Port Kembla Lateral Looping Project

Biodiversity Development Assessment Report

FINAL REPORT

Prepared for Jemena

24 September 2020

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- 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.

Biosis staff involved in this project were:

- Bianca Klein and Byron Dale (assistance in the field).
- Anne Murray (mapping).

Contents

Tables

Figures

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
CSSI	Critical State Significant Infrastructure
DA	Development Application
DBH	Diameter at Breast Height
DCDB	Digital cadastral database
DEE	Commonwealth Department of the Environment and Energy
DoIW	Directory of Important Wetlands
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.
EES	NSW Environment, Energy and Science (formerly OEH)
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
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).
Matters of NES	Matters of National Environmental Significance protected by a provision of Part 3 of the EPBC Act

PCT	Plant Community Type
SAII	Serious and Irreversible Impact
SALIS	NSW Soil and Land Information System
study area	The broader area in which the subject site is located, including all direct and indirect impacts
subject site	The area of direct impact for the proposed development
TEC	Threatened Ecological Community
WM Act	NSW *Water Management Act 2000*

Summary

Jemena proposes to accommodate 5.6 kilometres of pipeline to connect Port Kembla's newly proposed gas terminal to the existing Eastern Gas Pipeline (EGP). The existing EGP stretches 797 kilometres from Longford, Victoria to Horsley Park, New South Wales (NSW). The newly proposed pipeline will consist of an 18 to 22 inch carbon steel Gas pipeline running from Australian Industrial Energy (AIE) proposed a Cringila facility to a Jemena tie-in facility located in Kembla Grange to connect into the existing EGP (the project). The development requires 1.8 kilometres of Horizontal Direct Drilling (HDD) and 5 kilometres of open trenching over a total easement width of 5 metres. Additional areas facilitating temporary workspaces are also included within the proposed footprint, the proposed impact areas combined are referred to as the 'subject land' hereon in. An area of 5 metres either side of the subject land was also assessed and is referred to as the 'study area'.

The project involves the development of a liquefied natural gas (LNG) import terminal and includes a pipeline and tie-in facility to the existing EGP lateral in Cringila. The Port Kembla Gas Terminal is NSW's first LNG import terminal which, once constructed, would have the capacity to supply more than 70 per cent of NSW's current annual gas demand.

The project will be assessed under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). Biosis understands that a Modification Report is being prepared for the project to support a State Significant Infrastructure (SSI) application (SSI-9973-Mod-1) for the modification of the EGP which recently transitioned to an SSI project. The project will be assessed under section 5.12 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Jemena are seeking a modification of the Minister's approval to the EGP, proposing to modify the project in accordance with section 5.25 of the EP&A Act.

The proposed modification does not seek to significantly alter the nature or scale of the approved EGP. The Modification Scoping Report prepared by GHD in November 2019 (Ref: Eastern Gas Pipeline, 12517829) included a Preliminary Environmental Assessment to identify potential environmental impacts that may arise as a result of the proposed modification. As such, Jemena require an assessment of impacts to biodiversity in accordance with section 7.9 of the NSW *Biodiversity Conservation Act 2016* (BC Act) in the form of a Biodiversity Development Assessment Report (BDAR). This BDAR has been prepared to outline the ecological assessment in accordance with the NSW Biodiversity Assessment Method (BAM).

Field investigation, undertaken in accordance with the BAM, recorded three hectares of native vegetation within the study area, representing two threatened ecological communities. Avoidance of native vegetation, threatened ecological communities and threatened species habitat has been undertaken to restrict impacts to 0.37 hectares of naturally occurring native vegetation consisting of two Threatened Ecological Communities (TECs):

- 0.04 hectares of *Coastal Freshwater Wetlands on coastal floodplains of the New South Wales North Coast, Sydney Basin and South East Corner* (Endangered, BC Act).
- 0.33 hectares of *Illawarra Lowlands Grassy Woodland in the Sydney Basin bioregion* (Illawarra Lowlands Grassy Woodland) (Endangered, BC Act)

Illawarra Lowlands Grassy Woodland is a candidate Serious and Irreversible Impact (SAII) entity in accordance with Section 10.2 of the BAM. As such, an SAII assessment was prepared for this TEC and is provided in Section 7.1.1.

The project will also impact 1.12 hectares of planted native vegetation, unlikely to provide resources for threatened species. These impacts have been included in BAM calculations.

No threatened species were recorded within the study area.

As a result of impacts to naturally occurring native vegetation, and in accordance with Section 10.3 of the BAM, offsets are required to be secured for the proposed development.

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.

Stage 1 – Biodiversity assessment

1 Introduction

Biosis Pty Ltd was commissioned by Jemena to undertake a biodiversity assessment of the SSI project. The purpose of this assessment was to apply the NSW BAM (DPIE 2020) to the project, and provide Jemena with a BDAR to facilitate project approval..

1.1 Project background

Jemena plans to develop the 5.6 kilometres of proposed lateral pipeline and tie in facility located in Kembla Grange (the study area) (Figure1). The project will be assessed under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). Biosis understands that a Modification Report is being prepared for the project to support a SSI application (SSI-9973-Mod-1) for the modification of the EGP which recently transitioned to an SSI project. The project will be assessed under section 5.12 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Jemena are seeking a modification of the Minister's approval to the EGP, proposing to modify the project in accordance with section 5.25 of the EP&A Act.

The proposed modification does not seek to significantly alter the nature or scale of the approved EGP. The Modification Scoping Report prepared by GHD in November 2019 (Ref: Eastern Gas Pipeline, 12517829) included a Preliminary Environmental Assessment to identify potential environmental impacts that may arise as a result of the proposed modification. As such, Jemena require an assessment of impacts to biodiversity in accordance with section 7.9 of the BC Act in the form of a BDAR.

1.2 Purpose of this assessment

This BDAR, prepared and reviewed by BAM Accredited Assessors will:

- Address the BAM and the BOS.
- 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 development.
- 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 and reviewed by Accredited Assessor Bianca Klein (BAAS18050), and reviewed by Accredited Assessor Jane Raithby-Veall (BAAS 18134)

1.3 The subject land

The subject land is defined as the total area of proposed disturbance, encompassing the proposed development footprint and all areas that could be disturbed during construction (e.g. plant laydown, access tracks, open trenching). Figure 1 displays the entire disturbance footprint for all works required. The subject land includes the entire footprint inclusive of the HDD works and temporary work areas. The eastern boundary of the subject land falls within BlueScope Steel lands adjacent to Five Islands Road 180 metres north-west of Centenary Park, Cringila. Spring Hill neighbours the northern extent and Cringila the southern extent of this boundary with

Wollongong Central Business District (CBD) approximately 5 kilometres north. The western extent of the subject land lies adjacent to Wylie Road, Kembla Grange, 330 metres south-east of Bingo Recycling Centre, the western extent will consist of a tie-in facility that will lie next to an existing gas tie-in facility, at Farmborough Heights which lies 1 kilometre north of the western extent of the subject land with Brownsville directly south 1.7 kilometres.

The subject land is located in the Wollongong City Council Local Government Area (LGA) and the South East Local Land Services (LLS) Region. The study area covers multiple land use zones under the *Wollongong Local Environmental Plan 2009* (LEP) due to its lineal extent, these consist of IN2 – Light Industrial, IN3 – Heavy Industrial, RE1 – Public Recreation, SP1 – Special Activities and SP2 – Infrastructure. The current land use consists of industrial lands, road easements, farmlands and large infrastructure. The terrain is undulating covering multiple landscapes these consist of; alluvial plains, flood plains, terraces and valley flats. There is a single watercourse running directly through the western extent of the study area.

1.4 The study area

The study area encompasses the subject land inclusive of a five metre buffer to allow for areas in close proximity of the subject land that could be indirectly impacted by the project including adjacent areas downslope where, for example, there may be minor changes to hydrology through alteration to overland flow patterns.

Legend

- Study area
- Subject land
- Kilometre point
- Habitat connectivity
- Property boundary

IBRA

- Region
- Subregion

Hydrology

- Natural watercourse

Strahler stream order

- 1
- 2
- 3
- 5

Strahler order buffered areas

- 1
- 2
- 3
- 5

Figure 1.1 Site map

0 40 80 120 160 200

Metres
Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert

biosis
Biosis Pty Ltd

N

Matter: 31485
Date: 27 February 2020,
Checked by: BD, Drawn by: LW, Last edited by: lwilson
Location:P:\31400s\31485\Mapping
31485_F1_SiteMap

Legend

- Study area
- Subject land
- Kilometre point
- Habitat connectivity
- Property boundary

IBRA

- Region
- Subregion

Hydrology

- Canal-Drain

Strahler stream order

- 1
- 2
- 3

Strahler order buffered areas

- 1
- 2
- 3

Figure 1.2 Site map

0 40 80 120 160 200

Metres
Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert

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Biosis Pty Ltd

Matter: 31485
Date: 27 February 2020,
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31485_F1_SiteMap

Acknowledgements: Basemap © Land and Property Information 2016

Legend

- Study area
- Subject land
- Kilometre point
- Habitat connectivity
- Property boundary

IBRA

- Region
- Subregion

Strahler stream order

- 1

Strahler order buffered areas

- 1

Figure 1.3 Site map

0 40 80 120 160 200

Metres
Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert

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Legend

- Study area
- Subject land
- Kilometre point
- Habitat connectivity
- Property boundary

IBRA

- Region
- Subregion

Strahler stream order

- 1
- 2

Strahler order buffered areas

- 1
- 2

Figure 1.4 Site map

0 40 80 120 160 200

Metres
Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert

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Matter: 31485
Date: 27 February 2020,
Checked by: BD, Drawn by: LW, Last edited by: lwilson
Location:P:\31400s\31485\Mapping
31485_F1_SiteMap

1.5 Sources of information

Sources of information used in the assessment include; 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 10 kilometres (the locality) were collated from the following databases:

- Commonwealth Department of Agriculture Water and Environment (DAWE) Protected Matters Search Tool for matters protected by the EPBC Act.
- 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 2020).
- Relevant vegetation mapping, such as *South East Local Land Services Biometric Vegetation Map, 2014. VIS_ID 4211* (DPE 2014).

Mapping was conducted using hand-held (uncorrected) 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 NSW dataset.
- Mitchell Landscapes Version 3.0.
- Interim Biogeographic Regionalisation of Australia (IBRA) Version 7.
- Directory of Important Wetlands (DoIW).
- State Environmental Planning Policy (SEPP) Coastal Management 2018.
- Spatial data associated with Illawarra Regional Native Vegetation Map (OEH 2016a).

Mapping has been produced using a Geographic Information System (GIS). The following maps and data have been prepared:

- 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*
- *Biosecurity Act 2015*
- State Environmental Planning Policy (Koala Habitat Protection) 2019
- Wollongong City Council Local Environmental Plan 2009 (LEP)

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 (DPIE 2020). Figure 2 shows the location of the subject land and landscape features (IBRA region and subregion, hydrology, habitat connectivity, Strahler order and Mitchell landscapes) within the 1500 metre buffer.

2.1 Landscape features

2.1.1 Bioregions

The study area occurs within the Sydney Basin IBRA bioregion and the Illawarra IBRA subregion. The 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 Brigalow Belt South and North Coast 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 Kiama Coastal Slopes and Lake Illawarra Alluvial Plains Mitchell Landscape.

