub
Dennstaedtiaceae	*Pteridium esculentum*	Bracken	N	0.1	2	Fern
Cyperaceae	*Schoenus melanostachys*		N	0.5	30	Grass & grasslike
Proteaceae	*Telopea speciosissima*	Waratah	N	0.1	2	Shrub
Proteaceae	*Xylomelum pyriforme*	Woody Pear	N	0.1	1	Shrub

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Table A. 7 Flora species recorded in the Additional Driveage from BAM plots (NWM06)

Family	Scientific name	Common name	NWM06			
			N. E or HTE	Cover	Abundance	Stratum
Fabaceae	*Acacia suaveolens*	Sweet Wattle	N	0.1	1	Shrub
Fabaceae	*Acacia terminalis* subsp. *angustifolia*		N	0.1	5	Shrub
Proteaceae	*Banksia ericifolia* var. *ericifolia*		N	0.5	10	Shrub
Proteaceae	*Banksia serrata*	Old-man Banksia	N	0.2	5	Tree
Myrtaceae	*Corymbia gummifera*	Red Bloodwood	N	15	10	Tree
Cyperaceae	*Dillwynia retorta*		N	0.5	30	Shrub
Ericaceae	*Epacris pulchella*	Wallum Heath	N	0.5	20	Shrub
Myrtaceae	*Eucalyptus haemastoma*	Broad-leaved Scribbly Gum	N	2	1	Tree
Myrtaceae	*Eucalyptus sieberi*	Silvertop Ash	N	10	1	Tree
Fabaceae	*Glycine microphylla*	Small-leaf Glycine	N	0.2	10	Other
Restionaceae	*Leptocarpus tenax*		N	0.1	10	Grass & grasslike
Myrtaceae	*Leptospermum rotundifolium*		N	10	50	Shrub
Myrtaceae	*Leptospermum trinervium*	Slender Tea-tree	N	2	30	Shrub
Ericaceae	*Leucopogon setiger*		N	0.1	2	Shrub
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	N	0.2	20	Grass & grasslike
Lomandraceae	*Lomandra micrantha* subsp. *tuberculata*	Small-flowered Mat-rush	N	0.1	1	Grass & grasslike
Ericaceae	*Monotoca scoparia*		N	0.1	1	Shrub
Proteaceae	*Persoonia mollis* subsp. *mollis*		N	0.1	1	Shrub
Proteaceae	*Petrophile pulchella*	Conesticks	N	0.1	10	Shrub
Dennstaedtiaceae	*Pteridium esculentum*	Bracken	N	0.1	2	Fern

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Table A. 7 Flora species recorded in the Additional Driveage from BAM plots (NWM07)

Family	Scientific name	Common name	NWM07			
			N. E or HTE	Cover	Abundance	Stratum
Casuarinaceae	*Allocasuarina littoralis*	Black She-oak	N	30	1000	Tree
Proteaceae	*Banksia ericifolia* subsp. *ericifolia*		N	60	1000	Shrub
Cunoniaceae	*Bauera rubioides*	River Rose	N	0.1	10	Shrub
Cyperaceae	*Baumea* spp.		N	0.1	1	Grass & grasslike
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry	N	0.1	10	Other
Myrtaceae	*Callistemon citrinus*	Crimson Bottlebrush	N	0.1	10	Shrub
Myrtaceae	*Callistemon linearis*	Narrow-leaved Bottlebrush	N	0.1	5	Shrub
Lauraceae	*Cassytha glabella*		N	0.1	20	Other
Vitaceae	*Cissus antarctica*	Water Vine	N	0.1	1	Other
Vitaceae	*Cissus hypoglauca*	Giant Water Vine	N	0.1	5	Other
Restionaceae	*Empodisma minus*		N	0.1	100	Grass & grasslike
Poaceae	*Entolasia marginata*	Bordered Panic	N	0.1	10	Grass & grasslike
Poaceae	*Entolasia stricta*	Wiry Panic	N	0.5	10	Grass & grasslike
Myrtaceae	*Eucalyptus haemastoma*	Broad-leaved Scribbly Gum	N	0.5	1	Tree
Myrtaceae	*Eucalyptus piperita*	Sydney Peppermint	N	1	5	Tree
Cyperaceae	*Gahnia sieberiana*	Red-fruit Saw-sedge	N	1	10	Grass & grasslike
Gleicheniaceae	*Gleichenia microphylla*	Scrambling Coral Fern	N	0.2	500	Fern
Proteaceae	*Hakea dactyloides*	Finger Hakea	N	0.1	1	Shrub
Proteaceae	*Hakea sericea*	Needlebush	N	0.1	5	Shrub

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Family	Scientific name	Common name	NWM07			
			N. E or HTE	Cover	Abundance	Stratum
Proteaceae	*Hakea teretifolia*	Needlebush	N	5	50	Shrub
Proteaceae	*Isopogon anemonifolius*	Broad-leaf Drumsticks	N	0.1	5	Shrub
Cyperaceae	*Lepidosperma neesii*		N	40	1000	Grass & grasslike
Restionaceae	*Leptocarpus tenax*		N	1	1000	Grass & grasslike
Myrtaceae	*Leptospermum trinervium*	Slender Tea-tree	N	0.1	1	Shrub
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	N	0.1	10	Grass & grasslike
Myrtaceae	*Melaleuca squarrosa*	Scented Paperbark	N	0.5	20	Shrub
Poaceae	*Microlaena stipoides*	Weeping Grass	N	0.1	1	Grass & grasslike
Proteaceae	*Persoonia mollis* subsp. *mollis*		N	0.2	2	Shrub
Dennstaedtiaceae	*Pteridium esculentum*	Bracken	N	0.1	1	Fern
Orchidaceae	*Pterostylis nutans*	Nodding Greenhood	N	0.1	10	Forb
Cyperaceae	*Ptilothrix deusta*		N	2	1000	Grass & grasslike
Cyperaceae	*Schoenus brevifolius*		N	60	1000	Grass & grasslike
Cyperaceae	*Schoenus melanostachys*		N	1	100	Grass & grasslike
Cyperaceae	*Tetraria capillaris*		N	0.1	500	Grass & grasslike
Poaceae	*Tetrarrhena turfosa*		N	0.1	10	Grass & grasslike

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Table A. 8 Flora species recorded in the Additional Driveage from BAM plots (NWM08)

Family	Scientific name	Common name	NWM08			
			N. E or HTE	Cover	Abundance	Stratum
Fabaceae	*Acacia binervata*	Two-veined Hickory	N	0.1	20	Tree
Orchidaceae	*Acianthus fornicatus*	Pixie Caps	N	0.1	1	Forb
Casuarinaceae	*Allocasuarina littoralis*	Black She-oak	N	0.1	10	Tree
Proteaceae	*Banksia serrata*	Old-man Banksia	N	0.1	1	Tree
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry	N	0.1	5	Other
Blechnaceae	*Blechnum cartilagineum*	Gristle Fern	N	0.1	10	Fern
Ranunculaceae	*Clematis aristata*	Old Man's Beard	N	0.1	5	Other
Goodeniaceae	*Dampiera stricta*		N	0.1	10	Forb
Phormiaceae	*Dianella caerulea* var. *caerulea*		N	0.1	10	Forb
Poaceae	*Entolasia marginata*	Bordered Panic	N	0.1	10	Grass & grasslike
Poaceae	*Entolasia stricta*	Wiry Panic	N	0.1	10	Grass & grasslike
Myrtaceae	*Eucalyptus piperita*	Sydney Peppermint	N	35	5	Tree
Haloragaceae	*Gonocarpus teucrioides*	Germander Raspwort	N	0.1	10	Forb
Proteaceae	*Grevillea mucronulata*		N	0.1	10	Shrub
Proteaceae	*Hakea sericea*	Needlebush	N	0.1	10	Shrub
Dilleniaceae	*Hibbertia dentata*	Twining Guinea Flower	N	0.1	30	Other
Fabaceae	*Kennedia rubicunda*	Dusky Coral Pea	N	0.1	20	Other
Dryopteridaceae	*Lastreopsis microsora*	Creeping Shield Fern	N	10	1000	
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge	N	0.1	10	Grass & grasslike
Ericaceae	*Leucopogon lanceolatus*		N	0.2	10	Shrub
Campanulaceae	*Lobelia dentata*		N	0.1	1	Forb
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	N	5	200	Grass & grasslike
Proteaceae	*Lomatia silaifolia*	Crinkle Bush	N	0.2	50	Shrub

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Family	Scientific name	Common name	NWM08			
			N. E or HTE	Cover	Abundance	Stratum
Poaceae	*Microlaena stipoides*	Weeping Grass	N	0.1	50	Grass & grasslike
Iridaceae	*Patersonia sericea*	Silky Purple-Flag	N	0.1	5	Forb
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung	N	0.2	5	Shrub
Fabaceae	*Podolobium ilicifolium*	Prickly Shaggy Pea	N	0.1	10	Shrub
Dennstaedtiaceae	*Pteridium esculentum*	Bracken	N	15	1000	Fern
Orchidaceae	*Pterostylis* spp.	Greenhood	N	0.1	5	Forb
Smilacaceae	*Smilax glyciphylla*	Sweet Sarsparilla	N	0.2	10	Other
Proteaceae	*Telopea speciosissima*	Waratah	N	0.2	10	Shrub
Osmundaceae	*Tristaniopsis collina*	Mountain Water Gum	N	0.1	2	Tree

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Table A. 9 Flora species recorded in the Additional Driveage from BAM plots (NWM09)

Family	Scientific name	Common name	NWM09			
			N. E or HTE	Cover	Abundance	Stratum
Fabaceae	*Acacia longifolia*		N	0.5	100	Shrub
Fabaceae	*Acacia ulicifolia*	Prickly Moses	N	0.1	2	Shrub
Casuarinaceae	*Allocasuarina littoralis*	Black She-oak	N	0.2	20	Tree
Euphorbiaceae	*Amperea xiphoclada*		N	0.1	10	Shrub
Proteaceae	*Banksia serrata*	Old-man Banksia	N	0.2	2	Tree
Proteaceae	*Banksia spinulosa*	Hairpin Banksia	N	0.2	10	Shrub
Fabaceae	*Bossiaea heterophylla*	Variable Bossiaea	N	0.1	1	Shrub
Fabaceae	*Bossiaea obcordata*	Spiny Bossiaea	N	0.1	20	Shrub
Orchidaceae	*Chiloglottis formicifera*	Ant Orchid	N	0.1	10	Forb
Lamiaceae	*Chloanthes stoechadis*		N	0.1	10	Shrub
Myrtaceae	*Corymbia gummifera*	Red Bloodwood	N	10	5	Tree
Orchidaceae	*Cryptostylis* spp.		N	0.1	2	Forb
Goodeniaceae	*Dampiera purpurea*		N	0.1	5	Forb
Goodeniaceae	*Dampiera stricta*		N	0.1	100	Forb
Phormiaceae	*Dianella caerulea* var. *caerulea*		N	0.1	10	Forb
Poaceae	*Entolasia stricta*	Wiry Panic	N	0.2	100	Grass & grasslike
Myrtaceae	*Eucalyptus piperita*	Sydney Peppermint	N	10	3	Tree
Haloragaceae	*Gonocarpus teucrioides*	Germander Raspwort	N	0.1	10	Forb
Proteaceae	*Grevillea mucronulata*		N	0.1	20	Shrub
Proteaceae	*Hakea dactyloides*	Finger Hakea	N	0.1	5	Shrub
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower	N	0.1	5	Shrub
Proteaceae	*Lambertia formosa*	Mountain Devil	N	0.1	1	Shrub
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge	N	1	500	Grass & grasslike
Cyperaceae	*Lepidosperma urophorum*		N	0.1	10	Grass & grasslike

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Family	Scientific name	Common name	NWM09			
			N. E or HTE	Cover	Abundance	Stratum
Myrtaceae	*Leptospermum trinervium*	Slender Tea-tree	N	0.1	2	Shrub
Lomandraceae	*Lomandra confertifolia* subsp. *rubiginosa*		N	0.1	20	Grass & grasslike
Lomandraceae	*Lomandra cylindrica*		N	0.1	100	Grass & grasslike
Lomandraceae	*Lomandra filiformis* subsp. *filiformis*		N	0.1	10	Grass & grasslike
Lomandraceae	*Lomandra gracilis*		N	0.1	1	Grass & grasslike
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	N	0.1	50	Grass & grasslike
Lomandraceae	*Lomandra multiflora*	Many-flowered Mat-rush	N	0.1	1	Grass & grasslike
Lomandraceae	*Lomandra obliqua*		N	0.1	100	Grass & grasslike
Lycopodiaceae	*Lycopodiella lateralis*	Slender Clubmoss	N	0.1	1	Fern
Iridaceae	*Patersonia sericea*	Silky Purple-Flag	N	0.1	10	Forb
Proteaceae	*Persoonia levis*	Broad-leaved Geebung	N	0.1	20	Shrub
Proteaceae	*Petrophile pulchella*	Conesticks	N	0.1	1	Shrub
Phyllanthaceae	*Phyllanthus hirtellus*	Thyme Spurge	N	0.1	10	Shrub
Thymelaeaceae	*Pimelea linifolia*	Slender Rice Flower	N	0.1	1	Shrub
Apiaceae	*Platysace linearifolia*		N	0.1	1	Shrub
Phyllanthaceae	*Poranthera microphylla*	Small Poranthera	N	0.1	5	Forb
Dennstaedtiaceae	*Pteridium esculentum*	Bracken	N	0.5	1000	Fern
Orchidaceae	*Pterostylis* spp.	Greenhood	N	0.1	10	Forb
Xanthorrhoeaceae	*Xanthorrhoea media*		N	0.1	5	Other

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Table A. 10 Flora species recorded in the Additional Driveage from BAM plots (NWM10)

Family	Scientific name	Common name	NWM10			
			N. E or HTE	Cover	Abundance	Stratum
Fabaceae	*Acacia obtusata*	Blunt-leaf Wattle	N	0.2	5	Shrub
Fabaceae	*Acacia terminalis* subsp. *angustifolia*		N	0.1	1	Shrub
Proteaceae	*Banksia serrata*	Old-man Banksia	N	0.5	3	Tree
Blechnaceae	*Blechnum ambiguum*		N	0.1	1	Fern
Phormiaceae	*Dianella longifolia*	Blueberry Lily	N	0.1	2	Forb
Poaceae	*Entolasia stricta*	Wiry Panic	N	0.1	10	Grass & grasslike
Myrtaceae	*Eucalyptus muelleriana*	Yellow Stringybark	N	2	1	Tree
Myrtaceae	*Eucalyptus piperita*	Sydney Peppermint	N	5	3	Tree
Cyperaceae	*Gahnia sieberiana*	Red-fruit Saw-sedge	N	1	30	Grass & grasslike
Haloragaceae	*Gonocarpus teucrioides*	Germander Raspwort	N	0.1	20	Forb
Proteaceae	*Grevillea mucronulata*		N	0.1	1	Shrub
Proteaceae	*Hakea dactyloides*	Finger Hakea	N	0.1	1	Shrub
Dilleniaceae	*Hibbertia dentata*	Twining Guinea Flower	N	0.1	1	Other
Fabaceae	*Kennedia rubicunda*	Dusky Coral Pea	N	0.1	1	Other
Dryopteridaceae	*Lastreopsis microsora* subsp. *microsora*	Creeping Shield Fern	N	0.1	50	Fern
Myrtaceae	*Leptospermum polygalifolium*	Tantoon	N	0.1	5	Shrub
Ericaceae	*Leucopogon lanceolatus*		N	0.1	5	Shrub
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat	N	0.1	10	Grass & grasslike
Proteaceae	*Lomatia silaifolia*	Crinkle Bush	N	0.1	1	Shrub
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung	N	0.1	1	Shrub
Fabaceae	*Podolobium ilicifolium*	Prickly Shaggy Pea	N	0.1	2	Shrub
Dennstaedtiaceae	*Pteridium esculentum*	Bracken	N	0.2	20	Fern

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Family	Scientific name	Common name	NWM10			
			N. E or HTE	Cover	Abundance	Stratum
Fabaceae	*Pultenaea daphnoides*	Large-leaf Bush-pea	N	0.1	1	Shrub
Smilacaceae	*Smilax glyciphylla*	Sweet Sarsparilla	N	0.1	10	Other
Gleicheniaceae	*Sticherus flabellatus* var. *flabellatus*	Umbrella Fern	N	0.5	100	Fern
Osmundaceae	*Todea barbara*	King Fern	N	70	1000	Other

Table A. 11 Flora species recorded in the Additional Driveage from BAM plots (NWM11)

Family	Scientific name	Common name	NWM11			
			N. E or HTE	Cover	Abundance	Stratum
Cunoniaceae	*Bauera rubioides*	River Rose	N	0.2	500	Shrub
Blechnaceae	*Blechnum ambiguum*		N	0.2	50	Fern
Phormiaceae	*Dianella caerulea*	Blue Flax-lilly	N	0.1	1	Forb
Droseraceae	*Drosera auriculata*		N	0.1	10	Forb
Droseraceae	*Drosera binata*	Forked Sundew	N	0.5	1000	Forb
Gleicheniaceae	*Gleichenia microphylla*	Scrambling Coral Fern	N	40	1000	Fern
Haloragaceae	*Gonocarpus micranthus*		N	0.1	10	Forb
Haloragaceae	*Gonocarpus teucrioides*	Germander Raspwort	N	0.1	500	Forb
Fabaceae	*Pultenaea daphnoides*	Large-leaf Bush-pea	N	0.1	1	Shrub
Rhizogoniaceae	*Pyrrhobryum paramattense*		N	0.5	50	
Osmundaceae	*Todea barbara*	King Fern	N	0.2	20	Other

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Appendix 4 SIC Assessments

Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion

Illawarra-Shoalhaven Subtropical Rainforest is listed as a CEEC under the EPBC Act. Illawarra-Shoalhaven Subtropical Rainforest is endemic to NSW and contains two NSW listed EECs – the Illawarra Subtropical Rainforest and the Milton-Ulladulla Subtropical Rainforest (Department of Environment and Energy 2019). The community extends from the Port Hacking estuary and extends to the boundary of the Sydney Basin Bioregion. The community is associated with highly fertile soils on igneous and sedimentary rocks and primarily below 350 metres. The factors considered critical to the survival of the community include conservation of larger patches with high percentage native understorey (Department of Environment and Energy 2019). There is no adopted or made Recovery Plan for this ecological community.