The Kiama Coastal Slopes is comparable to the Dapto-Wollongong slopes but with higher relief, steep slopes and higher rainfall. Maximum elevation 250 metres, relief 160 metres. Well-structured red-brown loam with gradational profiles is widespread on the Gerringong volcanics of trachyte, latite and tuff. Sandstone is less common but tends to form steep slopes with texture-contrast soils marginal to the adjacent escarpment. The study area has been extensively cleared but originally had a wide distribution of rainforest, evident though remnant plants such as; Cabbage Palm *Livistona australis*, Scentless Rosewood *Synoum glandulosum*, Brush Cherry *Syzygium australe*, Black Apple *Planchonella australis*, Plum Pine *Podocarpus elatus* amongst Turpentine *Syncarpia glomulifera,* Grey Ironbark *Eucalyptus paniculata* and River Oak *Casuarina cunninghamiana* along the streams.

The Lake Illawarra Alluvial Plains have been highly cleared with a general elevation of up to 40 metres. The soils differ dependant on sediment type and elevation however, sandy loam with high organic content and humic podsols occur, noting that these soils are highly variable. Vegetation communities within the landscape originally had Forest Red Gum *Eucalyptus tereticornis,* Woollybutt *Eucalyptus longifolia*, White Stringybark *Eucalyptus globoidea,* Thin-leaved Stringybark *Eucalyptus eugenioides,* Cabbage Gum *Eucalyptus amplifolia* where low hills and rises occur. Extensive stands of Swamp Oak *Casuarina glauca,* Prickly Paperbark *Melaleuca styphelioides* and decorative paperbark *Melaleuca* spp. occur on brackish ground near creeks (Mitchell 2002).

2.1.3 Soil

The subject land falls within three soil landscapes predominantly within the Gwynneville soil landscape (Residual – Regw) with two sections falling within the Fairy Meadow soil landscape (swfa) and the Disturbed Terrain of the Wollongong/Port Hacking 1:100,000 soil landscape map (Hazelton & Tille 1990).

The Gwynneville soil landscape is characterised as foot slopes of the Illawarra Escarpment and isolated rises of the Wollongong Plain. The landscape generally has local relief of 10 to 70 metres, with slopes ranging from 3 to 25%. This landscape also includes broad to moderately (250 metres to 850 metres) rounded ridges and gently to

steeply inclined slopes. Soils within this landscape consist of shallow brown podzolic soils and xanthozems on upper slopes, lithosols on simple slopes and shallow brown earths on midslopes and lower slopes. Some of the ridges or steeper slopes allow for structural benches and occasional rock outcrops to occur. Limitations of the landscapes include extreme erosion hazards large land slipes and local flooding.

The Fairy Meadow soil landscape is characterized by alluvial plains, floodplains, valley flats and terraces below the Illawarra Escarpment with minimal slop predominately cleared with low forest and woodland regions. The landscape is made up of gently undulating alluvial plains including floodplains, valley flats and minor terraces. The landscape provides >20m relief to surrounding landscapes. Floodplains and terraces contain pockets of sandy loams and alluvial loam soils. Whilst valley flats consist of sandy clay loams which can be highly variable.

The disturbed terrain soil landscape is a highly variable landscape, it has been created by human activity to a minimum depth of at least 100 centimetres. Most of the terrain has been previously levelled clearing all top soil and vegetation to be replaced with fill material. Fill material can be highly impermeable with low fertility and may contain toxic material and is generally used for commercial and industrial complexes, quarries and waste disposal sites.

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 (Figure 4). Conservation status of the communities is also provided. PCTs within the subject land and study area are consistent; no PCTs occur within the one and not the other.

Table 1 PCTs identified within the study area and 1500m buffer

PCT – mapped (DPE 2014) and Biosis 2019	Conservation Status	Subject land	Study area	1500 m buffer
781 Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	Endangered BC Act	Yes	Yes	Yes
838 Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	Endangered BC Act Critically Endangered EPBC Act	Yes	Yes	Yes
1300 Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion	Endangered BC Act Critically Endangered EPBC Act	No	No	Yes
906 Lilly Pilly - Sassafras - Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion	Endangered BC Act Critically Endangered EPBC Act	No	No	Yes
1326 Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion	Endangered BC Act Critically Endangered EPBC Act	No	No	Yes

PCT – mapped (DPE 2014) and Biosis 2019	Conservation Status	Subject land	Study area	1500 m buffer
1126 Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Endangered BC Act Vulnerable EPBC Act	No	No	Yes
1245 Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	N/A	No	No	Yes
Urban/native and Exotic	-	Yes	Yes	Yes

2.1.1 Cleared areas

Parts of the study area mapped as planted natives and exotic grasses with no native over storey or mid storey cover and less than 50% cover of native groundcover have been defined as cleared land. Similarly areas within the 1500 metre buffer that showed no mid-storey or canopy cover on aerial imagery were not considered as native vegetation due to the urban context of the surrounding area. Roads, buildings and other infrastructure were also considered as cleared lands. A total of 2469.48 hectares of cleared land occurs within the study area and 1500 metre buffer.

2.1.2 Differences between mapped vegetation extent and aerial imagery

There were significant differences between the mapped vegetation extent and that visible on the aerial imagery. Through the western extent of the project within the Wollongong Lawn Cemetery grounds, vegetation previously mapped (DPE 2014) as cleared was found by Biosis to contain patches of threatened ecological communities (TECs). The first vegetation community, associated with PCT 781; *Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* (Endangered Ecological Community [EEC], BC Act) referred to as Coastal Freshwater Wetlands was found to meander through a known watercourse that tracks through the Wollongong Lawn Cemetery. It is likely that the wetlands community had been opportunistic and thrived through a built up drainage swale. Weed species were found to be present within the wetland vegetation at moderate to high levels in places. The second threatened vegetation community, associated with PCT 838; *Illawarra lowlands grassy woodland in the Sydney Basin Bioregion* (Critically Endangered Ecological Community [CEEC], BC Act) referred to as Illawarra lowlands grassy woodlands had patches throughout the cleared land northeast of the Wollongong Lawn Cemetery, although it wasn't well connected it had previously been mapped as cleared (OEH 2016a).

2.1.3 Rivers and streams

The study area is located within the southeast Local Land Services Region and the Lake Illawarra catchment. The closest river-mouth is the Lake Illawarra entrance located approximately 8 kilometres to the south-east of the study area with the closest major waterbody being Lake Illawarra, located approximately 1 kilometre to the south-east of the site.

Several drainage lines and creek lines are associated with the study area. In the western portion of the study area, two unnamed drainage lines intersect the study area and Gibson's Creek is located one kilometre to the south. In the eastern portion, three drainage lines intersect the study area, while Allen's creek being just 200 metres directly north of the northern extent of the study area. In all cases, these watercourses have been altered from their natural positions due to modern urban developments (Figure 1).

There are no Key Fish Habitats as mapped by the NSW Department of Primary Industries (DPI) within the study area (DPI 2013).

2.1.4 Wetlands

The study area does not contain areas mapped as important wetlands in accordance with the Directory of Important Wetlands of Australia (DoIW 2004). Lake Illawarra is located 1.5 kilometres southeast of the study area the size of the wetland is 3227 hectares providing for a 15000 hectare catchment region. The major watercourses are also situated approximately 1.5-2.5 kilometres south of the study area. The wetland predominantly consists of shallow estuarine waters that are heavily influenced by tidal movements. There are also no wetlands of international importance (Ramsar sites) within proximity to the subject land.

A small coastal freshwater wetland is situated within a drainage line though the western extent of the study area, the wetland is approximately 1280 metres squared and is in low condition due to the opportunistic weeds that have also taken advantage of the drainage line.

2.1.5 Connectivity features

The lateral footprint generally has sparse vegetation features that have been broken up through major developments. A major highway runs through the study area, all areas of the footprint have been meticulously chosen to minimise the environmental impact. Patches of urban native and exotic vegetation border the eastern side of the highway where the eastern extent of the footprint runs parallel with the Nein-Tien temple. This patch of vegetation provided the greatest habitat for smaller birds and had the highest abundance of fauna. The urban native and exotic vegetation community was isolated due to development bordering all sides. Previously cleared small vehicle tracks and power line easements provide another level of disturbance to which the pipeline easement follows. A high abundance of weeds throughout the study area disrupts the native vegetation understorey, a large stripe of urban native and exotic vegetation. Throughout the western extent of the study area a train line borders the footprint, minor watercourses and a dam provides adequate foraging habitat for migratory species, the watercourse run through large open grasslands with isolated patches of woodland bordering the vegetation, this vegetation provided reasonable foraging for predatory birds. No intact vegetation was discovered throughout the whole study area, no hollow-bearing trees were found, and all vegetation has a poor understorey and is isolated due to development and prior or current land use patterns, therefore the study area has been considered to have poor connectivity to its surrounds.

2.1.6 Areas of geological significance

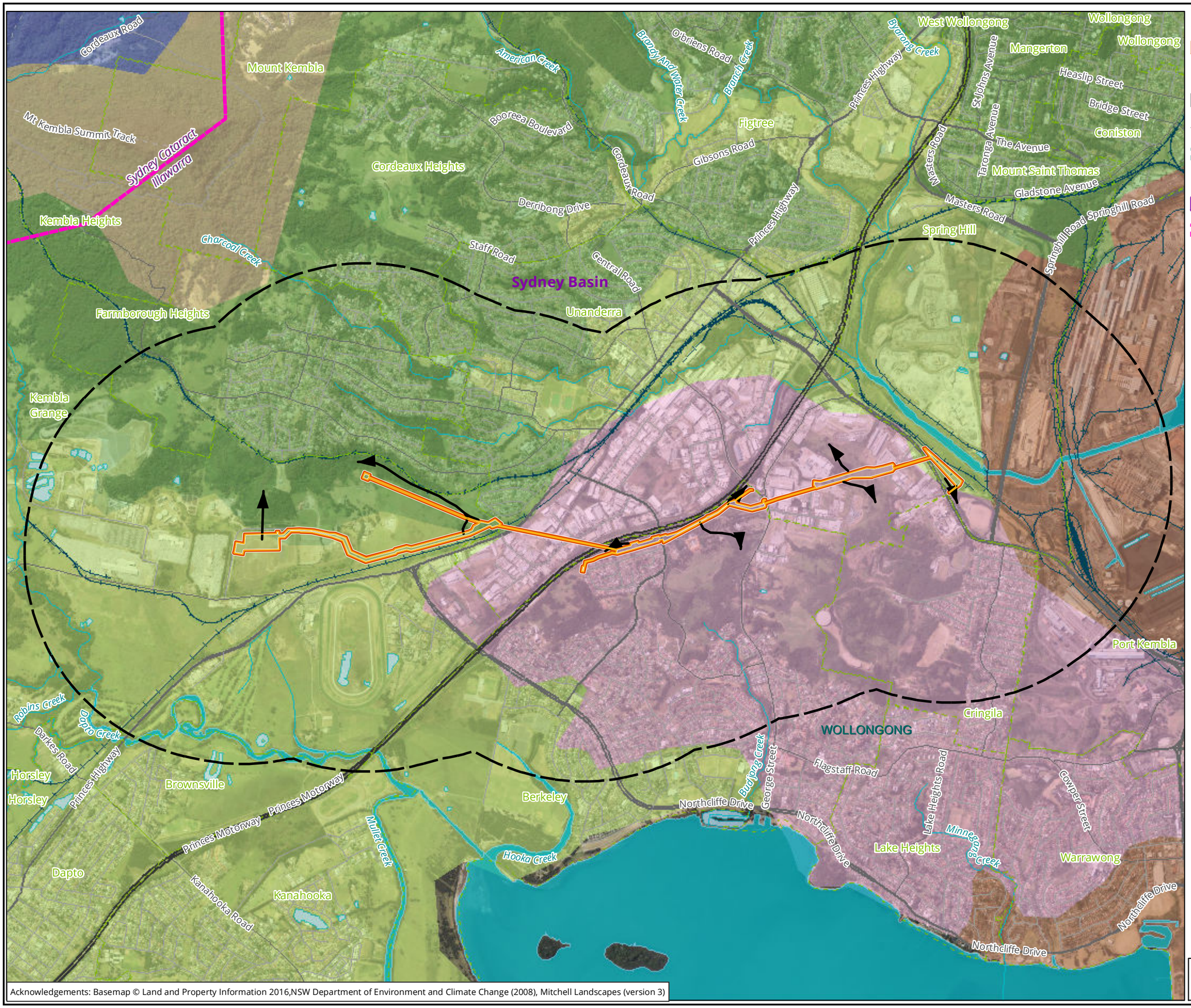
There were no recorded karst, caves, crevices, cliffs or other areas of geological significance within the study area or within the 1500 metre buffer area surrounding the study area.

2.1.7 Biodiversity Values Map

The biodiversity values mapping showed no areas of Biodiversity Values within the study area (OEH 2020a).

2.1.8 Soil hazard features

The south-west edge of the study area is mapped as class 5 acid sulfate soils, class 5 soils are considered soils with proximity to class 1-4 soils but do not trigger further assessment. Acid sulfate soils are not typically found in class 5 areas but are located within 500 metres of a higher class acid sulfate areas. As the class 5 area is unlikely to contain acid sulfate soils, no further assessment was considered necessary (Stone et. al. 1998).



Acknowledgements: Basemap © Land and Property Information 2016,NSW Department of Environment and Climate Change (2008), Mitchell Landscapes (version 3)

Legend

- Study area
- Subject land
- Subject land 1,500m buffer
- Habitat connectivity
- Local government area

IBRA

- Region
- Subregion

Hydrology

- Canal-Drain
- Natural watercourse
- Waterway

Mitchell landscapes

- Bulli Coastal Escarpment
- Dapto - Wollongong Coastal Slopes
- Kiama Coastal Slopes
- Lake Illawarra Alluvial Plains
- Lake Illawarra Barrier
- Woronora Plateau

Figure 2 Subject land

0 200 400 600 800 1,000

Metres

Scale: 1:25,000 @ A3

Coordinate System: GDA 1994 NSW Lambert

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Biosis Pty Ltd

Matter: 31485
Date: 04 March 2020,
Checked by: BD, Drawn by: LW, Last edited by: lwilson
Location:P:\31400s\31485\Mapping
31485_F2_SubjectLand

2.2 Site context

The site context was assessed using a site-based method undertaken 17 January 2020. 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 *South East Local Land Services Biometric Vegetation Map, 2014. VIS_ID 4211* (DPE 2014), and aerial imagery interpretation to ensure any areas not previously mapped as native vegetation are included in the calculations where appropriate.

Native vegetation cover within the 1500 metre buffer was found to be 22.46%.

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 small patch of connecting vegetation with a patch size less than five hectares.

Study area
Subject land
Subject land 1,500m buffer
Habitat connectivity
Native vegetation
Region
Subregion

Figure 3 Native vegetation and habitat connectivity

0 200 400 600 800 1,000
Metres
Scale: 1:25,000 @ A3
Coordinate System: GDA 1994 NSW Lambert

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Matter: 31485
Date: 01 July 2020,
Checked by: BD, Drawn by: LW, Last edited by: lwilson
Location:P:\31400s\31485\Mapping
31485_F3_VegetationAndConnectivity

3 Native vegetation

The extent of native vegetation, TECs and vegetation integrity within the study area was determined using the results of site investigations and Chapter 5 and Appendix 6 of the BAM (OEH 2017a).

3.1 Methods

3.1.1 Background review

Regional vegetation mapping ((DPE 2014) and database searches (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 biodiversity assessment was conducted 17 January 2020 under the terms of Biosis' Scientific Licence issued by NSW Environment Energy and Science (EES) under the *National Parks and Wildlife Act 1974* (SL100758, expiry date 31 March 2020). The fauna survey was conducted under approval 11/355 from the NSW Animal Care and Ethics Committee (expiry date 31 January 2020). The field investigation was carried out by Accredited Assessor Bianca Klein (BAAS # 18050) and Byron Dale.

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 South East Land Services Biometric Vegetation map (DPE 2014).
- 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 *NSW Guide to surveying Threatened Plants* (OEH 2016b).
- 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 PCTs was determined according to:

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

Detailed mapping of PCTs was conducted using hand-held (uncorrected) tablet units (Samsung Galaxy Tab 3) using Collector for ArcGIS 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 (OEH 2020b). Locations of floristic plots surveyed are shown on Figure 5.

3.2 Results

3.2.1 Vegetation description

The majority of the study area is located within an urban landscape, supporting three hectares of native vegetation, all with moderate to high levels of disturbance. Two native PCTs were identified, described further in Section 3.2.3 below.

Patches of planted native vegetation were also identified within the study area. In accordance with the *BAM Operational Manual - Stage 1* (OEH 2018), planted vegetation was assigned to an appropriate PCT, which best matches the floristic attributes and landscape position of the vegetation patch. These are also described further in Section 3.2.3 below.

Parts of the study area that were found to be devoid of native vegetation were mapped as cleared vegetation (Figure 4). These areas did not support a native over storey or mid storey cover and less than 50% of the groundcover consisted of native species.

3.2.2 Native vegetation extent

Figure 4 provides a map of the native vegetation extent recorded within the study area and impact area, as assessed during field investigations undertaken in January 2020. The figure includes all areas of native vegetation (native ground cover and areas with canopy). Areas not shown as native vegetation cover within Figure 4, and which do not provide habitat for threatened species, were not included for further assessment in accordance with Section 5.1.1.5 of the BAM (OEH 2017a). Non native vegetation which is likely to provide habitat for threatened species was assessed.

3.2.3 Plant community types

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

- PCT 781 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion (Table 2).
- PCT 838 - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion (Table 3).

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

Table 2 Vegetation type – Coastal Freshwater Wetlands

PCT 781 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	
Common name	Coastal Freshwater Wetlands
Vegetation formation	Freshwater Wetlands
Vegetation class	Coastal Freshwater Lagoons
Extent within subject	0.04 ha

PCT 781 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	
land	
Condition	This community at the subject land was recorded in a low condition state.
Description	Within the subject land this community consisted of a range of sedges, grasses and rushes occurring in low-lying depressions. No trees or shrubs were present. The most common native species were Marsh Club-rush *Boloboschoenus fluviatilis* and Tall Sedge *Carex appressa*, with Bulrush *Typha orientalis* and Couch *Cynodon dactylon* present in lower density. Blackberry *Rubus fruticosus* was present in the northern extent of the patch.
Survey effort	One BAM plot/transect (Figure 5)
Justification of PCT	The community is consistent with the descriptive attributes of PCT 781 as detailed in the NSW BioNet database(DPIE 2020) due to: • PCT occurrence within the Sydney Basin bioregion. • Floristic composition. • The range of sedges and rushes common to drainage impeded habitats. • The landscape position being, 10 metres above sea level.
TEC Status	EPBC Act: Not listed BC Act: *Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* – Endangered (DPE 2004).
Estimate of percent cleared value of PCT in NSW	74 % (OEH 2017b).
PCT 781 within the subject land	

Table 3 Vegetation type - Forest Red Gum - Thin-leaved Stringybark Grassy Woodland

PCT 838 - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	
Common name	Illawarra Lowlands Grassy Woodlands
Vegetation formation	Grassy Woodlands
Vegetation class	Coastal Valley Grassy Woodlands

PCT 838 - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	
Extent within subject land	0.33 ha
Condition	This naturally occurring community at the subject land was recorded in a low condition state.
Description	This community was present in poor condition and consisted mainly as acacia scrub with a mixed native and exotic understorey species assemblage. The vegetation lacked a distinct canopy and supported a midstorey layer up to 8 m tall of mature and regenerating Black Wattle *Acacia mearnsii*. The midstorey was sparse with exotic species including Lantana, Blackberry and African Boxthorn *Lycium ferocissimum* present. The groundcover supported a mix of native and exotic species such as Tall Sedge, Weeping Grass *Microlaena stipoides*, Kidney Weed *Dichondra repens* and Kikuyu *Cenchrus clandestinus*.
Survey effort	One BAM plot/transect (Figure 5)
Justification of PCT	The community is consistent with the descriptive attributes of PCT 838 as detailed in the NSW BioNet database (DPIE 2020) due to: • Occurrence within the Sydney Basin bioregion. • Structure of the community, being an open woodland with a predominantly grassy understorey. Although in poor condition, this community is a remnant of the community following historical clearing. • Occurrence on lower slopes in coastal rain shadow valleys within the landscape below 350 m elevation. • The study area supported clay loam soils.
TEC Status	EPBC Act: Not listed. The condition of the community within the subject land did not meet the minimum condition thresholds specified in the Conservation Advice for the EPBC listed TEC (Threatened Species Scientific Committee 2016) as: • The patch is less than 0.5 ha and • Less than 30% of total perennial understorey vegetative cover is comprised of native species. BC Act: *Illawarra lowlands grassy woodland in the Sydney Basin Bioregion* – Critically Endangered Ecological Community (NSW Threatened Species Scientific Committee 2000).
Estimate of percent cleared value of PCT in NSW	85 % (OEH 2017b).

PCT 838 - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	
PCT 838	

Planted native vegetation communities

PCT 1232 - Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion

One patch of vegetation occupying 0.19 hectares in the eastern extent of the subject land consisted of a monoculture of Swamp Oak *Casuarina glauca* planted in straight lines (Appendix 5, Plate 1) along Five Islands Road. Lantana *Lantana camara* was present in moderate density in the understorey. The species assemblage of this community resembles that of disturbed Swamp Oak Floodplain Forest EEC; however due to the planted nature of this community and its occurrence along a roadside, not within a periodically inundated landscape position, it does not meet the definition of the EEC. This patch of vegetation is not contiguous with any patches of naturally occurring native vegetation, it did not support habitat for threatened species such as hollow-bearing trees or nests, or any forage resources, and the soil profile has undergone historic disturbance. One BAM floristic plot was completed in this vegetation type (Figure 5 and Appendix 3).

PCT 1326 - Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion

One patch of vegetation occupying 0.01 hectares, immediately south of the planted PCT 1232 vegetation, in the eastern extent of the study area consisted of an isolated stand of Spotted Gum *Corymbia maculata* (Figure 4). Lantana and Bitou Bush *Chrysanthemoides monilifera* were prominent. Exotic grasses made up the majority of the groundcover. The species assemblage of this community somewhat resembles that of disturbed Illawarra Lowlands Grassy Woodland EEC, however due to the planted nature of this community and its occurrence along a roadside, not being contiguous with other patches of remnant vegetation, it does not meet the definition of this community. The vegetation supports negligible habitat for threatened species, with no hollow-bearing trees or nests present, and limited forage resources. This patch of vegetation is not proposed to be impacted.

PCT 838 - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion

A linear patch of planted native vegetation within the subject land, comprising 0.93 hectares, occurs on the fill embankment within the Princes Motorway road corridor, from adjacent to the landscaped grounds and parking area of the Fo Guang Shan Nan Tien Temple, to the rear of the residential houses on Warwick Street, Berkley. The vegetation consists of a mix of locally occurring and non-locally occurring eucalypts including Forest Red Gum *Eucalyptus tereticornis*, Spotted Gum and Lemon-scented Gum *Corymbia citriodora* (Figure 4). Sweet Pittosporum *Pittosporum undulatum*, Small-leaved Privet *Ligustrum sinense* and Chinese Celtis *Celtis sinensis* were

common in the midstorey (Plate 2). The species assemblage of this community somewhat resembles that of disturbed Illawarra Lowlands Grassy Woodland EEC, however the vegetation was replanted following the construction of the motorway and occurs on fill soil, and non-local canopy species make up a substantial portion of the community. The species assemblage and landscape position does not align with the description of the Illawarra Lowlands Grassy Woodland EEC. The vegetation supports negligible habitat for threatened species, with no hollows or nests recorded within the subject land. The vegetation is also considered to support highly limited forage resources due to its disturbed and weedy nature, and its occurrence adjacent to a major motorway. The vegetation does not support habitat for threated flora due to historical soil disturbance. One BAM floristic plot was completed in this vegetation type (Figure 5 and Appendix 3).