Illawarra-Shoalhaven Subtropical Rainforest CEEC was recorded within the Wongawilli Pit Top study area. The community occurs as a modified form of the CEEC, lacking structural complexity and a limited floristic composition. Diagnostic tree species were limited to, Giant Stinging Tree and Red Cedar with a canopy cover of 50 %. Shrub and vine species were also in low densities, and included, *Elaeodendron australe*, Sandpaper Fig, Hairy-leaved Doughwood, *Melicope micrococca*, Scrub Beefwood, Gum Vine and Water Vine, with a total cover of 6 % in the midstory layer.

PCT 906 in its current condition meets the Commonwealth listing for *Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion* CEEC under the EPBC Act, as a Regenerating rainforest –Category D, as it meets the following criteria in the Conservation Advice (Department of Environment and Energy 2019):

- An area of least at least 0.1 hectares.
- At least 30 % canopy cover.
- A minimum of 15 native plant species from Table A1 per 0.04 hectare sample plot on average for the patch.
- Evidence of regeneration (e.g. seedlings, saplings or other sub-mature stages of rainforest tree species).

The proposed works will result in the removal of 0.01 hectares of Illawarra-Shoalhaven Subtropical Rainforest CEEC within the subject site.

Table A. 5 Assessment against significant impact criteria for Illawarra-Shoalhaven Subtropical Rainforest

Significant impact criteria (critically endangered / endangered community)	Likelihood of significant impact	Justification
Reduce the extent of an ecological community.	Unlikely	The proposed works will result in the removal of 0.01 hectares of Illawarra-Shoalhaven Subtropical Rainforest CEEC within the subject site. The proposed works will reduce the extent of the ecological community in the locality, however the vegetation to be impacted form part of a larger patch of the CEEC totalling 11 hectares in size. The removal of 0.01 hectares of the CEEC, equates to >0.1% in the locality, and therefore the reduction on the extent of the community is unlikely to be significant.

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Significant impact criteria (critically endangered / endangered community)	Likelihood of significant impact	Justification
Fragment or increase fragmentation of an ecological community.	Unlikely	The proposed works will involve the installation a 2 x 63 metre conveyer belt, through the middle of the existing patch of Illawarra-Shoalhaven Subtropical Rainforest CEEC within the Wongawilli Pit Top study area, resulting in the removal of 0.01 hectares of the CEEC. This will result in minor fragmentation and isolation of the community, however given the works are limited to a 2 m wide corridor it is highly unlikely to impede genetic flow of seed propagules and pollinators. Additionally, the conveyer belt route is raised above the ground and avoids the removal of vegetation where possible and maintains connectivity. Therefore, the proposed works is considered unlikely to result in the fragmentation of Illawarra-Shoalhaven Subtropical Rainforest CEEC within the study area.
Adversely affect habitat critical to the survival of an ecological community.	Unlikely	All EPBC listed vegetation is considered critical habitat (Department of Environment and Energy 2019) to the survival of ecological community. At a landscape scale over 100 hectares of Illawarra-Shoalhaven Subtropical Rainforest is mapped within a 5 kilometre radius of the study area (DPIE 2010). However, the condition of this vegetation has not be confirmed. At a local scale, the vegetation to be impacted within the Wongawilli Pit Top (0.01 ha) is contiguous with a larger patch comprising of 11 ha, which equates to >0.1% of the CEEC to be impacted within the locality. In addition, the works are limited to a 2 m wide corridor and will avoid vegetation removal where possible, and will not impact connectivity of the existing patch in the landscape. Furthermore a CEMP will be prepared for the proposed works which will include weed management requirements within the CEEC which will avoid further weed incursion. Given the impact is small (0.01 ha), the proposed works are not considered to fragment the existing patch, and the works will not result in further weed impacts to the CEEC, the proposed works is not considered to adversely affect habitat critical to the survival of the of Illawarra-Shoalhaven Subtropical Rainforest CEEC.
Modify or destroy abiotic factors necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns.	Unlikely	Construction is unlikely to result in changes to surface water drainage patterns. The project has been designed to ensure the conveyor belt has been raised above the ground to mitigate disruption to flow patterns of water. However, any potential sediment or erosion impacts will be managed appropriately through a CEMP and OEMP. Removal of canopy and larger shrub species is likely to increase light availability to the understorey stratum. However, the conveyer belt route is raised above the ground and avoids the removal of vegetation where possible and maintains connectivity. In addition, the location of the conveyor belt will decrease the level of light increase such that the increase light is unlikely to cause a significant change in abiotic factors. As such the proposed works will not modify or destroy abiotic factors necessary for the Illawarra-Shoalhaven Subtropical Rainforest CEEC's survival.

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Significant impact criteria (critically endangered / endangered community)	Likelihood of significant impact	Justification
Cause a substantial change in the species composition of an occurrence of an ecological community, including a decline or loss of functionally important species, for example through regular burning or flora and fauna harvesting.	Unlikely	The community occurs as a modified form of the Illawarra-Shoalhaven Subtropical Rainforest CEEC, lacking structural complexity and a limited floristic composition. Diagnostic tree species were limited to, Giant Stinging Tree and Red Cedar with a canopy cover of 50 %. Shrub and vine species were also in low densities, and included, Elaeodendron australe, Sandpaper Fig, Hairy-leaved Doughwood, Melicope micrococca, Scrub Beefwood, Gum Vine and Water Vine, with a total cover of 6 % in the midstory layer. The works will results in the permanent removal of 0.01 ha of the CEEC consisting of a 2 m wide corridor. However, the conveyer belt route is raised above the ground and avoids the removal of vegetation where possible, and the diversity of the existing community is lacking structural complexity. In addition, the species likely to be impacted are proportionately represented in the adjacent retained vegetation. Therefore, the proposed works will cause a substantial change in the species composition of an occurrence of Illawarra-Shoalhaven Subtropical Rainforest CEEC.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including but not limited to: - ***Assisting invasive species establishment*** ***- 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.***	Unlikely	Exotic species were recorded in moderate densities within the CEEC, with opportunistic herbaceous perennial species being observed throughout the vegetation type, with heavier weed density observed along the boundaries with cleared and disturbed areas to the east and west. A heavy infestation of Lantana was observed in the south-west corner of the patch. Deer are also known to occur within the locality. The proposed works are not considered to increase weed or pest invasion, or cause mobilisation of fertilisers, herbicides or other chemical within the CEEC. The construction of the conveyer belt will also be managed under a CEMP, and will include measures such as weed removal practices, disposal and hygiene practices, and chemical storage. Therefore, the proposed works are unlikely to cause a substantial reduction in the quality or integrity of an occurrence of Illawarra-Shoalhaven Subtropical Rainforest CEEC.
Interfere with the recovery of an ecological community.	Unlikely	Illawarra-Shoalhaven Subtropical Rainforest is not currently subjected to a recovery plan, however is included within the Save Our Species program which develops critical actions to undertake against key threats to the community. The critical actions are centred around the removal of pest and increasing research efforts to understand the extent and condition of the community. The project will be subjected to CEMP which will align the project with the critical actions described for the community. Therefore, the proposed actions area considered unlikely to interfere with recovery actions.

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Conclusion

Based on the factors above, it is concluded that the proposed works are unlikely to lead to a significant impact on the Illawarra-Shoalhaven Subtropical Rainforest CEEC.

Large-eared Pied Bat Chalinolobus dwyeri

The Large-eared Pied Bat is a medium-sized insectivorous bat measuring a total length of approximately 100 millimetres and weighing 7–12 grams (Hoye and Dwyer 1995). The species is listed as Vulnerable under the BC Act and the EPBC Act. The species' current distribution is poorly known. Records exist from Shoalwater Bay, north of Rockhampton, Queensland, through to the vicinity of Ulladulla, NSW in the south (Hoye 2005). Despite the large range, it has been suggested that the species is far more restricted within the species' range than previously thought (DECC 2007a). Much of the known distribution is within NSW. Available records suggest that the largest concentrations of populations appear to be in the sandstone escarpments of the Sydney basin and the north-west slopes (Coolah Tops, Mt Kaputar, Warrumbungle National Park and Pilliga Nature Reserve. Although the species is widely distributed, it is uncommon and patchy within this area (DERM 2011).

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 (TSSC 2012). Almost all records have been found within several kilometres of cliff lines or rocky terrain (Hoye 2005). Roosting has also been observed in disused mine shafts, caves, overhangs and disused Fairy Martin *Hirundo ariel* nests (Hoye and Dwyer 1995).

Only four maternity roosts have been discovered in NSW, with two of these since abandoned due to flood and disturbance by macropods (Pennay 2008). The structure of maternity roosts appears to be very specific (arch caves with dome roofs). Caves need to be high and deep enough to allow juvenile bats to learn to fly safely inside and have indentations in the roof. Roosting bats cluster in these indentations, presumably to allow the capture of heat. These physical characteristics are very uncommon in the landscape and their scarcity presumably poses an important limiting factor in the distribution of the Large-eared pied bat (Pennay 2008).

Large-eared Pied Bat populations

A 'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area (EPBC Act). In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:

- A geographically distinct regional population, or collection of local populations, or
- A population, or collection of local populations, that occurs within a particular bioregion.

To date, there have been no genetic studies undertaken on the Large-eared Pied Bat. Movement of this species between areas has not been recorded and its dispersal ability and habits are not known (DERM 2011). Thus, it is difficult to define 'populations' of the species.

Approximately 24 occurrences of Large-eared Pied Bat have been recorded within the Illawarra IBRA subregion in the last 20 years, with ten of those records occurring within 12 kilometres of the subject land, and the closest occurring approximately 3 kilometres away (BioNet 2020). While very little is known about the distribution or size of populations of this species, for the purpose of this assessment these 10 records are considered to make up the local population. The next closest grouping of records occurs around Wilton, approximately 26 kilometres north-west of the subject land, followed by a grouping around Nowra approximately 45 kilometres south.

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It should be noted that each of the ten closest records to the subject land were obtained from ultrasonic recordings, and thus the reproductive status and roosting locations of individuals are unknown. It is likely that bats were recorded while foraging, and that the clifflines of the Illawarra Escarpment provide nearby roosting habitat.

The proposed works will likely result in the following impacts to Large-eared Pied Bat habitat:

- Loss of 0.03 hectares of potential foraging habitat.
- Disturbance (via noise, light, dust or vibration) to two man-made structures that provide potential roosting and/or breeding habitat. This may result in the abandonment of these structures by microbats.

Table A. 6 Assessment against significant impact criteria for Large-eared Pied Bat

Significant impact criteria (Vulnerable species)	Likelihood of significant impact	Justification
Is there a real chance that the action could lead to a long-term decrease in the size of an important population of a species?	Unlikely	Information about the size, distribution and interactions of Large-eared Pied Bat populations is largely unknown. No populations have been defined as 'important populations' for the species. The largest concentration of records for this species appears to be in the sandstone escarpments of the Sydney basin, and northwest slopes of NSW. Important populations are likely to occur at the edge of the species range, for example in the sandstone escarpments of the Morton National Park at the southern end of its range, and in Shoalwater Bay, QLD where only one individual has been recorded. The local population, defined from records nearby the subject land, does not occur at the edge of the species' range. It is unlikely that the population would constitute an 'important population', and thus a decrease in the size of an important population of this species is considered unlikely.
Is there a real chance that the action could reduce the area of occupancy of an important population?	Unlikely	As above, it is unlikely that the local population of Large-eared Pied Bat potentially utilising the subject land would be considered an 'important population', and thus a reduction in occupancy of an important population is unlikely.
Is there a real chance that the action could fragment an existing important population into two or more populations?	Unlikely	As above, it is unlikely that the local population of Large-eared Pied Bats potentially utilising the subject land would be considered an 'important population', and thus fragmentation of an important population is unlikely.
Is there a real chance that the action could adversely affect	Unlikely	Habitat critical to the survival of the species is defined as (DERM 2011): • Maternity roosts. • Sandstone cliffs and fertile wooded valley habitat within close proximity of each other.