3.2.4 Threatened ecological communities

Vegetation within the study area was found to represent two TECs listed under the NSW BC Act. Figure 6 shows the TECs recorded within the study area as detailed in Table 2 and Table 3 above.

Acknowledgements: Basemap © Land and Property Information 2016

Legend

- Study area
- Subject land
- Kilometre point
- Floristic plot (20x50m)

Hydrology

- Natural watercourse

Strahler stream order

- 1
- 2
- 3
- 5

Strahler order buffered areas

- 1
- 2
- 3
- 5

Plant Community Type (PCT)

- PCT1232 - Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion (planted)
- PCT1326 - Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion (planted)

Figure 4.1 Vegetation of the study area

0 40 80 120 160 200

Metres
Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert

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Matter: 31485
Date: 08 July 2020,
Checked by: BD, Drawn by: LW, Last edited by: lwilson
Location:P:\31400s\31485\Mapping
31485_F4_Vegetation

Legend

- Study area
- Subject land
- Kilometre point
- Floristic plot (20x50m)
- Hollow-bearing tree

Hydrology

- Canal-Drain

Strahler stream order

- 1
- 2
- 3

Strahler order buffered areas

- 1
- 2
- 3

Plant Community Type (PCT)

- PCT1232 - Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion (planted)
- PCT 838 - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion (planted)

Figure 4.2 Vegetation of the study area

0 40 80 120 160 200

Metres

Scale: 1:4,000 @ A3

Coordinate System: GDA 1994 NSW Lambert

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Date: 08 July 2020,
Checked by: BD, Drawn by: LW, Last edited by: lwilson
Location:P:\31400s\31485\Mapping
31485_F4_Vegetation

Legend

- Study area
- Subject land
- Kilometre point
- Floristic plot (20x50m)

Strahler stream order

- 1

Strahler order buffered areas

- 1

Plant Community Type (PCT)

- PCT1232 - Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion (planted)
- PCT 781 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion
- PCT 838 - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion

Figure 4.3 Vegetation of the study area

0 40 80 120 160 200

Metres

Scale: 1:4,000 @ A3

Coordinate System: GDA 1994 NSW Lambert

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Date: 08 July 2020.
Checked by: BD, Drawn by: LW, Last edited by: lwilson
Location:P:\31400s\31485\Mapping
31485_F4_Vegetation

Legend

- Study area
- Subject land
- Kilometre point
- Floristic plot (20x50m)

Strahler stream order

- 1
- 2

Strahler order buffered areas

- 1
- 2

Plant Community Type (PCT)

- PCT 781 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion
- PCT 838 - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion

Figure 4.4 Vegetation of the study area

0 40 80 120 160 200

Metres
Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert

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Matter: 31485
Date: 08 July 2020,
Checked by: BD, Drawn by: LW, Last edited by: lwilson
Location:P:\31400s\31485\Mapping
31485_F4_Vegetation

3.3 Vegetation integrity assessment

3.3.1 Vegetation zones

PCTs within the subject land were assessed and stratified, based on broad condition state, into vegetation zones. This resulted in four vegetation zones identified within the impact area, two of which consist of non-naturally occurring planted native vegetation communities. 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
VZ1	PCT 781	Low	0.04	One
VZ2	PCT 838	Low	0.33	One
VZ3	PCT 838	Planted	0.93	One
VZ4	PCT 1232	Planted	0.19	One

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 4 of the BAM (OEH 2017a). A total of four BAM plots were completed within the impact area. 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, in accordance with Biosis licence requirements. These species have been included in Appendix 2.

3.3.3 Vegetation integrity score

Plot data were entered into the BAM calculator to determine vegetation integrity scores. Plot data are presented in Appendix 2. Vegetation integrity scores for the vegetation zones are provided in Table 5. Impacts within all vegetation zones trigger the requirement for offsets. Impacts to PCT 781 Coastal Freshwater Wetlands are proposed to occur over a short timeframe; given the ground disturbance during the installation of the pipeline, after which the land will be rehabilitated to allow for natural regeneration of the wetland. Thus, total clearance of the vegetation has not been assumed for this vegetation community. The vegetation composition and structure scores were reduced in the BAM Calculator by an amount reasonably representative of the proposed impacts and rehabilitation of the disturbed vegetation. This included a reduced species richness and cover of shrubs and grass and grass-like plants following completion of the project.

Table 5 Vegetation zone integrity scores

PCT (No)	Vegetation zone	Composition condition score	Structure condition score	Function condition score	Vegetation integrity score	Future vegetation integrity score	Offset required
781	VZ1	62	88.9	-	**74.2**	42.5	Yes
838	VZ2	5	50.1	39.8	**21.5**	0	Yes
838	VZ3	13	43.8	74.7	**34.9**	0	Yes
1232	VZ4	11.2	22.5	29.8	**19.6**	0	Yes

Legend

- Study area
- Subject land
- Floristic plot (20x50m)

Figure 5.1 Vegetation zones and survey effort

0 40 80 120 160 200

Metres
Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert

N

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Matter: 31485
Date: 06 March 2020,
Checked by: BD, Drawn by: LW, Last edited by: jshepherd
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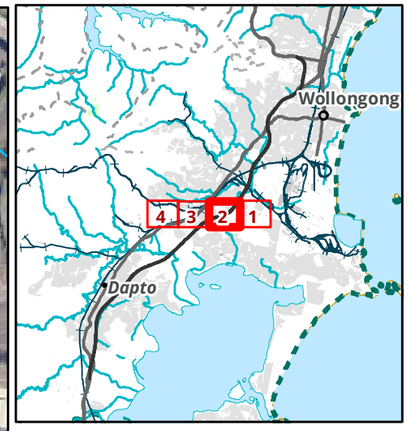
31485_F5_SurveyEffort



Legend

- Study area
- Subject land
- Floristic plot (20x50m)

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Figure 5.2 Vegetation zones and survey effort

0 40 80 120 160 200

Metres
Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert

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Matter: 31485
Date: 06 March 2020,
Checked by: BD, Drawn by: LW, Last edited by: jshepherd
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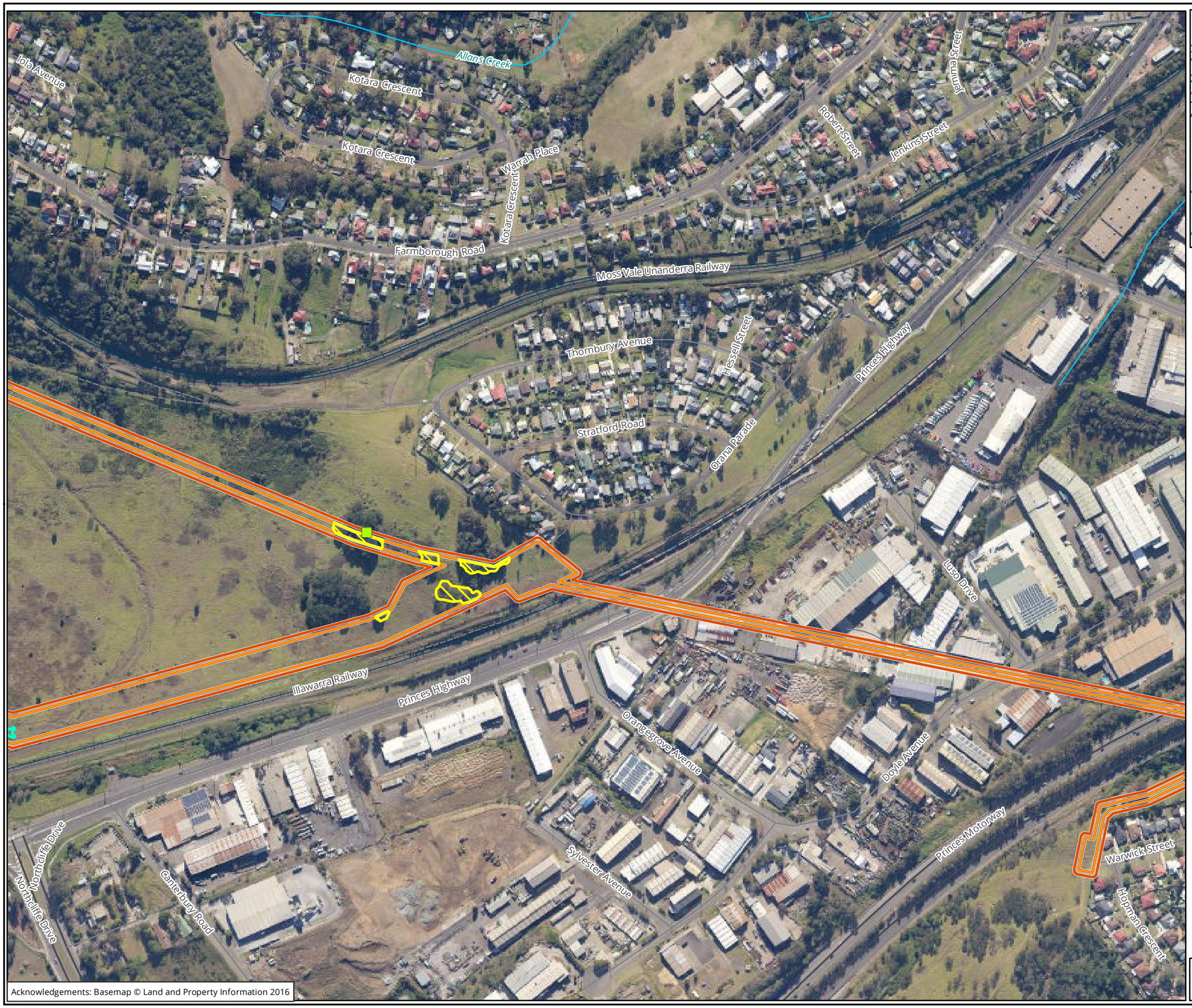
31485_F5_SurveyEffort



Acknowledgements: Basemap © Land and Property Information 2016

Legend

- Study area
- Subject land
- Floristic plot (20x50m)

Vegetation Zone (VZ)

- VZ1
- VZ2

Figure 5.3 Vegetation zones and survey effort

0 40 80 120 160 200

Metres
Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert

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Matter: 31485
Date: 06 March 2020,
Checked by: BD, Drawn by: LW, Last edited by: jshepherd
Location:P:\31400s\31485\Mapping
31485_F5_SurveyEffort

Legend

- Study area
- Subject land
- Floristic plot (20x50m)

Vegetation Zone (VZ)

- VZ1
- VZ2

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Figure 5.4 Vegetation zones and survey effort

0 40 80 120 160 200

Metres

Scale: 1:4,000 @ A3

Coordinate System: GDA 1994 NSW Lambert

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N

Matter: 31485
Date: 06 March 2020,
Checked by: BD, Drawn by: LW, Last edited by: jshepherd
Location:P:\31400s\31485\Mapping
31485_F5_SurveyEffort

Legend

- Study area
- Subject land
- Kilometre point

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Figure 6.1 TECs within the study area

0 40 80 120 160 200

Metres
Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert

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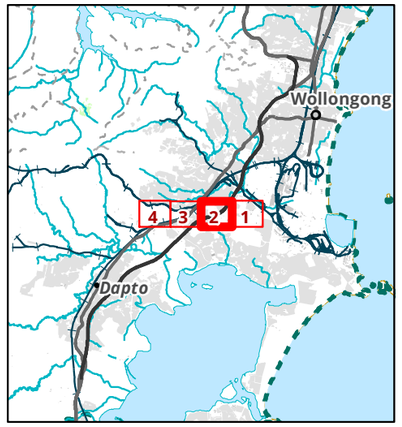
Matter: 31485
Date: 27 February 2020,
Checked by: BD, Drawn by: LW, Last edited by: lwilson
Location:P:\31400s\31485\Mapping
31485_F6_TECs



Legend

- Study area
- Subject land
- Kilometre point

Figure 6.2 TECs within the study area

0 40 80 120 160 200

Metres
Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert

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Matter: 31485
Date: 27 February 2020,
Checked by: BD, Drawn by: LW, Last edited by: lwilson
Location:P:\31400s\31485\Mapping
31485_F6_TECs

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Legend

- Study area
- Subject land
- Kilometre point

Threatened Ecological Community (TEC)

- Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered Ecological Community, BC Act)
- Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion' (Critically Endangered EPBC Act, Endangered Ecological Community, BC Act)

Figure 6.3 TECs within the study area

0 40 80 120 160 200

Metres
Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert

Biosis Pty Ltd

Matter: 31485
Date: 27 February 2020,
Checked by: BD, Drawn by: LW, Last edited by: lwilson
Location:P:\31400s\31485\Mapping
31485_F6_TECs

Legend

- Study area
- Subject land
- Kilometre point

Threatened Ecological Community (TEC)

- Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered Ecological Community, BC Act)
- Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion' (Critically Endangered EPBC Act, Endangered Ecological Community, BC Act)

Figure 6.4 TECs within the study area

0 40 80 120 160 200

Metres

Scale: 1:4,000 @ A3

Coordinate System: GDA 1994 NSW Lambert

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Matter: 31485
Date: 27 February 2020,
Checked by: BD, Drawn by: LW, Last edited by: lwilson
Location:P:\31400s\31485\Mapping
31485_F6_TECs

4 Threatened species

4.1 Predicted species

A list of predicted species (ecosystem credit species) expected to occur within the subject land was refined as per Section 6 of the BAM. Impacts to these species require assessment, however a targeted survey is not required as these species are assumed to occur, based on the occurrence of the PCTs and patch sizes. Table 6 lists the ecosystem credit species predicted to occur in the study area.

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. Species with geographical or habitat restrictions not matching that within the subject land were not required to be surveyed. Targeted searches were undertaken for remaining species.

In addition to predicted species, species previously recorded within a 5 kilometre radius of the study area were also reviewed. Predicted species and those previously recorded were considered with respect to their habitat requirements and potential to be impacted by the proposal. These assessments are included Appendix 2.

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

Species name	Common name
Anthochaera phrygia	Regent Honeyeater
Artamus cyanopterus cyanopterus	Dusky Woodswallow
Botaurus poiciloptilus	Australasian Bittern
Calidris ferruginea	Curlew Sandpiper
Callocephalon fimbriatum	Gang-gang Cockatoo
Calyptorhynchus lathami	Glossy Black-Cockatoo
Circus assimilis	Spotted Harrier
Dasyurus maculatus	Spotted-tailed Quoll
Ephippiorhynchus asiaticus	Black-necked Stork
Epthianura albifrons	White-fronted Chat
Glossopsitta pusilla	Little Lorikeet
Haliaeetus leucogaster	White-bellied Sea-Eagle
Hieraaetus morphnoides	Little Eagle
Irediparra gallinacea	Comb-crested Jacana
Ixobrychus flavicollis	Black Bittern
Lathamus discolor	Swift Parrot
Limicola falcinellus	Broad-billed Sandpiper
Limosa limosa	Black-tailed Godwit

Species name	Common name
Lophoictinia isura	Square-tailed Kite
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat
Miniopterus orianae oceanensis	Large Bent-winged Bat
Miniopterus australis	Little Bent-winged Bat
Neophema pulchella	Turquoise Parrot
Oxyura australis	Blue-billed Duck
Pandion cristatus	Eastern Osprey
Petroica boodang	Scarlet Robin
Petroica phoenicea	Flame Robin
Phascolarctos cinereus	Koala
Pteropus poliocephalus	Grey-headed Flying-fox
Rostratula australis	Australian Painted Snipe
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat
Stictonetta naevosa	Freckled Duck
Tyto novaehollandiae	Masked Owl
Xenus cinereus	Terek Sandpiper

Planted vegetation present within the subject land, adjacent to Five Islands Road and the Princes Motorway is not considered to support habitat for the above threatened species. Both patches are subject to historical and ongoing disturbance and are considered highly unlikely to provide regular resources to locally occurring threatened species, including blossom resources for nectivourous species.

4.2 Species credit species

Appendix 2 provides the lists of species credit species that are predicted to occur within the subject land based on the presence of the PCTs within a patch size of less than five 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. Species with geographical or habitat restrictions not matching that within the subject land were not required to be surveyed. An assessment of the habitats present within the subject land and study area, potential occurrence, and potential for impact, for all species credit species is provided in Appendix 2. It should be noted that the two patches of planted native vegetation within the subject land were subject to the assessment of habitat suitability for threatened species.

After detailed habitat assessments were undertaken, only a single species required assessment. One species credit fauna species, Green and Golden Bell Frog *Litoria aurea* (Endangered BC Act, Vulnerable EPBC Act), was assessed as having a moderate likelihood of occurrence within the subject land. Areas mapped as PCT 781 Coastal Freshwater Wetalnds were considered potential Green and Golden Bell Frog habitat, however following targeted surveys not detecting this species, breeding habitat was considered to be absent.

Three species credit flora species were was assessed as having a moderate likelihood of occurrence within the subject land; Square Raspwort *Haloragis exalata* subsp. *exalata* (Vulnerable, BC Act and EPBC Act), *Lespedeza juncea* subsp. *sericea* (endangered population, BC Act) and Illawarra Zieria *Zieria granulata* (Endangered, BC Act and EPBC Act).

Targeted surveys were undertaken and did not record these species (Section 4.3).

4.3 Threatened species surveys

4.3.1 Fauna habitat assessment and field investigation

Fauna habitat assessments were undertaken to determine whether the vegetation to be impacted by the proposed development contained microhabitats suitable to support threatened fauna species predicted ot occur within the study area. The habitat assessments focussed on the presence of the following features within the study area:

- Hollow-bearing trees.
- Large rock outcrops.
- Buildings, culverts or infrastructure for microbat roosting.
- Availability of flowering shrubs and feed tree species.
- Condition of native vegetation and the presence of exotic species.
- Condition of pools, watercourses and waterbodies.
- Quantity and type of ground litter and logs.
- Searches for indirect evidence of fauna.
- Evidence of previous and ongoing disturbance.

Following habitat assessments, a single species credit species, the Green and Golden Bell Frog was considered to potentially breed in PCT 781 Freshwater Coastal Wetlands within the subject land. Due to the absence or degraded nature of suitable habitat no other species were considered to be found within the subject land. Further information is provided below in 4.3.2 and Appendix 2.

4.3.2 Targeted Surveys

Targeted flora and fauna surveys were undertaken on 17 January 2020 for the species listed in as candidates in Appendix 2. Targeted surveys for the Green and Golden Bell Frog of the study area were undertaken 3 February – 7 February 2020. Weather observations for each survey date are shown in Table 7. Surveys were undertaken in accordance with Department of Environment and Climate Change (DECC 2008).

The subject land supports one ephemeral dam, and a drainage line with small ephemeral ponds.

The ephemeral dam found in the Wollongong Lawn Cemetery located in the western extent of the study area was surveyed as part of the targeted surveys. The dam supported moderate breeding habitat for the Green and Golden Bell Frog with little water and dense Cumbungi *Typha orientalis.* The dam was isolated from watercourses and had poor connectivity to its surrounds. No rocky areas or partially covered areas to provide refuge habitat were found within the dam and it was surrounded by fringing emergent vegetation predominately made up of long Kikuyu grass *Cenchrus clandestinus*.

The drainage swale with small ephemeral ponds found in the western extent to the east of the Wollongong Lawn Cemetery towards the Princes highway provided potential breeding habitat for the Green and Golden

Bell Frog. The drainage swale contained Coastal Freshwater Wetland vegetation that was partially dry at the time of survey. The drainage swale runs east, through multiple waterbodies and watercourses that are linked to Mullet Creek. Due to the connectivity and partially open habitat, the Coastal Freshwater Wetland provided moderate breeding habitat for the species.

The targeted surveys consisted of four consecutive nights following rainfall, the targeted surveys comprised of 5 minutes of call playback followed by a 10 minute listening period, and the survey site was finished by an active 15 minute survey. The targeted surveys were undertaken at each potential site.

Table 7 Weather observations during flora and fauna surveys (Albion Park, NSW)

Survey undertaken	Survey date	Temperature (°C)		Rain (mm)
		Min.	Max.	
Threatened flora survey	17/01/2020	18.7	22.9	17.8
Green and Golden Bell Frog survey	3/02/2020	21.5	33.6	10.4
	4/02/2020	15.0	23.0	0
	5/02/2020	15.6	25.7	0
	6/02/2020	19.1	25.3	2.6

Information from the Australia Government Bureau of Meteorology website.

No Green and Golden Bell Frogs were recorded within the study area, however one dam and the Coastal Freshwater Wetlands are considered to provide potential dispersal habitat for the species, providing areas of connectivity and do not restrict movement of the species.

4.3.3 Flora habitat assessment and field investigation

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. Threatened flora habitat within the impact area consisted of disjunct and isolated patches of low condition Illawarra Lowlands Grassy Woodland (PCT 838).

Three species assessed to have a moderate likelihood of occurring within the subject land are known to tolerate disturbed environments, including the condition of the vegetation within the subject land described in Table 2. Targeted surveys were undertaken for Square Raspwort, *Lespedeza juncea* subsp. *sericea* and Illawarra Zieria. These species were thoroughly searched for using targeted meanders in areas of potential habitat. Due to the small patch sizes, 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.

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

Stage 2 – Impact assessment (biodiversity values)

5 Avoid and minimise impacts

This section identifies the potential impacts of the proposal on the biodiversity values of the study area and subject land, and includes measures taken. 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.

5.1 Actions to avoid/minimise project impacts

The principle 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.

5.1.1 Site selection and planning

The pipeline alignment has been selected, in-part, to minimise impacts to all associated biodiversity values and allow for the proposed linear development to tie into the EGP facility, and the yet to be built proposed Cringila tie-in facility. The location of the HDD has been re aligned to minimise disturbance to PCT 838 and other areas of native vegetation wherever possible. The purpose of HDD is to under bore the Princes Highway and urban development. The proposed pipeline alignment will predominantly follow the route of the existing Port Kembla lateral, which was constructed approximately 15 years ago. Since its installation, industrial development as occurred along the existing alignment, limiting the potential of the proposed pipeline to completely follow the existing easement. Therefore, this has further constrained the possible locations of the proposed HDD entry and exit points. As such, impacts to PCT 838 (and low condition Illawarra Lowlands Grassy Woodlands TEC) are unavoidable on the northern side of Princes Highway, and the Illawarra Railway. Where impacts to vegetation are unavoidable, Jemena propose to keep the disturbance footprint required to facilitate underboring works to an absolute minimum. The open trenching alignment utilises as much urban native and exotic vegetation as possible and allows for the alignment with existing services corridors.

Due to the scale and linear nature of the project, complete avoidance of impacts to threatened species and TECs was not possible. The project will likely impact on:

- 0.33 hectares of low condition Illawarra Lowlands Grassy Woodland (CEEC, BC Act).
- 0.04 hectares of low condition Coastal Freshwater Wetlands (EEC, BC Act).