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Significant impact criteria (Vulnerable species)	Likelihood of significant impact	Justification
habitat critical to the survival of a species?		It is very unlikely that the subject land supports a maternity roost for this species. Maternity roost sites require highly specific conditions, and only four sites have ever been recorded in NSW. However, if a Large-eared Pied Bat maternity roost was to be located within the subject land (either within the old gantry and tumbler house or the existing mine tunnel entrance), the proposed works would likely cause disturbance to this habitat via increased noise, light, vibrations and human presence within the vicinity. The mitigation measures outlined within this report, and extensively in Section 6, state that a preclearance survey will be conducted within each of these structures prior to works. If a maternity roost is located within either structure, works will be ceased, and the appropriate ecologists and approval authorities will be notified and consulted. WCL will not disturb or adversely affect habitat if it is known to support breeding Large-eared Pied Bats. The subject land supports wooded habitat within close proximity to the clifflines of the Illawarra Escarpment. However, the vegetation within the subject land is disturbed, with significant weed presence and areas of underscrubbing. 0.03 ha of this vegetation is proposed to be removed as part of the proposed works. However, this vegetation occurs within a patch of native vegetation larger than 100 ha. The removal of 0.03 ha of this vegetation is considered minor, and unlikely to adversely affect the availability of habitat for the species.
Is there a real chance that the action could disrupt the breeding cycle of an important population?	Unlikely	As above, it is unlikely that the local population of Large-eared Pied Bat potentially utilising the subject land would be considered an 'important population'. Additionally, the mitigation measures outlined within this report, and extensively in Section 6, state that a preclearance survey will be conducted within each of these structures prior to works. If a maternity roost is located within either structure, works will be ceased, and the appropriate ecologists and approval authorities will be notified and consulted. WCL will not disturb or adversely affect habitat if it is known to support breeding Large-eared Pied Bats. Thus, it is unlikely that the proposed works would disrupt the breeding cycle of an important population.
Is there a real chance that the action could modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	Unlikely	The proposed works will likely result in the following impacts to Large-eared Pied Bat habitat: • Loss of 0.03 ha of potential foraging habitat. • Disturbance (via noise, light, dust or vibration) to two man-made structures that provide potential roosting and/or breeding habitat. This may result in the abandonment of these structures by microbats. Loss of 0.03 ha of potential foraging habitat within a vegetation patch of larger than 100 ha is unlikely to cause the species to decline. The mitigation measures outlined within this report, and extensively in Section 6, state that a preclearance survey will be conducted within each of the potential roosting structures within the subject land prior to works. If a maternity roost is located within either structure, works will be ceased, and the appropriate ecologists and approval authorities will be notified and consulted. WCL will not disturb or adversely affect habitat if it is known to support

Significant impact criteria (Vulnerable species)	Likelihood of significant impact	Justification
		breeding Large-eared Pied Bat. If Large-eared Pied Bats are found to be utilising structures within the subject land as general roosting habitat, it is likely that there are appropriate roosting locations available throughout the clifflines of the Illawarra Escarpment. It is considered unlikely that disturbance to two potential roosting structures is likely to result in the decline of the species.
Is there a real chance that the action could result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	Unlikely	The subject land and surrounds likely support several invasive animal species including Red Fox *Vulpes vulpes*, Feral cats *Felis catus* and several species of deer. The CEMP and OEMP will detail monitoring and management measures to ensure that the presence of such species does not increase due to proposed works, for example through increases in rubbish that might attract pest species. Weeds occurring within the subject land include Crofton Weed, Cape Ivy, Lantana, Pellitory and Madeira Winter Cherry, and are common with those occurring within adjacent vegetation to be retained. As the vegetation to be retained is in similar condition, increased transport of pathogens and weeds is unlikely to occur. Regardless, measures to ensure adequate control of weeds and pathogens will be detailed and managed by biosecurity measures outlined in the CEMP and OEMP. Overall, no increase in invasive animals or plants is predicted as a result of the proposed works.
Is there a real chance that the action could introduce disease that may cause the species to decline?	Unlikely	The IUCN Species Survival Commission released a statement on 19 June 2020 stating that there is a credible risk of human-to-bat transmission of SARS-Cov-2, a virus currently circulating the globe and causing a pandemic of the illness Covid-19 (IUCN SSC 2020). However, introduction of this disease to Large-eared Pied Bats within the subject land as a result of the proposed works is unlikely for the following reasons: • The species has not been recorded at the Wongawilli pit top despite extensive previous survey, and is not considered likely to be present. • No contact or sharing of closed areas between humans and bats is expected as a result of the proposed works. • When a preclearance inspection is undertaken by an ecologist within the old gantry and tumbler house and the existing mine tunnel entrance, the recommendations provided by the IUCN will be followed, including the wearing of a face mask by the ecologist, and avoidance of handling of any microbats. The transmission of SARS-Cov-2 is considered unlikely as a result of the proposed works.
Interfere substantially with the recovery of the species.	Unlikely	The following recovery objectives have been specified within the National recovery plan for the Large-eared Pied Bat: • Identify priority roost and maternity sites for protection. • Implement conservation and management strategies for priority sites. • Educate the community and industry to understand and participate in the conservation of the Large-eared Pied Bat.

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Significant impact criteria (Vulnerable species)	Likelihood of significant impact	Justification
		• Research the large-eared pied bat to augment biological and ecological data to enable conservation management. • Determine the meta-population dynamics throughout the distribution of the Large-eared Pied Bat. One of the recovery actions stated under these objectives is the protection of known roosts and associated foraging habitats and management of threats. If Large-eared Pied Bats were found to be utilising the subject land as either roosting or breeding habitat (within the old gantry and tumbler house or the existing mine tunnel entrance), disturbance to these structures may interfere with this recovery action. However, it is highly unlikely that these structures are being utilised as a maternity roost for this species. If a maternity roost is located within either structure, works will be ceased, and the appropriate ecologists and approval authorities will be notified and consulted. WCL will not disturb or adversely affect habitat if it is known to support breeding Large-eared Pied Bats. Additionally, more general roosting habitat is likely available throughout the clifflines of the Illawarra Escarpment, where sandstone caves and overhangs are present within close proximity to fertile woodlands. If Large-eared Pied Bat were to be utilising structures within the subject land as roosting habitat and these were to be disturbed by the proposed works, this would likely not interfere substantially with the recovery of the species.

Conclusion

Based on the factors above, it is concluded that the proposed works are unlikely to lead to a significant impact on the Large-eared Pied Bat.

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Appendix 5 SCS and ECS for the Additional Driveage

Table A.1 Ecosystem Credit Species for the Additional Driveage

Common Name	Scientific Name	Vegetation Type(s)
Birds		
Regent Honeyeater	*Anthochaera phrygia*	1804-Coastal upland wet heath swamp 1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub 1250-Coastal sandstone gully forest
Dusky Woodswallow	*Artamus cyanopterus cyanopterus*	1804-Coastal upland wet heath swamp 1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub 1127-Sandstone cliff-face soak 1250-Coastal sandstone gully forest
Gang-gang Cockatoo	*Callocephalon fimbriatum*	1804-Coastal upland wet heath swamp 1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub 1250-Coastal sandstone gully forest
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub

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Common Name	Scientific Name	Vegetation Type(s)
		1250-Coastal sandstone gully forest
Spotted Harrier	*Circus assimilis*	1804-Coastal upland wet heath swamp
Varied Sittella	*Daphoenositta chrysoptera*	1804-Coastal upland wet heath swamp 1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub 1250-Coastal sandstone gully forest
Little Lorikeet	*Glossopsitta pusilla*	1804-Coastal upland wet heath swamp 1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub 1127-Sandstone cliff-face soak 1250-Coastal sandstone gully forest
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	1804-Coastal upland wet heath swamp 1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub 1127-Sandstone cliff-face soak 1250-Coastal sandstone gully forest
Little Eagle	*Hieraaetus morphnoides*	1804-Coastal upland wet heath swamp 1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub 1127-Sandstone cliff-face soak 1250-Coastal sandstone gully forest
Black Bittern	*Ixobrychus flavicollis*	1292-Coastal sandstone riparian scrub 1250-Coastal sandstone gully forest
Swift Parrot	*Lathamus discolor*	1804-Coastal upland wet heath swamp

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Common Name	Scientific Name	Vegetation Type(s)
		1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 1250-Coastal sandstone gully forest
Square-tailed Kite	*Lophoictinia isura*	1804-Coastal upland wet heath swamp 1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub 1250-Coastal sandstone gully forest
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis gularis*	1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion
Powerful Owl	*Ninox strenua*	1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub 1250-Coastal sandstone gully forest
Turquoise Parrot	*Neophema pulchella*	1804-Coastal upland wet heath swamp 1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub 1250-Coastal sandstone gully forest
Eastern Osprey	*Pandion cristatus*	1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 1250-Coastal sandstone gully forest
Scarlet Robin	*Petroica boodang*	1804-Coastal upland wet heath swamp 1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub 1250-Coastal sandstone gully forest

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Common Name	Scientific Name	Vegetation Type(s)
Flame Robin	*Petroica phoenicea*	878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion 1250-Coastal sandstone gully forest
Eastern Grass Owl	*Tyto longimembris*	1804-Coastal upland wet heath swamp
Masked Owl	*Tyto novaehollandiae*	1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub 1250-Coastal sandstone gully forest
Sooty Owl	*Tyto tenebricosa*	878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion 1250-Coastal sandstone gully forest
Mammals		
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub 1250-Coastal sandstone gully forest
Eastern Coastal Free-tailed Bat	*Micronomus norfolkensis*	1804-Coastal upland wet heath swamp 1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub 1127-Sandstone cliff-face soak 1250-Coastal sandstone gully forest
Little Bent-winged Bat	*Miniopterus australis*	1804-Coastal upland wet heath swamp 1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion

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Common Name	Scientific Name	Vegetation Type(s)
		1292-Coastal sandstone riparian scrub 1127-Sandstone cliff-face soak 1250-Coastal sandstone gully forest
Large Bent-winged Bat	*Miniopterus orianae oceanensis*	1804-Coastal upland wet heath swamp 1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub 1127-Sandstone cliff-face soak 1250-Coastal sandstone gully forest
Golden-tipped Bat	*Phoniscus papuensis*	1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion 1250-Coastal sandstone gully forest
Grey-headed Flying-fox	*Pteropus poliocephalus*	1804-Coastal upland wet heath swamp 1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub 1127-Sandstone cliff-face soak 1250-Coastal sandstone gully forest
Greater Broad-nosed Bat	*Scoteanax rueppellii*	1804-Coastal upland wet heath swamp 1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub 1250-Coastal sandstone gully forest
Reptiles		
Broad-headed Snake	*Hoplocephalus bungaroides*	1804-Coastal upland wet heath swamp

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Common Name	Scientific Name	Vegetation Type(s)
		1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub 1127-Sandstone cliff-face soak 1250-Coastal sandstone gully forest
Yellow-bellied Glider	*Petaurus australis*	1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub 1250-Coastal sandstone gully forest
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 878-Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub 1127-Sandstone cliff-face soak 1250-Coastal sandstone gully forest
Rosenberg's Goanna	*Varanus rosenbergi*	1804-Coastal upland wet heath swamp 1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion 1292-Coastal sandstone riparian scrub 1250-Coastal sandstone gully forest

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Table A.2 Species credit species for the Additional Driveage - Fauna

Common Name	Scientific Name
Birds	
Regent Honeyeater	*Anthochaera phrygia*
Bush Stone-curlew	*Burhinus grallarius*
Glossy Black-Cockatoo	*Calyptorhynchus lathami*
Gang-gang Cockatoo	*Callocephalon fimbriatum*
Eastern Bristlebird	*Dasyornis brachypterus*
Little Eagle	*Hieraaetus morphnoides*
White-bellied Sea-Eagle	*Haliaeetus leucogaster*
Square-tailed Kite	*Lophoictinia isura*
Powerful Owl	*Ninox strenua*
Eastern Osprey	*Pandion cristatus*
Eastern Ground Parrot	*Pezoporus wallicus wallicus*
Masked Owl	*Tyto novaehollandiae*
Sooty Owl	*Tyto tenebricosa*
Reptiles	
Broad-headed Snake	*Hoplocephalus bungaroides*
Frogs	
Green and Golden Bell Frog	*Litoria aurea*
Littlejohn's Tree Frog	*Litoria littlejohni*
Giant Burrowing Frog	*Heleioporus australiacus*
Stuttering Frog	*Mixophyes balbus*
Red-crowned Toadlet	*Pseudophryne australis*
Mammals	
Eastern Pygmy-possum	*Cercartetus nanus*
Large-eared Pied Bat	*Chalinolobus dwyeri*
Southern Brown Bandicoot (eastern)	*Isoodon obesulus obesulus*
Little Bent-winged Bat	*Miniopterus australis*
Large Bent-winged Bat	*Miniopterus orianae oceanensis*
Southern Myotis	*Myotis macropus*
Squirrel Glider	*Petaurus norfolcensis*
Koala	*Phascolarctos cinereus*
Grey-headed Flying-fox	*Pteropus poliocephalus*
Insects	
Giant Dragonfly	*Petalura gigantea*

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Table A.2 Species credit species for the Additional Driveage - Flora

Common Name	Scientific Name
Leafless Tongue Orchid	*Cryptostylis hunteriana*
Sublime Point Pomaderris	*Pomaderris adnata*
Prickly Bush-pea	*Pultenaea aristata*
Bauer's Midge Orchid	*Genoplesium baueri*
	Hibbertia stricta subsp. *furcatula*
	Helichrysum calvertianum
Bynoe's Wattle	*Acacia bynoeana*
Thick-leaf Star-hair	*Astrotricha crassifolia*
Small Pale Grass-lily	*Caesia parviflora* var. *minor*
Thick Lip Spider Orchid	*Caladenia tessellata*
Camfield's Stringybark	*Eucalyptus camfieldii*
	Hygrocybe anomala var. *ianthinomarginata*
	Epacris purpurascens var. *purpurascens*
Small-flower Grevillea	*Grevillea parviflora* subsp. *parviflora*
	Hibbertia puberula
Woronora Beard-heath	*Leucopogon exolasius*
Deane's Paperbark	*Melaleuca deanei*
Brown Pomaderris	*Pomaderris brunnea*
Slaty Leek Orchid	*Prasophyllum fuscum*
Hairy Geebung	*Persoonia hirsuta*
	Leucopogon fletcheri subsp. *fletcheri*
	Grevillea raybrownii

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Appendix 6 Assessment for Serious and Irreversible Impact Determinations (SAII)

11.1 Provisions for ecological communities

11.1.1 Illawarra Subtropical Rainforest in the Sydney Basin Bioregion

Background

Illawarra Subtropical Rainforest generally occurs on the coastal plain and escarpment foothills primarily overlying Permian volcanics on the coastal and escarpment foothills extending from north of Lake Illawarra to Gerringong (NSW Threatened Species Scientific Committee 2011). The structure and floristic composition of the community can be variable and influenced by rainfall, altitude, aspect and exposure to drier communities (Department of Environment and Energy 2019). This community is primarily structured as a closed rainforest community with tall overlying emergent, although in areas of high disturbance the community can become relatively open and height of the canopy can vary (Department of Environment and Energy 2019).

Illawarra Subtropical Rainforest in the Sydney Basin Bioregion is listed as an EEC under the BC Act, which is forms part of the Commonwealth listed CEEC Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion. Characteristic tree species include Brush Bloodwood *Baloghia inophylla*, Flame Tree *Brachychiton acerifolius*, Giant Stinging Tree *Dendrocnide excelsa*, Native Tamarind *Diploglottis australis*, *Ficus* spp., Brown Beech *Pennantia cunninghamii*, and Red Cedar *Toona ciliata*. Species of Eucalyptus, Syncarpia and Acacia may also be present as emergents or incorporated into the dense canopy (OEH, 2019).

0.1 hectares of Illawarra Subtropical Rainforest TEC was recorded within the Wongawilli Pit Top study area. The community occurs in the study area as a modified form of the TEC, lacking structural complexity and a limited floristic composition. Diagnostic tree species were limited to, Giant Stinging Tree and Red Cedar with a canopy cover of 50 %. Shrub and vine species were also in low densities, and included, *Elaeodendron australe*, Sandpaper Fig, Hairy-leaved Doughwood, *Melicope micrococca*, Scrub Beefwood, Gum Vine and Water Vine, with a total cover of 6 % in the midstory layer.

The proposed works will involve the installation a 2 x 63 metre conveyer belt, resulting in the removal of 0.01 hectares of Illawarra Subtropical Rainforest TEC. Indirect impact has been defined as the area of vegetation located outside of the subject land within the Wongawilli Pit Top study area of PCT 906 that satisfies thresholds for BC Act listed TEC, Illawarra Subtropical Rainforest.

As per Section 10.2.2 of the BAM (OEH 2017) the assessor is required to provide the following further information about impacted threatened ecological communities:

(a) The action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII.

The location of the proposed conveyor to be installed at the Wongawilli pit top is necessary to connect the existing mine entrance tunnel to the existing coal processing infrastructure at the Wongawilli Colliery. Considerations have been made during the site selection and planning, and mitigation measures have been outlined to be implemented during the construction and operation phase of the project.

During site selection and planning, the proposed conveyor has been sited to reutilise existing infrastructure at the Wongawilli Colliery to minimise impacts to the vegetation. The location of the proposed conveyor belt includes areas that have been previously disturbed, as well as being raised above the ground on pillars avoiding the removal of vegetation in all strata's within the TEC.