The disturbance footprint of the project occurs on a variety of different vegetation communities. An area of 0.33 hectares of low condition Illawarra Lowlands Grassy Woodlands (PCT 838) will be removed for open trenching due to the required HDD within the public lands northeast of the Wollongong Lawn Cemetery.

An area of 0.04 hectares of low condition Coastal Freshwater Wetlands (PCT 781) was unable to be avoided and will be partly open trenched for the pipeline. The open trenching requires a 20 metre footprint to allow for; machinery, excavation and open trenching.

5.1.2 Construction

Direct and indirect impacts to biodiversity values retained within the subject land and adjoining the subject land may occur if adequate mitigation and management measures are not in place during construction of the proposed development.

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

- Installation of appropriate exclusion fencing around trees and vegetation to be retained in the study area. This would include appropriate signage such as 'No Go Zone' or 'Environmental Protection Area'.
    - The radius of the tree protection zone (TPZ) is calculated for each tree by multiplying its diameter at breast height (DBH) by 12. (*TPZ = DBH x 12*) in accordance with the Standards Australia Committee (2009).
    - A TPZ should not be less than 2 metres nor greater than 15 metres, except where crown protection is required (Commonwealth of Australia 2009).
- All material stockpiles, vehicle parking and machinery storage will be located within cleared areas proposed for clearing, and not in areas of native vegetation that are to be retained.
- Any habitat trees inclusive of large nesting material to be removed is inspected prior to clearing by an appropriately qualified ecologist to avoid and minimise the potential for injuries to fauna that may be occupying hollows.
    - Habitat trees with nests require a pre-clearance assessment 24 hours prior to felling.
- 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.
- Sedimentation and erosion control measures including silt fencing, sediment traps, etc. to prevent sediment-laden stormwater exiting the construction areas and to prevent scouring and erosion of land beyond the development footprint. All erosion and sediment control measures are to be constructed and installed in accordance with relevant guidelines, are to be regularly maintained for the duration of the construction period and are to be carefully removed at completion of works.
    - Implementation of temporary stormwater controls during construction and to ensure that discharges to the drainage channels are consistent with existing conditions.
- Weed and pathogen management including weed hygiene protocols for personnel, machinery and construction materials entering and exiting construction areas to minimise risk of weed and pathogen introduction and spread.
- Waste management to ensure food scraps and other organic waste that may attract introduced predators (e.g. fox, cats) or other pests (e.g. rats) is not stored for prolonged periods within the construction site.
- If bush rock or boulders are encountered during site preparation, these should be moved into adjacent habitats within the study area, and should not be removed from the site.

5.1.3 Operation

The following recommendations are made to mitigate impacts resulting from 'operation' of the proposed development:

- Install appropriate fencing to ensure no access to areas of vegetation outside of the subject land.
- Stormwater controls should direct all water flowing from the subject land away from surrounding vegetation.
- On-going treatment of exotic species from within retained vegetation should be undertaken to assist resilience and vegetation quality.
    - The EGP Operations Environment Management Plan (OEMP) (OEMP Plan GTS-500-PA-EV-003) will be amended to include the Port Kembla Looping Lateral. The EGP Pest and Weed Management Plan (GTS-500-PA-EV-003) forms part of the OEMP, and will also be reviewed and updated to include Port Kembla Looping Lateral.
- Revegetation of areas proposed to be temporarily impacted by the project is recommended. Only native grass and shrub species naturally associated with the impacted PCT are to be planted.
- Restrict slashing of PCT 781 that occurs within the subject land avoiding additional slashing to surrounding native vegetation.

6 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 development.

6.1 Direct impacts to flora and fauna

Direct impacts arising from the project include:

- Removal of 0.33 hectares of low condition Illawarra Lowlands Grassy Woodlands (PCT 838).
- Partial removal of 0.04 hectares of low condition Freshwater Coastal Wetlands (PCT 781).
- Removal of 1.1 hectares planted native vegetation.

These impacts will be permanent and will occur from the outset of the project. Mitigation measures outlined in Section 5 above will help to minimise the potential impacts to biodiversity values that remain present within the study area.

6.2 Indirect impacts

Potential indirect impacts arising from the project are outlined and addressed in Table 8 below.

Table 8 Assessment of indirect impacts

Indirect impact	Assessment / likelihood of occurrence
Inadvertent impacts on adjacent habitat or vegetation.	All contractors will be inducted and notified about the sensitivity of the adjacent vegetation (see Section 5.1 above).
Reduced viability of adjacent habitat due to edge effects.	The native wetland patches are quite susceptible to weed encroachment. Areas of native vegetation adjacent to areas of removal will be prepared with the mitigation measures provided in Section 5.1 to reduce the potential for this impact.
Reduced viability of adjacent habitat due to noise or dust spill.	Noise impacts from increased traffic shall be minimised through the use of low speed limits, and exempt hours of construction works. Increased levels of dust could be expected to result during the construction phase of the development. Dust suppression should be undertaken during all construction phases and all stockpiles should be covered at all times. Measures to reduce the potential for these impacts are provided in Section 5.1.
Loss of breeding habitats.	The removal of native trees, including hollow-bearing trees, and shrubs from the subject land could remove potential nest sites for bird species. Measures to mitigate potential impacts to native fauna species are provided in Section 5.1.
Transport of weeds and pathogens from the site to adjacent vegetation.	Site access points during construction should be restricted to single gates if feasible to minimise the transportation of weeds throughout the site. Mitigation measures are provided in Section5.1 and include directing

Indirect impact	Assessment / likelihood of occurrence
	surface water away from surrounding native vegetation and watercourses. Measures outlined in the EGP Pest and Weed Management Plan (GTS-500-PA-EV-003) will be implemented during construction and operation stages of the pipeline, minimising the spread and potential facilitation of pest animal movement along the pipeline corridor. It is also recommended that measures are undertaken for the control of pest fauna species including Wild Rabbit *Oryctolagus cuniculus* and European Fox *Vulpes vulpes* in accordance with the *South East Regional Strategic Pest Animal Plan 2018-2023* (South East Local Land Services 2018).
Rubbish dumping.	The project will result in an increased risk of rubbish dumping during the construction and operation phases. All contractors are to dispose of waste appropriately. Given the type of development proposed and part of the subject lands residing on public land, rubbish dumping is more likely to occur, fencing and appropriate rubbish dedicated areas are to be implemented on site within the study area.
Fragmentation of movement corridors.	The project is not likely to fragment existing habitat connectivity for mobile species, however fragmentation of less mobile fauna species may occur. Mitigation actions to limit habitat fragmentation are provided in Section 5.1.

6.3 Prescribed impacts

Assessment of prescribed biodiversity impacts are outlined and addressed in Table 9 below.

Table 9 Assessment of prescribed impacts

Prescribed impact	Assessment / likelihood of occurrence
Impacts of development on the habitat of threatened species or ecological communities associated with karst, caves, crevices, cliffs and other features of geological significance.	The proposal will not result in this impact. There is no habitat associated with karst, caves, crevices, cliffs or other features of geological significance to be affected.
Impacts of development on the habitat of threatened species or ecological communities associated with rocks.	There were no threatened species or ecological communities recorded within the subject land that are strictly associated with rock.
Impacts of development on the habitat of threatened species or ecological communities associated with human made structures.	The proposal will not result in this impact. There are no human made structures within the subject land or adjacent to the subject land that could be affected by the proposal.
Impacts of development on the habitat of threatened species associated with non-native vegetation.	No threatened species habitat was associated with non-native vegetation.
Impacts of development on the connectivity of different areas of habitat of threatened	The proposal will not result in this impact. There are no habitats that facilitate movement of a species across its range within the subject

Prescribed impact	Assessment / likelihood of occurrence
species that facilitates the movement of those species across their range.	land.
Impacts of the development on movement of threatened species that maintains their life cycle	The proposal will not result in this impact. The subject land does not represent an area that would interrupt movement of species.
Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including subsidence or upsidence resulting from underground mining or other development)	The project footprint inhibits a small watercourse that provides water to a small dam outside of the footprint. The project will also be removing Coastal Freshwater Wetland vegetation (PCT 781). The dam doesn't sit in within the footprint but has been subject to assessment due to its potential to provide dispersal and basking habitat for Green and Golden Bell frog. The Coastal Freshwater Wetland is considered potential Green and Golden Bell Frog habitat. Targeted surveys were completed and no Green and Golden Bell frogs were recorded.
Impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC	The proposal has the potential to increase the frequency of vehicle strikes to fauna in the area; however, the design of low vehicle speeds, dedicated vehicle tracks and worker awareness will reduce the likelihood of vehicle strike.

6.4 Impacts to groundwater dependent ecosystems

The subject land does not contain any groundwater dependent ecosystems (GDEs), including aquatic, terrestrial and subterranean ecosystems as mapped in the *GDE Atlas* (BOM 2019). The study area measures to reduce any potential indirect impacts to the mapped watercourses inclusive of stormwater and runoff controls during construction and operation of the development (see Section 5.1).

6.5 Adaptive management strategy

The proposed development 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.

7 Impact summary

7.1 Thresholds for assessment and offsetting

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

7.1.1 Serious and irreversible impacts

As of 27 April 2020, *Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion* was newly listed as an entity at risk of serious and irreversible impacts (SAII) in accordance with Section 10 of the BAM:

Section 10.2 of the BAM requires the BDAR to assess whether the proposed development will result in a SAII to any candidate listed TEC or species.

Illawarra Lowlands Grassy Woodland EEC

The Illawarra Lowlands Grassy Woodland EEC (PCT 838) is listed under NSW legislation as Endangered. The EEC is listed in the BioNet Threatened Biodiversity Data Collection as a SAII in NSW. Given the absence of definitive impact thresholds stated for the community, the potential for a SAII will be determined by the consent authority, guided by the additional assessment regarding this EEC in Table 10.

A total of 0.5 hectares of Illawarra Lowlands Grassy Woodland EEC is present within the study area, 0.33 hectares of which will be impacted. The community exists in poor condition, lacking characteristic canopy species, and the mid-storey being made up of disturbance tolerant, coloniser acacia species.

Table 10 Assessment of SAII for Illawarra Lowlands Grassy Woodland EEC

Information required (BAM Section 10.2.2)	Response
a. the action and measures taken to avoid the direct and indirect impact on the potential entity for a SAII.	Measures undertaken by the proponent to avoid and minimise impact to the EEC (PCT 838) are provided in Section 5.1 above. The development design has been sited to avoid 33% of the mapped PCT 838 vegetation within the study area. Unavoidable impacts following all measures to avoid and minimise impacts will result in the removal of 0.33 ha of EEC vegetation in low condition.
b. the area (ha) and condition of the threatened ecological community (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.	Direct removal of 0.33 ha of low condition PCT 838 (VI score of 21.5). The 0.33 ha of the EEC that will be impacted exists in low condition, with high levels of weed cover and a depauperate understorey and ground layer. The EEC occurs only in VZ2. Of note is that the condition of the EEC within the study area is poor and does not meet minimum condition thresholds of the corresponding EPBC Act listed community based on its isolated nature, small patch size and depauperate groundcover species assemblage.
c. a description of the extent to which the impact exceeds the threshold for the potential entity that is specified in the Guideline for determining an SAII.	No threshold for impacts to Illawarra Lowlands Grassy Woodland EEC have been published to date.
d. the extent and overall condition of the potential TEC within an area of 1000ha,	According to *Southeast NSW Native Vegetation Classification and Mapping - SCIVI. VIS_ID 2230* (OEH 2011), 41.68 ha of the EEC is present within the 1000