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During construction, mitigation measures recommended to avoid and minimise further indirect impacts to vegetation and habitat include:

- Installation of appropriate exclusion fencing around trees and vegetation to be retained in the study area.
- Installation of appropriate signage such as 'No Go Zone' or 'Environmental Protection Area'.
- Identification the location of any 'No Go Zones' in site inductions and a Construction Environmental Management Plan (CEMP).
- All material stockpiles, vehicle parking and machinery storage will be located within cleared areas or areas proposed for clearing, and not in areas of native vegetation that are to be retained.
- Where appropriate native vegetation cleared from the study area should be mulched for re-use on the site, to stabilise bare ground.
- Wet down areas to reduce dust generation during construction.
- Implementation of temporary stormwater controls during construction and to ensure that discharges to the drainage channels are consistent with existing conditions.
- Sediment and erosion control measures should be implemented prior to construction works commencing (e.g. silt fences, sediment traps), to protect current drainage channels. These should conform to relevant guidelines, should be maintained throughout the construction period and should be carefully removed following the completion of works.

Further mitigation measures during the construction phase of the project will be detailed in the CEMP.

During operation the site measures will be implemented to ensure on-going treatment of exotic species from within retained vegetation should be undertaken to assist vegetation resilience and quality.

(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.

It is proposed that the project will result in the direct removal of 0.01 hectares of moderate condition PCT 906 that is consistent with the Illawarra Subtropical Rainforest TEC, listed under the BC Act and EPBC Act. The TEC that will be directly impacted exists in moderate condition (VI score of 64.8), with limited structural complexity, and weed ingress resulting from previous clearing and disturbance. Floristic diagnostic tree species included Giant Stinging Tree, Red Cedar but as a result of the modified nature of the vegetation type, both tree species richness (7) percentage tree cover (50 %) did not meet to that of the PCT benchmark of 14 % and 90 % respectively. The modified nature of the community was also evident within the recorded shrub growth form, with both species richness (5) and percentage cover (36 %) to be recorded below benchmark conditions with the floristic composition limited to *Elaeodendron australe*, Sandpaper Fig, Hairy-leaved Doughwood, Sweet Pittosporum and Scrub Beefwood. Grass and Grass like species richness provided a score of 2, with a percentage cover of 6% for which exceeded that of the PCT benchmarks of 1 % and 0 % respectively. Forb species richness (2) was recorded to be lower than PCT benchmark conditions (3), yet recorded to exceed (2 %) that of the percentage cover benchmark (0 %). Both fern and 'other' growth forms failed to reach PCT benchmark conditions with the collated fern data providing a species richness score of 1 and a percentage cover of 25 %.

The TEC within the study area that is to be indirectly impacted varies in condition, with weed ingress along the boundaries of the vegetation that are located adjacent to cleared and disturbed areas. This includes vegetation which is subject to significant Lantana infestation located in the southern portion of the study area and extends to areas outside the study area.

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(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 threshold for impacts to Illawarra Subtropical Rainforest TEC have been published to date.

(d) The extent and overall condition of the potential TEC within an area of 1000ha, and then 10,000ha, surrounding the proposed development footprint.

According to S*outheast NSW Native Vegetation Classification and Mapping - SCIVI. VIS_ID 2230* (OEH 2011a), 85.55 hectares of Illawarra Subtropical Rainforest TEC is present within a 1,000 hectare buffer around the study area. This was calculated using GIS methods, filtering the SCIVI mapping database to only include 'Illawarra Subtropical Rainforest' vegetation within the EEC mapping data. The SCIVI database was used as it provides the best coverage of the Illawarra region and relatively up to date mapping of the Illawarra Subtropical Rainforest TEC. The overall condition of the community within the 1,000 hectare is expected to be moderate with multiple large core areas present, low fragmentation and connectivity. The patch associated with the Illawarra Subtropical Rainforest TEC located within the study area comprises approximately 15% of the Illawarra Subtropical Rainforest TEC within this area.

Within a 10,000 hectare area, the community comprises approximately 353.16 hectares. The overall is expected to be varying condition with good core areas located within tracts of intact vegetation along the foothills of the escarpment and small fragmented areas located along the coastal plain beneath the escarpment.

(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 proposed development has been taken into consideration.

The study area occurs in the Illawarra IBRA subregion. An estimate of the area of Illawarra Subtropical Rainforest TEC extant in the subregion is 5,701 hectares (OEH 2011). This was calculated by filtering for the TEC within the spatial coverage of the SCIVI mapping database. The proposed development will result in the removal of 0.01 hectares of Illawarra Subtropical Rainforest TEC vegetation, equating to less than 0.01% of the Illawarra Subtropical Rainforest TEC in the subregion. Within this larger landscape context it is expected the overall condition of the community will be moderate-low due to the community being heavily cleared with many of remaining patches being small, degraded and isolated (Department of Environment and Energy 2019). Large areas of the Illawarra Subtropical Rainforest TEC have been cleared, with most remnants existing as small, fragmented patches with over 90% of patches occurring as <10 hectares (Department of Environment and Energy 2019). Due to this fragmentation and with a large proportion of remaining Illawarra Subtropical Rainforest TEC occurring within private properties (NSW Threatened Species Scientific Committee 2011), it is likely a large percentage of remaining Illawarra Subtropical Rainforest TEC at this larger scale is expected to bein moderate or low condition. Approximately 13% of remaining TEC occurs within reserve areas which is expected to be in higher condition than the representation of the community within private land.

The works are limited to a 2 m wide corridor and the conveyer belt route is raised above the ground and avoids the removal of vegetation where possible and maintains connectivity. Therefore, removal of less than 0.01% of Illawarra Subtropical Rainforest TEC from this larger area is not likely to impact the overall condition of the TEC remaining in the IBRA sub region.

(f) An estimate of the area of the potential TEC that is in the reserve system within the IBRA region and the IBRA subregion.

The majority of the remaining areas of Illawarra Subtropical Rainforest TEC (5,701 hectares) within the IBRA Illawarra subregion is present on private land (NSW Threatened Species Scientific Committee 2011).

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Approximately, 376 hectares of Illawarra Subtropical Rainforest TEC is present in reserves including; Budderoo National Park, Macquarie Pass National Park, Morton National Park, Cambewarra Range Nature Reserve, Devils Glen Nature Reserve and Rodway Nature Reserve (NSW Threatened Species Scientific Committee 2011) and represents 6.7% of the TEC within the Illawarra subregion.

Mapped areas of the Illawarra Subtropical Rainforest TEC in reserves within the Sydney Basin IBRA region amount to 579.6 hectares.

To determine an estimated area of Illawarra Subtropical Rainforest TEC in the IBRA region and subregion, and NSW reserve systems, existing vegetation datasets (OEH 2011, DPIE 2018, NPWS 2013, DPE 2014, OEH 2016a, DPIE 2019a, OEH 2009 and DPIE 2019b) were filtered according to area of mapped equivalent PCT 906 and PCT 1300 vegetation. The aim of compiling these datasets was to capture as much of the area within the IBRA region as possible. In the IBRA region a total of 84% coverage of previous mapping was obtained using this method.

(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.***

The proposal is not expected to result in negative affects to abiotic factors critical to the long term survival of the Illawarra Subtropical Rainforest TEC (see Section 6.1 and 7.3). The project has been designed to ensure the conveyor belt has been raised above the ground to minimise disruption to flow patterns of water. Construction is unlikely to result in alteration of surface water drainage patterns. However, any potential sediment or erosion impacts will be managed appropriately through a CEMP and OEMP.

- ***(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.***

The proposed works will involve the installation a 2 x 63 metre conveyer belt, through the middle of the existing patch of Illawarra Subtropical Rainforest TEC, resulting in the removal of 0.01 hectares of the TEC. This is unlikely to alter fire/flooding regimes or increase the harvesting of plants, given it is located on private land with limited security access. The conveyer belt route is also raised above the ground and limits removal of vegetation to selective clearing within the alignment of the conveyor belt route. This will allot for retention of understorey species and will maintain connectivity within this strata.

- ***(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.***

Exotic species were recorded in moderate densities within the Illawarra Subtropical Rainforest TEC, with opportunistic herbaceous perennial species being observed throughout the vegetation type, with heavier weed density observed along the boundaries with cleared and disturbed areas to the east and west. A heavy infestation of Lantana was observed in the south-west corner of the patch. Deer are also known to occur within the locality.

The proposed works are not considered to increase weed or pest invasion, or cause mobilisation of fertilisers, herbicides or other chemical within the TEC, which may harm or inhibit growth of species in the TEC. The construction and operation of the conveyer belt will also be managed under a CEMP and OEMP, and will include measures such as weed removal practices, disposal and hygiene practices, and chemical storage.

(g) Direct or indirect fragmentation and isolation of an important area of the potential TEC.

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The proposed works will involve the installation a 2 x 63 metre conveyer belt, along the northern most extent of the existing 11 hectare patch of Illawarra Subtropical Rainforest TEC, resulting in the removal of 0.01 hectares of the Illawarra Subtropical Rainforest TEC. This will result in minor fragmentation and isolation of the community, however given the works are limited to a 2 metre wide corridor it is highly unlikely to impede genetic flow of seed propagules and pollinators. Additionally, the conveyer belt route is raised above the ground, avoids the removal of vegetation where possible and maintains connectivity within the understorey. Furthermore, it is likely that native ground and mid-storey species will recolonize beneath the raised conveyor belt following the works.Therefore, the proposed works will not fragment or isolate an important area of the Illawarra Subtropical Rainforest TEC.

(i) The measures proposed to contribute to the recovery of the potential TEC in the IBRA subregion.

In addition to the required credit offset, the proponent will contribute to the improvement of condition of the Illawarra Subtropical Rainforest TEC to be retained within the study area and immediate surrounds, through the ongoing management of pests and weeds by a qualified contractor. This will result in improved condition for 0.09 hectares of the Illawarra Subtropical Rainforest TEC vegetation which is proposed to be retained. This program will include the treatment of a heavy Lantana infestation located within the study area which would have otherwise continued to impact the Illawarra Subtropical Rainforest TEC. The project's OEMP will specify measures to be implemented.

11.2 Provisions for threatened species or populations

11.2.1 Large-eared Pied Bat *Chalinolobus dwyeri*

It has been identified that potential breeding habitat for Large-eared Pied Bat occurs within 100 metres of the subject land. According to the *'Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method* (OEH 2018), potential breeding habitat for this species is defined as:

'the PCTs associated with the species within 100 metres of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts or derelict concrete buildings.'

The subject land contains two PCTs associated with the species (PCT 906 and PCT 1245), and occurs within 100 metres of:

- The old GI tumbler house and gantry at the southern edge of the subject land.
- The entrance to the NWMD tunnel at the western edge of the subject land.

According to the BAM, any impact to breeding habitat for this species is considered a potential SAII. Thus, as per Section 10.2.3 of the BAM (OEH 2017a) the following information has been included.

Background

In NSW, Large-eared Pied Bat has been recorded from a large range of vegetation types including dry and wet sclerophyll forest, Cyprus Pine *Callitris glauca* dominated forest, tall open eucalypt forest with a rainforest sub-canopy, sub-alpine woodland and sandstone outcrop country (DAWE 2020). The species requires a combination of sandstone cliff or 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. Almost all records have been found within several kilometres of cliff lines or rocky terrain, and roosting has also been observed in disused mine shafts, caves and overhangs (TSSC 2012).

Known breeding locations are extremely limited within NSW. Five locations are known to have been used for breeding within NSW, including:

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- A mine tunnel at Copeton which was used for breeding until flooded by dam waters in 1976 (Dwyer 1966).
- A sandstone cave near Coonabarabran, NSW (Pennay 2008).
- Capture of lactating females adjacent to sandstone cliffs in Ulan, NSW (Fly By Night 2005).
- Observations of small groups of females in a disused gold mine near Barraba, NSW (DERM 2011).
- Anecdotal observations of small groups of females and young bats in the sandstone Pilliga region, NSW (DERM 2011).

The structure of primary nursery roosts appears to be highly specific. While individuals are known to utilise disused mine adits as roost sites (i.e. hibernacula, day roost), limited research suggests that the species requires a highly specific karst configuration (bell-shaped) with a dome roof (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), as well as a specific microclimate (i.e. temperature of 15.5 – 18°C and 51 – 76% relative humidity) for rearing young (Pennay 2008). These physical characteristics are not very common in the landscape and therefore are a limiting factor.

According to BioNet and in-house knowledge, various microbat surveys have previously been undertaken in close proximity to the subject land, including:

- Biosis 2011 (ultrasonic recording).
- DPI Forestry 2013 (harp trapping, dusk surveys using thermal imagery and ultrasonic recording).
- Biosis (2019, 2020) ultrasonic recording, dusk surveys, roost searches in adjacent adits (less than100 metres away from the study area).

Across these assessments, the following species were identified:

- Long-eared bats *Nyctophilus* sp. (Biosis 2011)
- Large Bentwing-bat *Miniopterus orianae oceanensis* (Biosis 2011, DPI Forestry 2013, Biosis 2020).
- Eastern Horse-shoe Bat *Rhinolophus megaphyllus* (Biosis 2011, DPI Forestry 2013, Biosis 2020).
- White-striped Freetail Bat *Austronomous australis* (Biosis 2011, DPI Forestry 2013).

No surveys to date have identified Large-eared Pied Bat within the vicinity of the old gantry and tumbler house, or the existing mine tunnel. Furthermore, the species has a high affinity with its breeding habitat, using the same location year after year (Pennay 2008). The closest known evidence of a maternity roost (capture of pregnant and lactating females) occurred approximately 260 kilometres north-west of the subject land, in close proximity to Ulan, NSW (Fly By Night 2005).

Due to the urbanisation of the surrounding area and construction of several housing estates, many microbat surveys have also been conducted within the locality over recent years as part of larger ecological assessments (BioNet 2020). While microbat records are abundant within the locality, these surveys have not recorded Large-eared Pied Bat.

Given Biosis' history with the study area and locality, and prior knowledge of bats utilising the mine adits at Wongawilli, it is unlikely that Large-eared Pied Bat would be using the old gantry and tumbler house or the existing mine tunnel as breeding habitat. Thus, it is unlikely that the proposed works will impact Large-eared Pied Bat breeding habitat. Regardless, the below SAII assessment has been prepared.

(a) The action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII.

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The location of the proposed conveyor to be installed at the Wongawilli pit top is necessary to connect the existing mine entrance tunnel to the existing coal processing infrastructure at the Wongawilli Colliery. The reutilisation of infrastructure at the Wongawilli Colliery minimises impacts to threatened microbat habitat overall, by avoiding construction of completely new infrastructure within the study area. However, direct impact to 0.03 hectares of Large-eared Pied Bat breeding habitat (via removal of vegetation nearby a potential breeding structure) is necessary for the NWMD tunnelling project to be successful.

Old gantry and tumbler house

The location of the proposed conveyor has been aligned to avoid direct impact to the old gantry and tumbler house located at the southern edge of the subject land. However, vegetation will be removed directly adjacent to the structure. There is potential for these proposed works to have indirect impacts on microbats utilising this structure, due to increased noise, light, vibration, dust and foot traffic in the vicinity. The mitigation measures that will be carried out by WCL in order to minimise impacts to Large Bent-winged Bats potentially utilising this structure are detailed below.

Existing tunnel entrance

The existing tunnel entrance will need to be reutilised as part of the proposed project. The construction of the tunnel was covered under previous project approvals, however the tunnel has remained unused for a substantial period of time, and now provides potential breeding habitat for Large-eared Pied Bat. A recent site investigation undertaken by a qualified zoologist of Biosis (2020) did not identify microbats to be roosting within the tunnel entrance. However, this tunnel is connected to other adits including the old gantry and tumbler house via a series of underground tunnels, and microbat movement between structures is possible. Additionally, Large-eared Pied Bat abandon maternity roost sites over winter, returning to the sites in September (DERM 2011). As the site investigation was undertaken in August, no observations could be made about the use of structure as a maternity roost.

The following mitigation measures will be undertaken by WCL to minimise indirect impacts to potential threatened microbat species utilising the old gantry and tumbler house or the existing mine tunnel entrance as roosting or breeding habitat. These are discussed within the report above in more detail, see Section 6.

- A thorough microbat preclearance survey will be undertaken by a qualified ecologist prior to the start of construction, to determine the presence and location of microbats within the two structures.
- If microbats are found to be roosting within the existing mine tunnel entrance, exclusion measures will be undertaken to remove potential microbat habitat within this structure, and ensure the relocation of bats to alternate areas of habitat. Such measures would be undertaken outside of the breeding and overwintering season, during microbat activity. Measures might include the sealing off of the tunnel after the evening exit of microbats, the sealing of cracks and crevices that bats might be utilising within the tunnel, and/or the installation of smooth surfaces over areas of substrate that could be used by roosting bats.
- Due to the interconnected nature of the mine tunnels owned by WCL, alternate microbat habitat is available to individuals nearby, including within the old gantry and tumbler house and other unused adits. All side entrances leading from the existing mine tunnel to unused sections of the adit system will be completely sealed, such that microbats are no longer able to access the main tunnel from these areas. The alternate entrances/exits of the unused portions of the adit system will be fitted with bat-friendly gates, such that microbats are able continue accessing these areas.
- As the proposed coal conveyor will be constructed in close proximity to the old gantry and tumbler house, measures will be undertaken to limit the indirect impacts to microbats within this structure due to noise, light and foot traffic.

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- Appropriate noise barriers will be installed permanently between the proposed conveyor and the old gantry and tumbler house, to limit noise disturbance to resident microbats. Noise barriers will require placement that avoids impediment of movement of microbats in and out of the structure.
- Any necessary construction or operation lighting will be directed away from the gantry and tumbler house, and lighting will be designed to avoid spill nearby the structure.
- The old gantry and tumbler house will be designated a no-go-zone, and any staff or contractors involved in the proposed works will be briefed on the importance of avoiding disturbance to this area.
- Once construction of the proposed conveyor is complete, a secondary microbat survey will be undertaken by a qualified ecologist in both the old gantry and tumbler house, and the existing mine tunnel entrance to ensure that:
  - Microbats have not returned to the existing mine tunnel entrance after initial exclusion.
  - Microbats within the old gantry and tumbler house have not started to decline as a result of indirect disturbances from the proposed works.
- If microbats have returned to the existing mine tunnel entrance, or microbats within the tumbler house have decreased, WCL will consult with the ecologist, and actions will be recommended.
- Both the old gantry and tumbler house, and the existing mine tunnel entrance will continue to be monitored regularly to ensure that:
  - Microbats do not return to the existing mine tunnel entrance after initial exclusion.
  - Microbats within the old gantry and tumbler house do not begin to decline as a result of indirect disturbances from the use of the proposed coal conveyor.
- If at any time a maternity roost is found to be present within either structure, works will be ceased and the appropriate ecologists and approval authorities will be consulted.

(b) The size of the local population directly and indirectly impacted by the development, clearing or biodiversity certification.

Approximately 24 occurrences of Large-eared Pied Bat have been recorded within the Illawarra IBRA subregion in the last 20 years, with 10 of those records occurring within 12 kilometres of the subject land, and the closest occurring approximately 3 kilometres away (BioNet 2020). While very little is known about the distribution or size of populations of this species, for the purpose of this assessment these 10 records are considered to make up the local population. The next closest grouping of records occurs around Wilton, approximately 26 kilometres north-west of the subject land, followed by a grouping around Nowra approximately 45 kilometres south.

It should be noted that each of the 10 closest records to the subject land were obtained from ultrasonic recordings, and thus the reproductive status and roosting locations of individuals are unknown.

(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.

The SAII threshold specified for Large-eared Pied Bat is 'breeding habitat as identified by survey'. No targeted surveys have been undertaken for the species, however previous microbat surveys (Biosis 2020) have identified the presence of Large Bent-winged Bats within 100 metres of the subject land, noteably within unused adit structures connected to the old gantry and tumbler house which provide potential Large-eared

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Pied Bat breeding habitat under the BAM definition given above. The existing mine tunnel entrance was also identified as potential Large Bent-winged Bat breeding habitat within the study area.

The proposed conveyor would be constructed directly adjacent to the old gantry and tumbler house, potentially subjecting resident microbats to indirect impacts such as noise, vibration and light disturbance. The existing tunnel entrance will be reused to transport coal materials as part of the proposed works, and any microbats using this structure would also be subject to disturbance. Additionally, 0.03 hectares of native vegetation will be removed within 100 metres of these structures. Therefore, the threshold for this species has been exceeded and the proposed works must be considered to have a potential serious and irreversible impact.

(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.***

Foraging habitat for this species is readily available within the locality, with vegetation in the subject land occurring within a patch of native vegetation more than 100 hectares in size. As a result of the proposed works, approximately 0.03 hectares of potential foraging habitat will be removed. A small amount of further foraging habitat in the vicinity of the proposed works may also be indirectly impacted as a result of light, noise or vibrations during the construction and operation phase of works. However, the change in available foraging habitat to the local population of Large-eared Pied Bats is considered minimal.

Roosting sites used by the local population are currently unknown, however the species often roosts in caves, overhangs, tunnels and mines. It has previously been noted that the species appear to roost in sandstone areas, and travel down to fertile gullies nearby to forage (DERM 2011). In this case, there is likely available roosting habitat within the clifflines of the Illawarra Escarpment and Plateau, as well as within mining structures throughout the locality, where coal mining is prevalent. Both the old gantry and tumbler house, and the existing mine tunnel entrance may provide roosting habitat for Large-eared Pied Bat. Both of these structures may be indirectly impacted by the proposed works through noise, dust, light and vibration disturbance, potentially leading to the loss of these sites as potential roosting habitat. Due to the presence of the Illawarra Escarpment area, as well as a wealth of both used and unused mining structures within the locality, this is considered to be a small change in the availability of roosting habitat to the species.

Maternity roosting sites for Large-eared Pied Bat are highly specific, and are most likely rare throughout the landscape (Pennay 2008). It is unlikely that either structure within the subject land provides potential breeding habitat for the species. No currently or previously used breeding habitat for the species is known within the locality. It is unlikely that disturbance to either structure as a result of the proposed works would lead to loss of breeding habitat for the species. In the unlikely event that either structure is being used for breeding of the species however, disturbance to these structures would mean the loss of all known available breeding habitat for the local population, and would be detrimental to the local population.

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

The impacts to available habitat for Large-eared Pied Bat as a result of the proposed works include the following:

  - Loss of 0.03 hectares of potential foraging habitat.
  - Disturbance (via noise, light, dust or vibration) to two man-made structures that provide potential roosting and/or breeding habitat. This may result in the abandonment of these structures by microbats.

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- ***(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.***

The proposed works are unlikely to modify habitat required for the maintenance of the processes important to the Large-eared Pied Bat's lifecycle. This is due to the unlikelihood that structures within the subject land are used as breeding habitat for the species. As discussed above, the specific requirements of maternity roosts for this species coupled with the lack of records within or nearby the subject land indicates that Large-eared Pied Bats most likely do not use the subject land for essential processes in their lifecycle such as breeding.

> ***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***

Known breeding locations for Large-eared Pied Bat are extremely limited within NSW, and highly susceptible to disturbance. The closest record of potential breeding of this species to the subject land is located approximately 260 kilometres north-west, where pregnant and lactating females were captured nearby Ulan, NSW (Fly By Night 2005).

The structure of maternity roosts appears to be very specific and the physical characteristics required are very uncommon in the landscape (Pennay 2008, DERM 2011). Additionally, multiple surveys undertaken nearby the subject land over the past nine years have not recorded this species. It is highly unlikely that structures within or nearby the subject land are being used as breeding habitat for this species, and thus impact to the breeding of the local population considered to be unlikely.

As detailed above, mitigation measures committed to by WCL include the conducting of a pre-clearance survey before works, within the time period that bats would be returning to their maternity roost site, to ensure that structures within the subject land do not contain active maternity roosts. If a maternity roost was to be unexpectedly located within the subject land, works would be delayed and the appropriate ecology professionals and approval authorities would be consulted.

  - ***Foraging***

Extensive trapping and call data indicates that Large-eared Pied Bats do not usually forage in sandstone habitat. Instead, modelling based on presence-only data indicates that bats forage in fertile valleys and plains, as well as areas with moderately-tall to taller trees along water courses. The majority of records are from canopied habitat, suggesting a sensitivity to clearing, although narrow connecting riparian strips in otherwise cleared habitat are sometimes quite heavily used (DECC 2007b).

Although the subject land contains rainforest vegetation nearby a sandstone escarpment, the site is disturbed and much more fertile vegetation exists within the locality. Vegetation within the subject land is connected to surrounding vegetation to the north, south and west, forming a vegetation patch of more than 100 hectares. It is unlikely that the subject land contains foraging habitat that is of particularly high value to this species. The removal of 0.03 hectares of vegetation as part of the proposed works, within a patch of more than 100 hectares is not considered to have potential to impact the foraging ecology of the species.

  - ***Roosting, and***

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Roosting sites used by the local population are currently unknown, however the species often roosts in caves, overhangs, tunnels and mines. It has previously been noted that the species appear to roost in sandstone areas, and travel down to fertile gullies nearby to forage. In this case, there is likely available roosting habitat within the clifflines of the Illawarra Escarpment, as well as within mining structures throughout the locality, where coal mining is prevalent. Both the old gantry and tumbler house, and the existing mine tunnel entrance may provide roosting habitat for Large-eared Pied Bat. Both of these structures may be indirectly impacted by the proposed works through noise, dust, light and vibration disturbance, potentially leading to the loss of these sites as roosting habitat. Due to the presence of the large Illawarra Escarpment area, as well as a wealth of both active and inactive mining structures within the locality, the loss of two roosting structures for the species is unlikely to have a substantial impact on the roosting ecology of the local population.

- ***Dispersal or movement pathways***

Movement of this species between areas has not been recorded and its dispersal ability and habits are not currently known (DERM 2011). While individuals are mobile, this species has relatively short, broad wings suggesting high manoeuvrability and relatively slow flight, and indicating that dispersal may occur over shorter distances than other similar microbat species (Hoye and Dwyer 1995). While it is assumed that connected vegetation is preferred by the species for movement, the existence of records of the species within urbanised areas suggests that the species does not rely on specialised dispersal or movement habitat, and thus the loss of approximately 0.03 hectares of vegetation nearby a potential roosting site is unlikely to impact the movement ecology of the local population.

(f) A description of the extent to which the local population will become fragmented or isolated as a result of the proposed development

The subject land occurs further north than any records of the Large-eared Pied Bat within the Illawarra IBRA subregion (BioNet 2020). The closest ten records of the species to the subject land occur directly south, indicating that the subject land occurs beyond the northern edge of the local population occurrence. Thus, the proposed works are unlikely to result in any form of fragmentation or isolation of the species or its habitat.

(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

Very little is currently known about the size and location of populations of Large-eared Pied Bats within NSW, and how these populations might interact. To date, there have been no genetic studies undertaken on the species, and movement of this species between areas has not been recorded (DERM 2011).

Small, fragmented sub-populations of the Large-eared Pied Bat may be at a greater risk of extinction from random events as a result of a loss of genetic variability, which can lead to inbreeding depression or decreased evolutionary potential to adapt to environmental changes (DERM 2011). However, records of the species encompass a large portion of NSW, and outside of the local population there are substantial groupings of occurrence records to the north, south and west. The local population is not located near the edge 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 potential threats to Large-eared Pied Bat within Australia as listed in the National Recovery Plan (DERM 2011), as well as other potential impacts relating to the proposed works have been identified and addressed below.

Table 22 Potential threats to Large-eared Pied Bat

Threat	Relevance to proposed works
Destruction of and interference with maternity and other roosts	It is unlikely that Large-eared Pied Bats utilise structures within the subject land for breeding. However if the species was found to be using such structures for breeding, the proposed works may result in disturbance to this habitat via an increase in noise, light, vibration and human traffic. This could potentially result in the abandonment of the roost site by the species.
Mining of roosts	No known roosts used by the species will be mined as part of the proposed works.
Mine induced subsidence of cliff lines	No subsidence is predicted to occur as a result of the proposed works.
Disturbance from human recreational activities	The subject land occurs on private land, and the wider study area occurs within the Water NSW Catchment Special Area which is not accessible by the public. Thus, disturbance of the species due to human recreational activities is unlikely.
Habitat disturbance by other animals, including livestock and feral animals	As the subject land occurs within private property, disturbance by livestock is unlikely. The study area and surrounds likely support several pest animal species including Red Fox *Vulpes vulpes*, Feral cats *Felis catus* and several species of deer. The OEMP will detail monitoring and management measures to ensure that the presence of such species does not increase due to proposed works, for example through increases in rubbish that might attract pest species. Overall, the removal of 0.03 ha of vegetation within a patch larger than 100 ha is unlikely to increase the presence of pest animal populations that might disturb potential bat habitat.
Predation by introduced predators	As above, it is unlikely that the removal of 0.03 ha of vegetation within a patch larger than 100 ha would lead to an increase in introduced predators that might disturb bat habitat within the subject land.
Vegetation clearance in the proximity of roosts	The proposed works would involve the removal of 0.03 ha of vegetation in close proximity to two potential roost sites. However, this vegetation forms part of a patch of native vegetation larger than 100

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	ha, and thus any potential roosting bats would have adequate access to nearby vegetation for foraging.
Fire in the proximity of roosts	The risk of fire as a result of sparks from machinery during proposed works is unlikely, but could increase the risk of fire occurring nearby potential roost sites. This risk will be managed by implementing appropriate mitigation measures such as spark dampeners, water spraying or the close proximity of fire-fighting gear such as extinguishers. Ongoing operation of the proposed conveyor within the study area after construction may also pose a small fire risk to surrounding bushland if a mechanical issue was to cause a spark. Fire-fighting equipment such as extinguishers will remain in close proximity to the proposed conveyor permanently. This will ensure substantially reduce the fire risk that the proposed works might pose to the study area and surrounds.
Loss of genetic diversity	As detailed above, it is unlikely that structures within the subject land provide breeding habitat for Large-eared Pied Bats. Hence, the proposed works will not impact on the breeding cycle of the species, or impact genetic diversity of the local population. If the species is found to be utilising the subject land for breeding, works will be ceased and the appropriate ecologists and approval authorities will be consulted.
Invasive flora	Weeds occurring within the subject land include Crofton Weed, Cape Ivy, Lantana, Pellitory and Madeira Winter Cherry, and are common with those occurring within adjacent vegetation to be retained. As the vegetation to be retained is in similar condition, increased transport of pathogens and weeds is unlikely to occur. Regardless, measures to ensure adequate control of weeds and pathogens will be detailed and managed by biosecurity measures outlined in the CEMP and OEMP. No increase in weeds is thus predicted as a result of the proposed works, that could potentially impact microbat habitat.
Indirect impacts from light, noise or human disturbance	There is potential for indirect impacts to potential microbat habitat within the subject land due to increased disturbance from noise, light and human traffic. Extensive mitigation measures to reduce such impacts are detailed in response a) above.

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(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

Little is known about the size or location of Large-eared Pied Bat populations within NSW, and how these populations might interact. The following information has been gathered from BioNet Atlas records as well as scientific literature and government reports.

New South Wales

Within the last 20 years there have been approximately 1,771 recordings of Large-eared Pied Bat within NSW. In the north east of the state at Coolah Tops, Mt Kaputar and Warrumbungle National Park the species is present in areas of volcanic strata. It is more widely distributed, but still uncommon and patchy within its distribution, in the sandstone areas of the Sydney Basin and the western slopes and plains including Pilliga Nature Reserve. It has tentatively been recorded from echolocation calls further west at Tottenham west of Narromine (Shelley 2001).

As of 2011, Large-eared Pied Bat had been recorded within the following conservation reserves within NSW: Bouddi National Park, Big Scrub Flora Reserve, Blue Mountains National Park, Bungonia Nature Reserve, Coolah Tops National Park, Goulburn River National Park, Mt Kaputar National Park, Morton National Park, Munghorn Gap Nature Reserve, Nattai National Park, Pilliga Scrub Nature Reserve, Richmond Range National Park, Royal National Park, Warrumbungle National Park, Wollemi National Park and Yengo National Park, among others.

The species had also been recorded within the following public lands: Bingara State Forest, Bourbah State Forest, Giro State Forest, Irrigapa State Forest, Kerringle State Forest, Montrose State Forest, Olney State Forest, Pilliga East State Forest, Pilliga West State Forest, Ruttley State Forest, Yarrigan State Forest, Watagan State Forest and Yalcogrin State Forest.