Information required (BAM Section 10.2.2)	Response
and then 10,000ha, surrounding the proposed development footprint.	ha area surrounding the study area. This was calculated using GIS methods, filtering the SCIVI mapping database to only include 'Illawarra Lowlands Grassy Woodland' 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 EEC. Within a 10,000 ha area, the community comprises approximately 438.46 ha. The overall condition across all areas is expected to be varied due to the majority occurring on privately owned land. Large areas of the EEC have been cleared, with most remnants existing as small, fragmented patches (NSW Threatened Species Scientific Committee 2000). In 2002, NSW National Parks and Wildlife Service completed a review of the EEC and found that approximately 5% of the vegetation comprising the EEC was considered to have demonstrated only 'light' levels of disturbance, 31% 'moderate' and 22% 'heavy', with 43% present only as scattered trees (NPWS 2002). The EEC proposed for impact is considered to demonstrate heavy levels of disturbance based on the absence of canopy trees. Ongoing threats to the EEC include further clearing, weed invasion and grazing.
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 EEC extant in the subregion is 2,939 ha (OEH 2011). This was calculated by filtering for the EEC within the spatial coverage of the SCIVI mapping database. The proposed development will result in the removal of 0.33 ha of poor condition EEC vegetation, equating to 0.01% of the EEC in the subregion. The small scale of poor condition EEC proposed for impacted is not likely to significantly alter the extent and overall condition of the EEC remaining in the IBRA subregion.
f. an estimate of the area of the candidate TEC that is in the reserve system within the IBRA region and the IBRA subregion	The majority of the remaining areas of EEC is present on private land. Approximately 275 ha is present in reserves including the following: Morton National Park, Illawarra Escarpment State Conservation Area, Yatteyattah Nature Reserve, Macquarie Pass National Park, Conjola National Park, Eurobodalla National Park and Murramarang National Park. The condition of the ecological community in these reserves is not known (Threatened Species Scientific Committee 2016). Over 70% of the remaining extent of the ecological community occurs in the Illawarra subregion; approximately 16% is in the Jervis subregion, with small amounts in each of Ettrema and Bateman subregions (NPWS 2002). The majority of the areas of extant EEC occur as isolated patches on private property within the Illawarra region (NSW Threatened Species Scientific Committee 2000). To determine an estimated area of EEC 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 838 and PCT 1326 vegetation. The aim of compiling these datasets was to capture as much of the area within the IBRA region as possible; 84% coverage was obtained using this method. Mapped areas of the EEC within reserve systems amount to 432.1 ha (OEH

Information required (BAM Section 10.2.2)	Response
	2011) which represents 14.7% of the EEC within the subregion. Mapped areas of the EEC in reserves within the Illawarra IBRA subregion amount to 79.7 ha.
g. the development, clearing or biodiversity certification proposal's impact on: • 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. • 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 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.	• The proposal is not expected to result in negative affects to abiotic factors critical to the long term survival of the EEC (see Section 5.1). Flow patterns of water into surrounding habitats will be maintained or re-instated and any runoff from the proposed development will be managed appropriately and detailed in the site management plans. • An area of 0.33 ha of low condition EEC is proposed to be cleared to facilitate the construction and operation of the gas pipeline. The midstorey is predominantly comprised of Lantana, and the groundcover comprised of a mix of common native and exotic species, not constituting functionally important species. As such, clearance of 0.33 ha of poor condition EEC vegetation will not impact on functionally important species of the EEC. • The low condition EEC proposed for removal does not support characteristic and functionally important species of the community. The proposed installation of a pipeline within poor condition EEC vegetation is unlikely to alter fire/flooding regimes or increase the harvesting of plants of retained EEC vegetation in the long term. Following installation of the pipeline via open trenching, the top soil will be re-instated and rehabilitated with characteristic native groundcover species. • Implementation of the project's OEMP as well as the project's Pest and Weed Management Plan will ensure that the presence of invasive flora and fauna species is not exacerbated within the retained EEC vegetation as a result of the project.
h. direct or indirect fragmentation and isolation of an important area of the potential TEC.	The EEC currently exists as a highly fragmented patch, subject to disturbances including weed infestation. Therefore the patch is not considered to be an important area of the EEC, overall. The proposal will slightly increase fragmentation through the removal of acacia scrub and groundcover species. Representative groundcover species will be re-planted to rehabilitate the area following pipeline installation.
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 EEC to be retained within the study area and immediate surrounds, through the ongoing management of pests and weeds by a qualified contractor. The project's Pest and Weed Management Plan will specify measures to be implemented.

7.2 Impacts requiring offsets

7.2.1 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 development on PCTs that are associated with vegetation integrity scores of:

- *≥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.*

Planted vegetation present within the subject land, adjacent to Five Islands Road and the Princes Motorway is not considered to support habitat for threatened species. Both patches are subject to historical and ongoing disturbance and are considered highly unlikely to provide regular resources to locally occurring threatened species, including blossom resources for foraging nectivourous species. Furthermore, historical disturbance to the soil profile has resulted in a lack of habitat for threatened flora. The patches of vegetation do not represent naturally occurring native vegetation communities, nor are they contiguous with areas of naturally occurring native vegetation. However as requested by DPIE, the planted native communities have been included in the credit assessment and an offset is required (DPIE 2020)

On this basis, offsets are required for VZ1 and VZ2, as they have vegetation integrity scores greater than 15 and consist of naturally occurring PCTs (Table 11).

The offset requirement for the proposal was calculated using the BAM Calculator. Table 11 provides a summary of the ecosystem credit offsets required for impacts from proposed development at the subject land.

Table 11 Offsets required for the proposed development (ecosystem credits)

Vegetation zone	Vegetation	Area (ha)	Impact	Vegetation integrity score	Offset required?	Credit requirement
VZ1	PCT 781 - Low	0.04	Clearance	34.2	Yes	1
VZ2	PCT 838 - Low	0.33	Clearance	21.5	Yes	4
VZ3	PCT 838 - Planted	0.93	Clearance	34.9	Yes	16
VZ4	PCT 1232 - Planted	0.19	Clearance	19.6	Yes	2

7.2.2 Impacts to threatened species (species credits)

As outlined in Section 4.2, no species credit species were recorded or assumed present within the subject land.

8 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 two vegetation zones at the subject land. A biodiversity credit report are provided on the following pages.

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00018953/BAAS18050/20/00019266	Jemena Gas Pipeline - SSI	20/08/2020
Assessor Name	Report Created	BAM Data version *
	24/09/2020	30
Assessor Number	BAM Case Status	Date Finalised
	Open	To be finalised
Assessment Revision	Assessment Type	
2	Major Projects	

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

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

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Coastal freshwater swamp forest								
4	1232_Planted	19.6	0.19	0.25	High Sensitivity to Potential Gain	2.50		2
							Subtotal	**2**

Coastal freshwater wetland							
1	781_Low	31.7	0.04	0.25	High Sensitivity to Potential Gain	2.00	1
						Subtotal	**1**
Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion							
2	838_Low	21.5	0.33	0.25	High Sensitivity to Potential Gain	2.00	TRUE	4
3	838_Planted	34.9	0.93	0.25	High Sensitivity to Potential Gain	2.00	TRUE	16
						Subtotal	**20**
						Total	**23**

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Potential SAII	Species credits

9 Assessment against biodiversity legislation

9.1 Environment Protection and Biodiversity Conservation Act 1999

An assessment of the impacts of the proposed development 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 development to the Commonwealth Minister for the Environment is required. Matters of NES relevant to the proposed development are summarised in Table 12.

Table 12 Assessment of the proposed development against the EPBC Act

Matter of NES	Project specifics	Potential for significant impact
Threatened species	EPBC listed threatened species previously recorded within the locality include 6 flora species and 11 fauna species. Targeted surveys were undertaken for the Green and Golden Bell Frog due to a moderate likelihood for the species. No individuals were identified. Additional threatened species listed under the EPBC Act were considered to have a low likelihood of occurrence and were not detected during targeted survey. Occurrence of threatened fauna is considered to be on a transient basis only and no significant or restricting habitat was identified within the subject land for these species.	The project will not result in a significant impact to any MNES.
Threatened ecological communities	There are no EPBC Act listed TECs within the subject land or study area.	No potential for impact.
Migratory species	Three migratory species have previously been recorded within the locality. Field surveys did not record any migratory species within the study area.	OEH mapping presented no direct impact is expected to any Migratory listed species.
National Heritage Place	There are no wetlands of international importance within proximity to the subject land.	No potential for impact.
Wetlands of international importance (Ramsar sites)	There are no wetlands of international importance within proximity to the subject land.	No potential for impact.

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

9.2 Environmental Planning and Assessment Act 1979

9.2.1 Wollongong City Council Local Environmental Plan 2009

The study area covers multiple land use zones under the *Wollongong Local Environmental Plan 2009* (LEP) due to its lineal extent, these consist of IN2 – Light Industrial, IN3 – Heavy Industrial, RE1 – Public Recreation, SP1 – Special Activities, SP2 – Infrastructure.

The objectives of management for IN2 zoned land under the LEP are:

- *To provide a wide range of light industrial, warehouse and related land uses.*
- *To encourage employment opportunities and to support the viability of centres.*
- *To minimise any adverse effect of industry on other land uses.*
- *To enable other land uses that provide facilities or services to meet the day to day needs of workers in the area.*
- *To support and protect industrial land for industrial uses.*
- *To encourage appropriate forms of industrial development which will contribute to the economic and employment growth of Wollongong*.

The objectives of management for IN3 Heavy Industrial zoned land under the LEP are:

- *To provide suitable areas for those industries that need to be separated from other land uses.*
- *To encourage employment opportunities.*
- *To minimise any adverse effect of heavy industry on other land uses.*
- *To support and protect industrial land for industrial uses.*
- *To facilitate the ongoing sustainability of steel making and steel product manufacturing that will contribute to the economic and employment growth of Wollongong.*

The objectives of management for RE1 Public Recreation zoned land under the LEP are:

- *To enable land to be used for public open space or recreational purposes.*
- *To provide a range of recreational settings and activities and compatible land uses.*
- *To protect and enhance the natural environment for recreational purposes.*
- *To cater for the development of a wide range of uses and facilities within open spaces for the benefit of the community.*

The objectives of management for SP1 Special Activities zoned land under the LEP are:

- *To provide for special land uses that are not provided for in other zones.*
- *To provide for sites with special natural characteristics that are not provided for in other zones.*
- *To facilitate development that is in keeping with the special characteristics of the site or its existing or intended special use, and that minimises any adverse impacts on surrounding land.*

The objectives of management for SP2 Infrastructure zoned land under the LEP are:

- *To provide for infrastructure and related uses.*
- *To prevent development that is not compatible with or that may detract from the provision of infrastructure.*

- *To provide for key transport corridors*

Assuming the avoidance and minimisation measures to reduce impacts to ecological values outlined in Section 5 are implemented, the proposed development does not contradict the objectives of the LEP for land within the study area.

9.2.2 Coastal Management State Environmental Planning Policy

The project is subject to the Coastal Management State Environmental Planning Policy (SEPP) and the consent authority required to assess the project under the EP&A Act. The Northern extent of the subject lands is deemed to form a part of the 'coastal environment area', under Division 3 Section 13 of the Coastal Management SEPP. The objectives of which include the following:

- *1) Development consent must not be granted to development on land that is within the coastal environment area unless the consent authority has considered whether the proposed development is likely to cause an adverse impact on the following—*
  - *(a) the integrity and resilience of the biophysical, hydrological (surface and groundwater) and ecological environment,*
  - *(b) coastal environmental values and natural coastal processes,*
  - *(c) the water quality of the marine estate (within the meaning of the Marine Estate Management Act 2014), in particular, the cumulative impacts of the proposed development on any of the sensitive coastal lakes identified in Schedule 1,*
  - *(d) marine vegetation, native vegetation and fauna and their habitats, undeveloped headlands and rock platforms,*
  - *(e) existing public open space and safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability,*
  - *(f) Aboriginal cultural heritage, practices and places,*
  - *(g) the use of the surf zone.*
- *2) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that—*
  - *(a) the development is designed, sited and will be managed to avoid an adverse impact referred to in subclause (1), or*
  - *(b) if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact, or*
  - *(c) if that impact cannot be minimised—the development will be managed to mitigate that impact.*
- *3) This clause does not apply to land within the Foreshores and Waterways Area within the meaning of Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005.*

The project is unlikely to have an adverse effect on the above, therefore this policy allows the proposed development to be carried out with consent under the EP&A Act.