Based on available records, the largest concentration of populations in NSW appears to be in the sandstone escarpments of the Sydney basin, and within the northwest slopes. Much of this habitat occurs within state reserves. The species has also been recorded from a few locations in the sandstone escarpments of the Morton National Park at the southern end of its range. However, further survey is required throughout its known range to determine the size and distribution of existing populations.

Sydney Basin IBRA Region

Within the last 20 years, there have been 864 records of Large-eared Pied within the Sydney Basin IBRA region. At least 308 of these records fall within the NSW reserve system. Large-eared Pied Bat has been recorded within the following National Parks, reserves and forests within the Sydney Basin IBRA subregion:

Angophera Reserve, Blue Mountains National Park, Brisbane Water National Park, Burragorang State Conservation Area, Eastern Parr State Conservation Area, Goulburn River National Park, Kelso Beach Reserve, Manobalai Nature Reserve, Morton National Park, Nattai National Park, Nattai State Conservation Area, Newnes State Forest, Royal National Park, Sugarloaf State Conservation Area, Wollemi National Park, Yellomundee National Park, Yengo National Park and Yerranderie State Conservation Area.

The following areas have been identified to contain substantial groupings of records that indicate the presence of Large-eared Pied Bat population.

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Table 23 Location of Large-eared Pied Bat record groupings within the Sydney Basin subregion

Location	No. of records	Time period	Distance from subject land
Wilton	10	2006 -2016	26 km
Nowra	13	2005 -2017	45 km
Royal National Park*	13	2010	50 km
Lake Burragorang and Nattai National Park*	47	2003 - 2017	50 km
North-eastern Blue Mountains National Park*	9	2007 - 2008	100 km
Newnes State Forest*	64	2007 - 2019	130 km
Yengo National Park*	45	2003 - 2006	150 km
Wollemi National Park*	85	2004 - 2012	160 km
Sugarloaf State Conservation Area* and Newstan mine	19	2006 - 2019	180 km
Bulga (including Bulga Mine)	24	2009 - 2015	200 km
Wambo (including Wambo Mine)	30	2006 - 2012	210 km
Bylong	17	2010	235 km
Mangoola Coal Mine and Wybong	22	2009 - 2014	240 km
Manobalai Nature Reserve* and Crown lands	12	2000 - 2011	250 km
Ulan	33	2015 - 2019	260 km

*within NSW reserve

Illawarra IBRA Subregion

In the last 20 years, there have been 24 records of Large-eared Pied Bat within the Illawarra IBRA subregion. These records are grouped in two main locations. Ten records occur north-west of Albion Park, scattered in

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the landscape up to Horsley in the north. This grouping occurs directly south of the subject land, with the closest record to the subject land approximately 3 kilometres away. Much further south, another ten records are grouped around Nowra, mostly located either side of Bugong Road. Neither of these groupings are located within the NSW reserve system, and no evidence of breeding individuals has been observed within the subregion.

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

No impact to Large-eared Pied Bat is predicted as a result of the proposed works, and thus no measures have been proposed to contribute to the recovery of the species.

11.2.2 Large Bent-winged Bat *Miniopterus orianae oceanensis*

It has been identified that potential breeding habitat for Large Bent-winged Bat occurs within 100 metres of the subject land. According to the BioNet Atlas (2020) potential breeding habitat for this species is defined as:

'*Caves, tunnels, mines or other structures known or suspected to be used by Miniopterus orianae oceanensis including species records in BioNet with microhabitat code 'IC – in cave'; observation type code 'E nest-roost'; with numbers of individuals >500; or from the scientific literature'.*

The BioNet Atlas also states that:

'All breeding habitat including the cave, or other features, used for breeding and the area immediately surrounding this feature must be mapped. Species polygon boundaries should have a 100m radius buffer around an accurate GPS point location centred on the cave/feature entrance'.

The subject land contains two man-made structures that could potentially provide roosting and/or breeding habitat for Large Bent-winged Bat. These are:

- The old GI tumbler house and gantry at the southern edge of the subject land.
- The entrance to the NWMD tunnel at the western edge of the subject land.

According to the BAM, any impact to breeding habitat for this species is considered a potential SAII. Thus, as per Section 10.2.3 of the BAM (OEH 2017a) the following information has been included.

Background

The Large Bent-winged Bat is a member of the Miniopteridae family. The species has recently been renamed, and was previously called *Miniopterus schreibersii* subsp. *oceanensis*, or the Eastern Bent-wing Bat. The species occurs along the coast from southern Queensland to central Victoria, and is listed as Vulnerable under the BC Act.

Large Bent-winged Bat uses a broad range of habitats including rainforests, wet and dry sclerophyll forests, open woodlands and open grasslands (Churchill 2008). The species hunts in forested areas, catching moths and other flying insects above the tree tops and along waterways. Large Bent-winged Bat is an obligate cave dwelling species, however it also utilises a number of man-made structures such as mine shafts and road culverts for roosting.

Maternity caves used for birthing and rearing of young during spring and summer tend to have specific and stable temperature and humidity regimes. These caves can contain a large number of individuals (up to 100,000) and are used year after year (Churchill 2008). Wombeyan Caves, located approximately 75 kilometres west and Bungonia Caves, located approximately 80 kilometres southwest, are the two closest known maternity caves to the subject land (OEH 2011b). Individuals may fly several hundred kilometres from their overwintering site to their breeding site (DPIE 2019b).

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Previous microbat surveys, including those undertaken by Biosis (2007, 2020), have identified the presence of Large Bent-winged Bats within 100 metres of the subject land, noteably within unused adit structures connected to the old gantry and tumbler house. Surveys recorded the species during autumn and winter (Biosis 2007), but not during summer (Biosis 2011) suggesting that individuals may be using structures within or nearby the subject land as over-wintering roosting habitat. Due to the specific requirements of maternity roost habitat for the species, the presence of a known maternity roost within 75 kilometres of the subject land, and the absence of the species within the subject land during previous summer surveys, it is unlikely that Large Bent-winged Bat utilise the subject land as breeding habitat. Regardless, the below SAII assessment has been prepared.

(a) The action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII.

The location of the proposed conveyor to be installed at the Wongawilli Pit Top is necessary to connect the existing mine entrance tunnel to the existing coal processing infrastructure at the Wongawilli Colliery. The reutilisation of infrastructure at the Wongawilli Colliery minimises impacts to threatened microbat habitat overall, by avoiding construction of completely new infrastructure within the study area. However, direct impact to 0.03 hectares of Large Bent-winged Bat breeding habitat (under the BAM, via removal of vegetation within 100 metres of a potential breeding structure) is necessary for the NWMD tunnelling project to be successful.

Old gantry and tumbler house

The location of the proposed conveyor has been aligned to avoid direct impact to the old gantry and tumbler house located at the southern edge of the subject land. However, vegetation will be removed directly adjacent to the structure. There is potential for these proposed works to have indirect impacts on microbats utilising this structure, due to increased noise, light, vibration, dust and foot traffic in the vicinity. The mitigation measures that will be carried out by WCL in order to minimise impacts to Large Bent-winged Bats potentially utilising this structure are detailed below.

Existing tunnel entrance

The existing tunnel entrance will need to be reutilised as part of the proposed project. The construction of the tunnel was covered under previous project approvals, however the tunnel has remained unused for a substantial period of time, and now provides potential breeding habitat for Large Bent-winged Bat. A recent site investigation undertaken by a qualified zoologist of Biosis (2020) did not identify microbats to be roosting within the tunnel entrance, suggesting that the structure does not provide over-wintering habitat for the species. However, this tunnel is connected to other adits including the old gantry and tumbler house via a series of underground tunnels, and microbat movement between structures is possible. Additionally, Large Bent-winged Bats abandon maternity roost sites over winter, returning to the sites around September. As the site investigation was undertaken in August, no observations could be made about use of the structure as a maternity roost.

The following mitigation measures will be undertaken by WCL to minimise indirect impacts to potential threatened microbat species utilising the old gantry and tumbler house or the existing mine tunnel entrance as roosting or breeding habitat. These are discussed within the report above in more detail, see Section 6.

- A thorough microbat preclearance survey will be undertaken by a qualified ecologist prior to the start of construction, to determine the presence and location of microbats within the two structures.
- If microbats are found to be roosting within the existing mine tunnel entrance, exclusion measures will be undertaken to remove potential microbat habitat within this structure, and ensure the relocation of bats to alternate areas of habitat. Such measures would be undertaken outside of the

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breeding and overwintering season, during microbat activity. Measures might include the sealing off of the tunnel after the evening exit of microbats, the sealing of cracks and crevices that bats might be utilising within the tunnel, and/or the installation of smooth surfaces over areas of substrate that could be used by roosting bats.

- Due to the interconnected nature of the mine tunnels owned by WCL, alternate microbat habitat is available to individuals nearby, including within the old gantry and tumbler house and other unused adits. All side entrances leading from the existing mine tunnel to unused sections of the adit system will be completely sealed, such that microbats are no longer able to access the main tunnel from these areas. The alternate entrances/exits of the unused portions of the adit system will be fitted with bat-friendly gates, such that microbats are able continue accessing these areas.
- As the proposed coal conveyor will be constructed in close proximity to the old gantry and tumbler house, measures will be undertaken to limit the indirect impacts to microbats within this structure due to noise, light and foot traffic.
- Appropriate noise barriers will be installed permanently between the proposed conveyor and the old gantry and tumbler house, to limit noise disturbance to resident microbats. Noise barriers will require placement that avoids impediment of movement of microbats in and out of the structure.
- Any necessary construction or operation lighting will be directed away from the gantry and tumbler house, and lighting will be designed to avoid spill nearby the structure.
- The old gantry and tumbler house will be designated a no-go-zone, and any staff or contractors involved in the proposed works will be briefed on the importance of avoiding disturbance to this area.
- Once construction of the proposed conveyor is complete, a secondary microbat survey will be undertaken by a qualified ecologist in both the old gantry and tumbler house, and the existing mine tunnel entrance to ensure that:
  - Microbats have not returned to the existing mine tunnel entrance after initial exclusion.
  - Microbats within the old gantry and tumbler house have not started to decline as a result of indirect disturbances from the proposed works.
- If microbats have returned to the existing mine tunnel entrance, or microbats within the tumbler house have decreased, WCL will consult with the ecologist, and actions will be recommended.
- Both the old gantry and tumbler house, and the existing mine tunnel entrance will continue to be monitored regularly to ensure that:
  - Microbats do not return to the existing mine tunnel entrance after initial exclusion.
  - Microbats within the old gantry and tumbler house do not begin to decline as a result of indirect disturbances from the use of the proposed coal conveyor.
- If at any time a maternity roost is found to be present within either structure, works will be ceased and the appropriate ecologists and approval authorities will be consulted.

(b) The size of the local population directly and indirectly impacted by the development, clearing or biodiversity certification.

Large Bent-winged Bat have been recorded on 22 occasions within the Wongawilli Pit Top (BioNet 2020). There are also nearby groupings of records at Kembla Grange (5 kilometres east) and West Dapto (2 kilometres south), making up 44 records of the species. The most individuals recorded at one time was 2100, recorded by an anabat at the Wongawilli Pit Top in July 2006. These individuals were most likely using a structure within the Wongawilli Pit Top as overwintering habitat. It is therefore assumed that the local

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population within the Wongawilli area comprises at least 2100 individuals. It should be noted however that the species is able to travel large distances, and may travel elsewhere for breeding and foraging.

(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.

The SAII threshold specified for Large Bent-winged Bat is 'breeding habitat as identified by survey'. No targeted surveys have been undertaken for the species, however previous microbat surveys (Biosis 2020) have identified the presence of Large Bent-winged Bats within 100 metres of the subject land, noteably within unused adit structures connected to the old gantry and tumbler house which provide potential Large Bent-winged Bat breeding habitat under the BAM definition given above. The existing mine tunnel entrance was also identified as potential Large Bent-winged Bat breeding habitat within the study area.

The proposed conveyor would be constructed directly adjacent to the old gantry and tumbler house, potentially subjecting resident microbats to indirect impacts such as noise, vibration and light disturbance. The existing tunnel entrance will be reused to transport coal materials as part of the proposed works, and any microbats using this structure would also be subject to disturbance. Additionally, 0.03 hectares of native vegetation will be removed within 100 metres of these structures. Therefore, the threshold for this species has been exceeded and the proposed works must be considered to have a potential serious and irreversible impact.

(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.***

Foraging habitat for this species is readily available within the locality, with vegetation in the subject land occurring within a patch of native vegetation more than 100 hectares in size. As a result of the proposed works, approximately 0.03 hectares of potential foraging habitat will be removed. A small amount of further foraging habitat in the vicinity of the proposed works may also be indirectly impacted as a result of light, noise or vibrations during the construction and operation phase of works. However, the change in available foraging habitat to the local population of Large Bent-winged Bat is considered minimal.

The two structures identified within the subject land may provide overwintering habitat for Large Bent-winged Bat. Both of these structures may be indirectly impacted by the proposed works through noise, dust, light and vibration disturbance, potentially leading to the abandonment of these sites as roosting habitat for the species. However, due to the presence of the Illawarra Escarpment area, which is comprised of a range of clifflines, caves and overhangs, as well as the wealth of both used and unused mining structures within the locality, this is considered to be a small change in the availability of roosting habitat for the species. Additionally, the mitigation measures outlined above are likely to minimise the impacts of the proposed works on the structures within the subject land, thus minimising the likelihood that this a habitat will be lost.

Maternity roosting sites for Large Bent-winged Bat are highly specific, and the species has not previously been recorded at the Wongawilli Pit Top during the breeding season, despite multiple surveys. It is unlikely that either structure within the subject land provides potential breeding habitat for the species. No currently or previously used breeding habitat for the species is known within the locality. It is unlikely that disturbance to either structure as a result of the proposed works would lead to loss of breeding habitat for the species.

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

The impacts to available habitat for Large Bent-winged Bat as a result of the proposed works include the following:

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- Loss of 0.03 hectares of potential foraging habitat.
- Disturbance (via noise, light, dust or vibration) to two man-made structures that provide potential roosting habitat. This may result in the abandonment of these structures by microbats.

- ***(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.***

The proposed works are unlikely to modify habitat required for the maintenance of the processes important to the Large Bent-winged Bat's lifecycle. This is due to the unlikelihood that structures within the subject land are used as breeding habitat for the species. As discussed above, the previous presence of Large Bent-winged Bat at the Wongawilli Pit Top during winter surveys, and absence of records during the breeding season suggests that Large Bent-winged Bat potentially use structures at the pit top as overwintering habitat, but relocate to other areas for breeding.

> ***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***

The closest known breeding habitat for Large Bent-winged Bat occurs 75 kilometres from the subject land, at Wombeyan Caves. While the species has previously been recorded at the Wongawilli Pit Top, sometimes in large numbers, records have been collected in the winter months, suggesting that structures at the pit top are used as overwintering habitat by the species only. It is highly unlikely that structures within or nearby the subject land are being used as breeding habitat for this species, and thus impact to the breeding of the local population considered to be unlikely.

As detailed above, mitigation measures committed to by WCL include the conducting of a pre-clearance survey before works, within the time period that bats would be returning to their maternity roost site, to ensure that structures within the subject land do not contain active maternity roosts. If a maternity roost was to be located within the subject land, works would be delayed and the appropriate ecology professionals and approval authorities would be consulted.

  - ***Foraging***

Large Bent-winged Bat uses a broad range of habitats including rainforests, wet and dry sclerophyll forests, open woodlands and open grasslands (Churchill 2008). The species hunts in forested areas, catching moths and other flying insects above the tree tops and along waterways. Although the subject land contains rainforest vegetation, the site is disturbed and much more intact vegetation exists within the locality.

Vegetation within the subject land is connected to surrounding vegetation to the north, south and west, forming a vegetation patch of more than 100 hectares. It is unlikely that the subject land contains foraging habitat that is of particularly high value to this species. The removal of 0.03 hectares of vegetation as part of the proposed works, within a patch of more than 100 hectares is not considered to have potential to impact the foraging ecology of the species.

  - ***Roosting, and***

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The two structures identified within the subject land may provide roosting and overwintering habitat for Large Bent-winged Bat. Both of these structures may be indirectly impacted by the proposed works through noise, dust, light and vibration disturbance, potentially leading to the abandonment of these sites as roosting habitat for the species. However, due to the presence of the Illawarra Escarpment area, which is comprised of a range of clifflines, caves and overhangs, as well as the wealth of both used and unused mining structures within the locality, this is considered to be a small change in the availability of roosting habitat for the species. Additionally, the mitigation measures outlined above are likely to minimise the impacts of the proposed works on the structures within the subject land, thus minimising the likelihood that this habitat will be lost.

- ***Dispersal or movement pathways***

Large Bent-winged Bat are highly mobile, and are able to travel hundreds of kilometres between roosting and breeding sites. While it is assumed that connected vegetation is preferred by the species for movement, the existence of many records of the species within urbanised areas suggests that the species does not rely on specialised dispersal or movement habitat. Thus, the loss of approximately 0.03 hectares of vegetation nearby a potential roosting site is unlikely to impact the movement ecology of the local population.

(f) A description of the extent to which the local population will become fragmented or isolated as a result of the proposed development

Large Bent-winged Bat has been recorded on 44 occasions within 5 kilometres of the subject land. While the proposed works may result in the loss of two potential overwintering structures, the wealth of used and unused mine adits in the surrounding landscape, as well as the presence of the Illawarra Escarpment directly adjacent the subject land indicates that any displaced individuals will not be lost from the area. Adequate roosting habitat is likely available in the area such that any microbats that are disturbed as a result of the proposed works are able to move to similar habitat in the locality. Thus, the proposed works are unlikely to result in any form of fragmentation or isolation of the species or its habitat.

(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

Large Bent-winged Bat records are generally continuous along the eastern coast of NSW, from southern Queensland to Victoria. The species has also been recorded as far west as Wagga Wagga in the south, and Coonamble in the north. The population present at Wongawilli do not fall at the limit of the species' range.

The species has been recorded travelling up to 300 kilometres from a roost site to a maternity site to breed. Thus, the species is highly mobile, and local populations are most likely widely connected throughout the landscape. While individuals previously recorded at Wongawilli are known to use the site as an overwintering roost, the population likely travels elsewhere in the landscape to breed, with the closest known breeding location at Wombeyan Caves, approximately 75 kilometres away. As the species is not geographically limited within its range, genetic variability and diversity is unlikely to be limited.

(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 potential threats to Large Bent-winged Bat within Australia as listed in the OEH species profile, as well as other potential impacts relating to the proposed works have been identified and addressed below.

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Table 24 Potential threats to Large Bent-winged Bat

Threat	Relevance to proposed works
Disturbance by recreational cavers and general public accessing caves and adjacent areas particularly during winter or breeding.	The subject land occurs on private land, and the wider study area occurs within the Water NSW Catchment Special Area which is not accessible by the public. Thus, disturbance of the species due to human recreational activities is unlikely.
Loss of high productivity foraging habitat.	Vegetation within the subject land is connected to surrounding vegetation to the north, south and west, forming a vegetation patch of more than 100 hectares. It is unlikely that the subject land contains foraging habitat that is of particularly high value to this species. The removal of 0.03 hectares of vegetation as part of the proposed works, within a patch of more than 100 hectares is not considered to pose a threat to the species.
Introduction of exotic pathogens, particularly white-nose fungus.	So far there have been no cases of white-nose fungus recorded in Australia. It is unlikely that the fungus could be spread to microbats as a result of the proposed works. The proposed works will involve the removal of 0.03 ha of vegetation. This vegetation is continuous with vegetation to be retained, and it is unlikely that this removal could result in the transfer or introduction of pathogens to the subject land.
Cave entrances being blocked for human health and safety reasons, or vegetation (particularly blackberries) encroaching on and blocking cave entrances.	Entrance to either potential roosting structure within the subject land will not be blocked as a result of the proposed works. The old gantry and tumbler house currently has considerable encroachment of Lantana occurring nearby the entrance. The CEMP and OEMP will detail measures to reduce and control weeds within the subject land. Thus, the blocking of the structure by weeds is unlikely.
Hazard reduction and wildfire fires during the breeding season.	The subject land occurs on private property containing buildings and machinery. Hazard reduction burning is not likely within the subject land. The risk of fire as a result of sparks from machinery during proposed works is unlikely, but could increase the risk of fire occurring nearby potential roost sites. This risk will be managed by implementing appropriate mitigation measures such

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	as spark dampeners, water spraying or the close proximity of fire-fighting gear such as extinguishers. Ongoing operation of the proposed conveyor within the study area after construction may also pose a small fire risk to surrounding bushland if a mechanical issue was to cause a spark. Fire-fighting equipment such as extinguishers will remain in close proximity to the proposed conveyor permanently. This will ensure substantially reduce the fire risk that the proposed works might pose to the study area and surrounds.
Predation by feral cats.	The CEMP and OEMP will detail monitoring and management measures to ensure that the presence of feral cats does not increase due to proposed works, for example through increases in rubbish that might attract animals. Overall, the removal of 0.03 ha of vegetation within a patch larger than 100 ha is unlikely to increase the presence of feral cats that might disturb potential bat habitat.
Impacts from invasive flora and fauna.	Weeds occurring within the subject land include Crofton Weed, Cape Ivy, Lantana, Pellitory and Madeira Winter Cherry, and are common with those occurring within adjacent vegetation to be retained. As the vegetation to be retained is in similar condition, increased transport of pathogens and weeds is unlikely to occur. Regardless, measures to ensure adequate control of weeds and pathogens will be detailed and managed by biosecurity measures outlined in the CEMP and OEMP. No increase in weeds is thus predicted as a result of the proposed works, that could potentially impact microbat habitat. The study area and surrounds likely support several pest animal species including Red Fox *Vulpes vulpes*, Feral cats *Felis catus* and several species of deer. The OEMP will detail monitoring and management measures to ensure that the presence of such species does not increase due to proposed works, for example through increases in rubbish that might attract pest species. Overall, the removal of 0.03 ha of vegetation within a patch larger than 100 ha is unlikely to increase the presence of pest animal populations that might disturb potential bat habitat.
Disturbance from noise, light, vibration and human traffic.	There is potential for indirect impacts to potential microbat habitat within the subject land due to

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	increased disturbance from noise, light and human traffic. Extensive mitigation measures to reduce such impacts are detailed in response a) above.

(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

The following information has been gathered from BioNet Atlas records as well as scientific literature and government reports.

New South Wales

Within the last 20 years there have been approximately 5,009 recordings of Large Bent-winged Bat within NSW. Records are generally continuous and encompass the length of the NSW coast, from Queensland to Victoria, and west to Wagga Wagga.

Large Bent-winged Bat has been recorded within the following National Parks within NSW: Botany Bay National Park, Bindarra National Park, Blue Mountains National Park, Cataii National Park, Gardens of Stone National Park, Georges River National Park, Kanangra-Boyd National Park, Kosciuszko National Park, Lane Cove National Park, Mt Kaputar National Park, Nataii National Park, North Yengo National Park, Royal National Park, Wollemi National Park, Middle Brother National Park, Mount Warning National Park and Yellomundee National Park.

The species had also been recorded within the following nature reserves, conservation areas and public lands: Bargo State Conservation Area, Burragorang State Conservation Area, Yerranderie State Conservation Area, Joadja Nature Reserve, Black Andrew Nature Reserve, Dalrymple-Hay Nature Reserve, Parr Conservation Area, Balls Head Reserve, Anembo Reserve, Caraii State Conservation Area, West Horsnby Reserve, Harry Howard Reserve, Fred Caterson Reserve, Cackayne Reserve, Newington Nature Reserve, Pambalong Nature Reserve, Irrawong Reserve, Pambalong Nature Reserve, Parsely Bay Reserve, The Basin Nature Reserve, Jenolan Caves Reserve, Ingleside Chase Reserve and Ben Bullen State Forest.

Sydney Basin IBRA Region

Within the last 20 years, there have been 2,885 records of Large Bent-winged Bat within the Sydney Basin IBRA region. At least 542 of these records fall within the NSW reserve system. Records encompass the subregion, from Newcastle in the north to Durras in the south, and Ulan in the west. Large Bent-winged Bat has been recorded within the following National Parks, reserves and forests within the Sydney Basin IBRA subregion:

Blue Mountains National Park, Balls Head Reserve, Burragorang State Conservation Area, Cattai National Park, Dharawal State Conservation Area, Eastern Parr State Conservation Area, Gulguer Nature Reserve, Goulburn River National Park, Georges River National Park, Harr Howard reserve, Lane Cove National Park, Manobalai Nature Reserve, Nattai National Park, Nattai State Conservation Area, Newnes State Forest, Royal National Park, Sugarloaf State Conservation Area, Wollemi National Park, Towra Point Nature Reserve, Yellomundee National Park, South Yengo National Park and North Yengo National Park.

Illawarra IBRA Subregion

In the last 20 years, there have been 130 records of Large Bent-winged Bat within the Illawarra IBRA subregion. These records are grouped in three main locations. Approximately 44 records occur within the Wongawilli, Kembla Grange and West Dapto area, with outlying records in Albion Park further south. Another grouping of approximately 18 records occurs around Broughton Village, approximately 30 kilometres south

of Wongawilli. Finally, a grouping of records occurs at the southern edge of the Illawarra subregion, around Nowra. Of the 130 records of Large Bent-winged Bat within the Illawarra subregion, the largest numbers of individuals have been recorded in the Wongawilli area, with southern records often comprising one or few individuals (where abundance has been recorded).

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

The proposed works are not considered likely to have a substantial impact on Large Bent-winged Bat, and thus no measures have been proposed to contribute to the recovery of the species.

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11.2.3 Little Bent-winged Bat *Miniopterus australis*

It has been identified that potential breeding habitat for Little Bent-winged Bat occurs within 100 metres of the subject land. According to the BioNet Atlas (2020) potential breeding habitat for this species is defined as:

'*Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave'; observation type code 'E nest-roost'; with numbers of individuals >500; or from the scientific literature*'

The BioNet Atlas also states that:

'All breeding habitat including the cave, or other features, used for breeding and the area immediately surrounding this feature must be mapped. Species polygon boundaries should have a 100m radius buffer around an accurate GPS point location centred on the cave/feature entrance'.

The subject land contains two man-made structures that could potentially provide roosting and/or breeding habitat for Little Bent-winged Bat. These are:

- The old GI tumbler house and gantry at the southern edge of the subject land.
- The entrance to the NWMD tunnel at the western edge of the subject land.

According to the BAM, any impact to breeding habitat for this species is considered a potential SAII. Thus, as per Section 10.2.3 of the BAM (OEH 2017a) the following information has been included.

Background

The Little Bent-winged Bat is a member of the Miniopteridae family (Churchill 2008). The species occurs along the east coast of Australia from northern Queensland to Albion Park south of Wollongong, and is listed as Vulnerable under the BC Act.

Little Bent-winged Bat uses a broad range of habitats including moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub (Churchill 2008, DPIE 2019c). Little Bent-winged bats prefer well-timbered areas where they feed primarily in the shrub and canopy layers. Their diet consists primarily of beetles, moths, flies and spiders (Churchill 2008).

The species is cave-dwelling, and congregate from August and into the summer months in maternity colonies. From the few maternity roosts known, it appears that the species uses limestone cave systems for breeding. They disperse during the winter, going into shallow hibernation in the southern extent of their range. There are very few known maternity roosts recorded for this species. Maternity roosts can host up to 100,000 individuals, and the species is often seen roosting with Large Bent-winged Bat (DPIE 2019c).

According to BioNet and in-house knowledge, various microbat surveys have previously been undertaken in close proximity to the subject land, including:

- Biosis 2011 (ultrasonic recording).
- DPI Forestry 2013 (harp trapping, dusk surveys using thermal imagery and ultrasonic recording).
- Biosis (2019, 2020) ultrasonic recording, dusk surveys, roost searches in adjacent adits (less than100 metres away from the study area).

Across these assessments, the following species were identified:

- Long-eared bats *Nyctophilus* sp. (Biosis 2011)
- Large Bentwing-bat *Miniopterus orianae oceanensis* (Biosis 2011, DPI Forestry 2013, Biosis 2020).
- Eastern Horse-shoe Bat *Rhinolophus megaphyllus* (Biosis 2011, DPI Forestry 2013, Biosis 2020).

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- White-striped Freetail Bat *Austronomous australis* (Biosis 2011, DPI Forestry 2013).

No surveys to date have identified Little Bent-winged Bat within the vicinity of the old gantry and tumbler house, or the existing mine tunnel. The closest record to the subject land occurs approximately 3 kilometres south on Bong Bong Road (BioNet 2020).

Due to the urbanisation of the surrounding area and construction of several housing estates, many microbat surveys have also been conducted within the locality over recent years as part of larger ecological assessments (BioNet 2020). While microbat records are abundant within the locality, these surveys have not recorded Little Bent-winged Bat.

Given Biosis' history with the study area and locality, the lack of limestone caves within the subject land, and prior knowledge of bats utilising the mine adits at Wongawilli, it is unlikely that Little Bent-winged Bat would be using the old gantry and tumbler house or the existing mine tunnel as breeding habitat. Thus, it is unlikely that the proposed works will impact Little Bent-winged Bat breeding habitat. Regardless, the below SAII assessment has been prepared.

(a) The action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII.

The location of the proposed conveyor to be installed at the Wongawilli Pit Top is necessary to connect the existing mine entrance tunnel to the existing coal processing infrastructure at the Wongawilli Colliery. The reutilisation of infrastructure at the Wongawilli Colliery minimises impacts to threatened microbat habitat overall, by avoiding construction of completely new infrastructure within the study area. However, direct impact to 0.03 hectares of Little Bent-winged Bat breeding habitat (under the BAM, via removal of vegetation within 100 metres of a potential breeding structure) is necessary for the NWMD tunnelling project to be successful.

Old gantry and tumbler house

The location of the proposed conveyor has been aligned to avoid direct impact to the old gantry and tumbler house located at the southern edge of the subject land. However, vegetation will be removed directly adjacent to the structure. There is potential for these proposed works to have indirect impacts on microbats utilising this structure, due to increased noise, light, vibration, dust and foot traffic in the vicinity. The mitigation measures that will be carried out by WCL in order to minimise impacts to Little Bent-winged Bats potentially utilising this structure are detailed below.

Existing tunnel entrance

The existing tunnel entrance will need to be reutilised as part of the proposed project. The construction of the tunnel was covered under previous project approvals, however the tunnel has remained unused for a substantial period of time, and now provides potential breeding habitat for Little Bent-winged Bat. A recent site investigation undertaken by a qualified zoologist of Biosis (2020) did not identify microbats to be roosting within the tunnel entrance, suggesting that the structure does not provide over-wintering habitat for the species. However, this tunnel is connected to other adits including the old gantry and tumbler house via a series of underground tunnels, and microbat movement between structures is possible. Additionally, Little Bent-winged Bats abandon maternity roost sites over winter and disperse into the landscape, returning to the sites from late August. As the site investigation was undertaken in early, no observations could be made about use of the structure as a maternity roost.

The following mitigation measures will be undertaken by WCL to minimise indirect impacts to potential threatened microbat species utilising the old gantry and tumbler house or the existing mine tunnel entrance as roosting or breeding habitat. These are discussed within the report above in more detail, see Section 6.

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- A thorough microbat preclearance survey will be undertaken by a qualified ecologist prior to the start of construction, to determine the presence and location of microbats within the two structures.
- If microbats are found to be roosting within the existing mine tunnel entrance, exclusion measures will be undertaken to remove potential microbat habitat within this structure, and ensure the relocation of bats to alternate areas of habitat. Such measures would be undertaken outside of the breeding and overwintering season, during microbat activity. Measures might include the sealing off of the tunnel after the evening exit of microbats, the sealing of cracks and crevices that bats might be utilising within the tunnel, and/or the installation of smooth surfaces over areas of substrate that could be used by roosting bats.
- Due to the interconnected nature of the mine tunnels owned by WCL, alternate microbat habitat is available to individuals nearby, including within the old gantry and tumbler house and other unused adits. All side entrances leading from the existing mine tunnel to unused sections of the adit system will be completely sealed, such that microbats are no longer able to access the main tunnel from these areas. The alternate entrances/exits of the unused portions of the adit system will be fitted with bat-friendly gates, such that microbats are able continue accessing these areas.
- As the proposed coal conveyor will be constructed in close proximity to the old gantry and tumbler house, measures will be undertaken to limit the indirect impacts to microbats within this structure due to noise, light and foot traffic.
- Appropriate noise barriers will be installed permanently between the proposed conveyor and the old gantry and tumbler house, to limit noise disturbance to resident microbats. Noise barriers will require placement that avoids impediment of movement of microbats in and out of the structure.
- Any necessary construction or operation lighting will be directed away from the gantry and tumbler house, and lighting will be designed to avoid spill nearby the structure.
- The old gantry and tumbler house will be designated a no-go-zone, and any staff or contractors involved in the proposed works will be briefed on the importance of avoiding disturbance to this area.
- Once construction of the proposed conveyor is complete, a secondary microbat survey will be undertaken by a qualified ecologist in both the old gantry and tumbler house, and the existing mine tunnel entrance to ensure that:
  - Microbats have not returned to the existing mine tunnel entrance after initial exclusion.
  - Microbats within the old gantry and tumbler house have not started to decline as a result of indirect disturbances from the proposed works.
- If microbats have returned to the existing mine tunnel entrance, or microbats within the tumbler house have decreased, WCL will consult with the ecologist, and actions will be recommended.
- Both the old gantry and tumbler house, and the existing mine tunnel entrance will continue to be monitored regularly to ensure that:
  - Microbats do not return to the existing mine tunnel entrance after initial exclusion.
  - Microbats within the old gantry and tumbler house do not begin to decline as a result of indirect disturbances from the use of the proposed coal conveyor.
- If at any time a maternity roost is found to be present within either structure, works will be ceased and the appropriate ecologists and approval authorities will be consulted.

(b) The size of the local population directly and indirectly impacted by the development, clearing or biodiversity certification.

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The closest grouping of Little Bent-winged bat records to the subject land occurs between Dapto and Albion Park, approximately 5-10 kilometres south of the subject land. The species has been recorded here approximately 30 times, with the most individuals recorded at one time being 91. For the purpose of this assessment, these records are considered to constitute the local population. However, as the species roosts in large groups up to 100,000 when breeding, it is likely that these records have been obtained from foraging, overwintering or roosting bats, and not from a maternity colony. Individuals from the local population likely migrate long distances to breed.

(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.

The SAII threshold specified for Little Bent-winged Bat is 'breeding habitat as identified by survey'. The field investigation conducted by Biosis (2020) identified two structures that provide potential Little Bent-winged Bat breeding habitat under the BAM definition given above. These are the old gantry and tumbler house, and the existing mine tunnel entrance. The proposed conveyor would be constructed directly adjacent to the old gantry and tumbler house, potentially subjecting resident microbats to indirect impacts such as noise, vibration and light disturbance. The existing tunnel entrance will be reused to transport coal materials as part of the proposed works, and any microbats using this structure would also be subject to disturbance. Additionally, 0.03 hectares of native vegetation will be removed within 100 metres of these structures. Therefore, the threshold for this species has been exceeded and the proposed works must be considered to have a potential serious and irreversible impact.

(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.***

Foraging habitat for this species is readily available within the locality, with vegetation in the subject land occurring within a patch of native vegetation more than 100 hectares in size. As a result of the proposed works, approximately 0.03 hectares of potential foraging habitat will be removed. A small amount of further foraging habitat in the vicinity of the proposed works may also be indirectly impacted as a result of light, noise or vibrations during the construction and operation phase of works. However, the change in available foraging habitat to the local population of Little Bent-winged Bat is considered minimal.

The two structures identified within the subject land, although unlikely, may provide roosting habitat for Little Bent-winged Bat. Both of these structures may be indirectly impacted by the proposed works through noise, dust, light and vibration disturbance, potentially leading to the abandonment of these sites as roosting habitat for the species. However, due to the presence of the Illawarra Escarpment area, which is comprised of a range of clifflines, caves and overhangs, as well as the wealth of both used and unused mining structures within the locality, this is considered to be a small change in the availability of roosting habitat for the species. Additionally, the mitigation measures outlined above are likely to minimise the impacts of the proposed works on the structures within the subject land, thus minimising the likelihood that this a habitat will be lost.

Maternity roosting sites for Little Bent-winged Bat are rare and highly specific. The species roosts in large groups of up to 100,000 individuals. The species has not previously been recorded at the Wongawilli pit top despite extensive survey. It is unlikely that either structure within the subject land provides potential breeding habitat for the species. No currently or previously used breeding habitat for the species is known within the locality. It is unlikely that disturbance to either structure as a result of the proposed works would lead to loss of breeding habitat for the species.

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

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The impacts to available habitat for Little Bent-winged Bat as a result of the proposed works include the following:

- Loss of 0.03 hectares of potential foraging habitat.
- Disturbance (via noise, light, dust or vibration) to two man-made structures that provide potential roosting habitat. This may result in the abandonment of these structures by microbats.

- ***(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.***

The proposed works are unlikely to modify habitat required for the maintenance of the processes important to the Little Bent-winged Bat's lifecycle. This is due to the unlikelihood that structures within the subject land are used as breeding habitat for the species. As discussed above, the rarity of maternity roosts for this species coupled with the lack of records within or nearby the subject land and the lack of limestone cave habitat indicates that Little Bent-winged Bats most likely do not use the subject land for essential processes in their lifecycle such as breeding.

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***

From the few maternity roosts known for the species, they appear to use limestone caves for breeding (Churchill 2008). There are no limestone caves located within the subject land. The species has also not been previously recorded in close proximity to the subject land, despite numerous surveys being undertaken. It would be unlikely that the species would use the structures within the subject land as breeding habitat.

As detailed above, mitigation measures committed to by WCL include the conducting of a pre-clearance survey before works, within the time period that bats would be returning to their maternity roost site, to ensure that structures within the subject land do not contain active maternity roosts. If a maternity roost was to be located within the subject land, works would be delayed and the appropriate ecology professionals and approval authorities would be consulted.

  - ***Foraging***

Little Bent-winged Bat uses a broad range of habitats including rainforests, wet and dry sclerophyll forests and vine thicket (Churchill 2008). The species hunts in timbered areas, catching beetles, moths and flies within the shrub and canopy layer. Although the subject land contains rainforest vegetation, the site is disturbed and much more intact vegetation exists within the locality.

Vegetation within the subject land is connected to surrounding vegetation to the north, south and west, forming a vegetation patch of more than 100 hectares. It is unlikely that the subject land contains foraging habitat that is of particularly high value to this species. The removal of 0.03 hectares of vegetation as part of the proposed works, within a patch of more than 100 hectares is not considered to have potential to impact the foraging ecology of the species.

  - ***Roosting, and***

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Roosting sites used by the local population are currently unknown, however the species often roosts in caves, tunnels and mines. There is likely to be available roosting habitat within the clifflines of the Illawarra Escarpment, as well as within mining structures throughout the locality, where coal mining is prevalent. Both the old gantry and tumbler house, and the existing mine tunnel entrance may provide roosting habitat for Little Bent-winged Bat. Both of these structures may be indirectly impacted by the proposed works through noise, dust, light and vibration disturbance, potentially leading to the loss of these sites as roosting habitat. Due to the presence of the large Illawarra Escarpment area, as well as a wealth of both active and inactive mining structures within the locality, the loss of two roosting structures for the species is unlikely to have a substantial impact on the roosting ecology of the local population.

- ***Dispersal or movement pathways***

Little Bent-winged Bat are highly mobile, and are able to travel hundreds of kilometres between roosting and breeding sites. While it is assumed that connected vegetation is preferred by the species for movement, the existence of many records of the species within urbanised areas suggests that the species does not rely on specialised dispersal or movement habitat. Thus, the loss of approximately 0.03 hectares of vegetation nearby a potential roosting site is unlikely to impact the movement ecology of the local population.

(f) A description of the extent to which the local population will become fragmented or isolated as a result of the proposed development

The proposed works will result in the loss of 0.03 hectares of foraging habitat for the species. However, the vegetation to be removed occurs within a patch of more than 100 hectares, and is unlikely to impact the occurrence of the species. It is unlikely that breeding habitat will be lost as a result of the proposed works. Both the old gantry and tumbler house, and the existing mine tunnel entrance may provide roosting habitat for Little Bent-winged Bat, and both of these structures may be indirectly impacted by the proposed works through noise, dust, light and vibration disturbance, potentially leading to the loss of these sites as roosting habitat. However due to the presence of the large Illawarra Escarpment area, as well as a wealth of both active and inactive mining structures within the locality, the loss of two roosting structures for the species is unlikely to have an impact on the local population.

It is not predicted that the local population will become fragmented or isolated as a result of the proposed development.

(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

Little Bent-winged Bat records are generally continuous along the eastern coast of Australia from Queensland to Albion Park, south of Wollongong, NSW. The species also occurs up to approximately 130 kilometres inland from the coast. The closest grouping of records to Wongawilli occurs from Dapto to Albion Park, and constitutes the southern limit of the species' range.

However, such records most likely constitute foraging and roosting individuals, with no evidence of breeding in the locality. These individuals most likely return to a maternity roost to breed elsewhere in the landscape, and thus are likely highly connected to other local populations. Considering the large numbers of individuals of the species that congregate to breed (up to 100,000) it is unlikely that genetic viability and diversity is limited.

The proposed works are not likely to impact the relationship between the local population of microbats and other populations in NSW.

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(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 potential threats to Little Bent-winged Bat within Australia as listed in the OEH species profile, as well as other potential impacts relating to the proposed works have been identified and addressed below.

Table 25 Potential threats to Little Bent-winged Bat

Threat	Relevance to proposed works
Disturbance of colonies, especially in nursery or hibernating caves.	Due to the preference of the species for limestone caves for breeding, as well as the lack of records within or nearby the subject land despite extensive survey, it is unlikely that the subject land supports breeding or roosting Little Bent-winged Bats. Thus, such colonies are unlikely to be disturbed by the proposed works.
Hazard reduction and wildfire fires during the breeding season.	The subject land occurs on private property containing buildings and machinery. Hazard reduction burning is not likely within the subject land. The risk of fire as a result of sparks from machinery during proposed works is unlikely, but could increase the risk of fire occurring nearby potential roost sites. This risk will be managed by implementing appropriate mitigation measures such as spark dampeners, water spraying or the close proximity of fire-fighting gear such as extinguishers. Ongoing operation of the proposed conveyor within the study area after construction may also pose a small fire risk to surrounding bushland if a mechanical issue was to cause a spark. Fire-fighting equipment such as extinguishers will remain in close proximity to the proposed conveyor permanently. This will ensure substantially reduce the fire risk that the proposed works might pose to the study area and surrounds.
Changes to habitat surrounding maternity caves and winter roosts.	Due to the preference of the species for limestone caves for breeding, as well as the lack of records within or nearby the subject land despite extensive survey, it is unlikely that the subject land supports breeding or roosting Little Bent-winged Bats. Although the proposed works will involve the removal of 0.03 hectares of vegetation, it is not considered likely that this habitat occurs nearby breeding or overwintering habitat for the species.

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Introduction of exotic pathogens such as White-nosed fungus.	So far there have been no cases of white-nose fungus recorded in Australia. It is unlikely that the fungus could be spread to microbats as a result of the proposed works. The proposed works will involve the removal of 0.03 ha of vegetation. This vegetation is continuous with vegetation to be retained, and it is unlikely that this removal could result in the transfer or introduction of pathogens to the subject land.Entrance to either potential roosting structure within the subject land will not be blocked as a result of the proposed works. The old gantry and tumbler house currently has considerable encroachment of Lantana occurring nearby the entrance. The CEMP and OEMP will detail measures to reduce and control weeds within the subject land. Thus, the blocking of the structure by weeds is unlikely.
Destruction of caves that provide roosting sites.	No caves will be impacted as a result of the proposed works.
Impacts from invasive flora and fauna.	Weeds occurring within the subject land include Crofton Weed, Cape Ivy, Lantana, Pellitory and Madeira Winter Cherry, and are common with those occurring within adjacent vegetation to be retained. As the vegetation to be retained is in similar condition, increased transport of pathogens and weeds is unlikely to occur. Regardless, measures to ensure adequate control of weeds and pathogens will be detailed and managed by biosecurity measures outlined in the CEMP and OEMP. No increase in weeds is thus predicted as a result of the proposed works, that could potentially impact microbat habitat. The study area and surrounds likely support several pest animal species including Red Fox *Vulpes vulpes*, Feral cats *Felis catus* and several species of deer. The OEMP will detail monitoring and management measures to ensure that the presence of such species does not increase due to proposed works, for example through increases in rubbish that might attract pest species. Overall, the removal of 0.03 ha of vegetation within a patch larger than 100 ha is unlikely to increase the presence of pest animal populations that might disturb potential bat habitat.
Disturbance from noise, light, vibration and human traffic.	There is potential for indirect impacts to potential microbat habitat within the subject land due to

	increased disturbance from noise, light and human traffic. Extensive mitigation measures to reduce such impacts are detailed in response a) above.

(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

The following information has been gathered from BioNet Atlas records as well as scientific literature and government reports.

New South Wales

Within the last 20 years there have been approximately 3,235 recordings of Little Bent-winged Bat within NSW. Records are generally continuous from the Queensland border in the north, to Albion Park in the south, and up to 130 kilometres inland from the coast.

It is predicted that approximately 23 % of Little Bent-winged Bats within NSW occur within the reserve system (within National Parks and Wildlife Service estate) (DPIE 2019c).

The species has been recorded within the following National Parks within NSW: Yengo National Park, Myall Lakes National Park, Bundjalung National Park, Broadwater National Park, Booti Booti National Park, Werakata National Park, Bindarra National Park, Brisbane Waters National Park, Caraii National Park, Curracabundi National Park, Richmond Range National Park, Bouddi National Park, Middle Brother National Park, Mebbin National Park and Wyrrabalong National Park, among others.

The species had also been recorded within the following nature reserves, conservation areas and public lands: Sugarloaf State Conservation Area, Chambigne State Conservation Area, Rawdon Creek Nature Reserve, Middle Brother State Forest, Cudgera Creek Nature Reserve, Bullinudgel Nature Reserve, Fred Caterson Reserve, Pambalong Nature Reserve, Sygna Close Reserve, Deepwater Reserve, Ingleside Chase Reserve and Koukandowie Nature Reserve.

Sydney Basin IBRA Region

Within the last 20 years, there have been 1,331 records of Little Bent-winged Bat within the Sydney Basin IBRA region. Most of these records occur in the north of the subregion, from Newcastle to the Central Coast. Little Bent-winged Bat has been recorded within the following National Parks, reserves and forests within the Sydney Basin IBRA subregion:

Ku-ring-gai Chase National Park, Brisbane Waters National Park, Yengo National Park, Werakata National Park, Hunter Wetlands National Park, Wallarah National Park, Wyrrabalong National Park, Bouddi National Park, Fred Caterson Reserve, Pambalong Nature Reserve, Angophera Reserve, Sugarload Conservation Area, Sygna Close Reserve, Ingleside Chase Reserve and Maroota Ridge State Conservation Area.

Illawarra IBRA Subregion

In the last 20 years, there have been 35 records of Little Bent-winged Bat within the Illawarra IBRA subregion. These records are mostly grouped within the area from Dapto to Albion Park, approximately 5-10 kilometres south of the subject land. Three outlying records occur at Bangalee and Worrigee to the south and Bulli to the north.

None of the records from within the Illawarra subregion have been recorded within the nature reserve system, however the two outlying southern records occur adjacent to Worrigee Nature Reserve and Tapitallee Nature Reserve respectively, indicating that these reserves may be used for foraging by the species.

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

The proposed works are not considered likely to have a substantial impact on Little Bent-winged Bat, and thus no measures have been proposed to contribute to the recovery of the species.

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Appendix M

Historical heritage assessment and statement of heritage impact

Appendix N

Archaeological assessment

Appendix O

Social impact assessment

Appendix P

Economic impact assessment