9.2.3 Koala Habitat Protection SEPP

The subject land is located within the Wollongong Council LGA. The Wollongong City Council is listed under the Koala Habitat Protection and is therefore subject to the requirements laid out by the policy. Specifically

before a consent authority may grant consent to a proposed development, it must satisfy itself whether or not the land is a potential koala habitat.

The proposed works do not meet the requirements under Part 3.1 Tier 1 - Low or no direct impact development of the Koala Habitat Protection Guidelines, and therefore require a Koala Plan of Management (KPoM). Two feed tree species, Forest Red Gum and Spotted Gum, listed within Appendix A of the policy were found to be present within the study area. However, these constitute less than 15% of the total number of trees in the upper or lower strata of the tree component.

9.3 *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.

A total of four priority weeds for the South East Local Land Services Region were recorded in the subject land and are listed in Table 13 along with their associated Duty. A general biosecurity duty is relevant to all priority weeds in the State. The objective of this duty is to prevent, eliminate or minimise any biosecurity risk the priority weed may pose.

Table 13 Priority weeds recorded at the subject land

Scientific name	Common name	General biosecurity duty
Chrysanthemoides monilifera* subsp. *rotundata	Bitou Bush	General biosecurity duty Prohibition on dealings - Must not be imported into the State or sold Biosecurity zone – applicable to all land within NSW except for land within 10 kilometres of the mean high water mark between Cape Byron in the north and Point Perpendicular in the south. The study area falls within the excepted land, therefore immediate eradication of the weed is not required.
Lantana camara	Lantana	General biosecurity duty Regional Recommended Measure: Land managers should mitigate the risk of new weeds establishing
Lycium ferocissimum	African Boxthorn	General biosecurity duty Prohibition on dealings - Must not be imported into the State or sold
***Rubus fruticosus* agg. species**	Blackberry	Prohibition on dealings - Must not be imported into the State or sold.

9.4 Water Management Act 2000

A controlled activity approval under the *Water Management Act 2000* (WM Act) is required for the following types of activities undertaken on waterfront land:

- the erection of a building or the carrying out of a work (within the meaning of the EP&A Act), or
- the removal of material (whether or not extractive material) or vegetation from land, whether by way of excavation or otherwise, or
- the deposition of material (whether or not extractive material) on land, whether by way of landfill operations or otherwise, or
- the carrying out of any other activity that affects the quantity or flow of water in a water source.

Waterfront land means the bed of any river, lake or estuary, and the land within 40 metres of the river banks, lake shore or estuary mean high water mark.

Development works are proposed within 40 metres of the top of the bank along five Strahler one watercourses, two Strahler 2 watercourses and one Strahler 3 watercourse within the subject land (Figure 1).

Therefore, a DPI controlled activity permit under s91 of the WM Act may be required for the proposal. A controlled activity approval exemption may apply if the project is a registered pipeline licensee under the *Pipelines Act 1967*.

10 Conclusion

Mitigation of impacts to native vegetation, TECs and fauna habitat have been provided to restrict proposed impacts associated with the project.

The project will result in the removal of a total of 0.37 hectares of native vegetation and 1.12 of planted native vegetation, which includes:

- Partial removal of 0.04 hectares of PCT 781- Coastal Freshwater Wetlands.
- Permanent removal of 0.33 hectares of PCT 838 - Illawarra Lowlands Grassy Woodland.
- Permanent removal of 0.93 hectares of planted native vegetation that best aligns with PCT 838 - Illawarra Lowlands Grassy Woodland
- Permanent removal of 0.19 hectares of planted native vegetation that best aligns with PCT1232 – Swamp Oak Floodplain
- Habitat supported from the subject land.

Plot data was entered into the BAM calculator to determine vegetation integrity score, and is presented in Appendix 3. The vegetation integrity scores for vegetation surveyed are such that 23 ecosystem credits are required to offset the impacts to both vegetation communities.

The western extent of the subject land provided potential habitat for the Green and Golden Bell Frog. After four consecutive nights of targeted surveys for the species, no species were recorded at the site and no additional offsets are required for offset of habitat for the species.

No threatened fauna species were recorded at the subject land, however potential foraging and dispersal habitat for 11 threatened species was present (Table 5). Mitigation measures to avoid direct impacts and mitigate potential indirect impacts to native fauna are provided in Section 5.1 of this report.

There were no threatened flora species recorded within the subject land or listed as predicted species credit species in the BAM calculator.

MNES are not likely to be significantly impacted by the proposed development and as such, a referral of the project to the Commonwealth is not required.

The project should proceed as planned whilst implementing the recommended mitigation measures listed herein.

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Appendices

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 23.

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 Assessors Bianca Klein (BAAS18050) and Byron Dale.

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 summer during rainy weather, which is a suitable time to determine the presence of most threatened 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.

Appendix 2 BAM Candidate species assessment

Table A. 1 Threatened flora species assessment

Species	Conservation status EPBC	BC	BAM Predicted SCS	Potential occurrence in subject land	Survey required/ undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description*
Cynanchum elegans **White-flowered Wax Plant**	E	E	Yes	Low	No	Unlikely	No	Habitat was not present within the subject land. Forest Red Gum woodland was present, however in poor condition, not likely to support this species.	The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree scrub and Forest Red Gum open forest and woodland.
Haloragis exalata subsp. *exalata* **Square Raspwort**	V	V	Yes	Moderate	Yes	Unlikely	Yes	Habitat for this species was present. Habitat included freshwater wetland areas. Targeted surveys were undertaken in January 2020; within the approved survey period for the species. This species was thoroughly searched for using targeted meanders in areas of potential habitat. . No individuals were recorded.	Requires protected and shaded damp situations in riparian habitat. It has been recorded in disturbed environments including along roadsides.
***Chorizema parviflorum* (population)**	-	E	Yes	Low	No	Unlikely	No	Habitat was not present within the subject land. Forest Red Gum woodland was present in poor condition, not	All known sites of this endangered population occupy woodland or forest dominated by Forest Red

Species	Conservation status EPBC	BC	BAM Predicted SCS	Potential occurrence in subject land	Survey required/ undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description*
								likely to support this species.	Gum and/or Woollybutt *Eucalyptus longifolia*.
***Lespedeza juncea* subsp. *sericea* (population)**	-	E	Yes	Moderate	Yes	Unlikely	Yes	Habitat for this species was present. Targeted surveys were undertaken in January 2020; within the approved survey period for the species. This species was thoroughly searched for using targeted meanders in areas of potential habitat. No individuals were recorded.	This endangered population is known from a single population of approximately 200 plants located within 6 kilometres of the subject land. It is associated with Forest Red Gum woodland, but has also been recorded within exotic grassland.
Pimelea curviflora* var. *curviflora	V	V	Yes	Low	No	Unlikely	No	Habitat was not present within the subject land. Forest Red Gum woodland was present in poor condition, not likely to support this species.	Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Also recorded in Illawarra Lowland Grassy Woodland habitat at Albion Park on the Illawarra coastal plain.
Pimelea spicata **Spiked Rice-flower**	E	E	Yes	Low	No	Unlikely	No	Habitat was not present within the subject land. Forest Red Gum woodland was present in poor condition, not likely to support this species.	In both the Cumberland Plain and Illawarra environments this species is found on well-structured clay soils. The Illawarra populations usually occur in one of two communities - a woodland or a coastal grassland.

Species	Conservation status EPBC	BC	BAM Predicted SCS	Potential occurrence in subject land	Survey required/ undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description*
									Woodland sites are dominated by Forest Red Gum with a groundcover dominated by Kangaroo Grass *Themeda triandra*.
Pterostylis gibbosa **Illawarra Greenhood**	E	E	Yes	Low	No	Unlikely	No	Habitat was not present within the subject land. Forest Red Gum woodland was present in poor condition, not likely to support this species.	All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, this species grows in woodland dominated by Forest Red Gum and Woollybutt.
Wilsonia rotundifolia **Round-leafed Wilsonia**	-	E	Yes	Low	No	Unlikely	No	Habitat was not present within the subject land. Saline or brackish environments were absent.	Grows in mud in coastal saltmarsh and inland saline or brackish lake beds.
Zieria granulata **Illawarra Zieria**	E	E	Yes	Moderate	Yes	Unlikely	Yes	Habitat for this species was present. Targeted surveys were undertaken in January 2020; within the approved survey period for the species. This species was thoroughly searched for using targeted meanders in areas of potential habitat. No individuals were recorded.	The typical habitat is dry ridge tops and rocky outcrops on shallow volcanic soils. Less frequently found on the moist slopes of the Illawarra escarpment and in low-lying areas. Associated vegetation includes Forest Red Gum woodland. Much of the natural habitat for the species has been removed and many sites now occupy road verges

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							
									and paddock edge.

* Habitat descriptions have been adapted by qualified ecologists from the DEE Species Profile and Threats (SPRAT) Database, DPIE Threatened Species online profiles and the NSW Scientific Committee final determinations for listed species, references within the above table are provided within the report reference list.

Table A. 2 Threatened fauna species assessment

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/ undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
Burhinus grallarius **Bush Stone-curlew**	-	EN	Yes	Low	No	Nil	No	Bush-stone Curlew depends on vegetation with an open understorey, and fallen debris for cover and foraging. The grasslands within the study area displayed a density and height, the species requires grasslands to be patchy and sparse. The woodlands throughout the dry sclerophyll forests throughout the subject land had a thick understorey dominated by Lantana. There are no records of the Bush-stone curlew within 10 kilometres of the study area.	Inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber, the species is largely nocturnal, being especially active on moonlit nights, the species feed on insects and small vertebrates, such as frogs, lizards and snakes. Nests on the ground in a scrape or small bare patch. Two eggs are laid in spring and early summer.

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/ undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
Calyptorhynchus lathami **Glossy Black-Cockatoo**	-	V	Yes	Low	No	Nil	No – classed as an ecosystem credit due to the absence of required habitat.	Breeding habitat for the species consists of large hollow-bearing eucalyptus trees with a minimum diameter of 14 cm (ACT Government 2013, DPE 2017a). No hollow-bearing trees containing hollows large enough to support breeding occur within the study area.	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (Allocasuarina littoralis) and Forest Sheoak (A. torulosa) are important foods. Feeds almost exclusively on the seeds of several species of she-oak (Casuarina and Allocasuarina species), shredding the cones with the massive bill.
Chalinolobus dwyeri **Large-eared Pied Bat**	V	V	Yes	Low	No	Nil	No.	The subject land has low topographic relief, there is also no rocky areas containing caves within 2 kilometres of the study area, eliminating the study area as foraging habitat. The proposed development is unlikely to have more than a low impact on individuals utilising these resources.	Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels.
Heleioporus australiacus **Giant Burrowing Frog**	V	V	Yes	Low	No	Nil	No	The species is not known to occur within previously disturbed areas with the species being absent from	Found in heath, woodland and open dry scleropyhll forest on a variety of soils expect those that are clay

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/ undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
								agricultural land. It has also been reported as being potentially unwilling or unable to burrow into soil covered by grasses and crops (Penman, Mahony, & F Lemckert 2004). Impacts to the remnant woodland vegetation within the study area are minor and these areas are considered to be too isolated to be utilised by frogs dispersing from breeding areas.	based. Breeding habitat of this species is generally soaks or pools within first of second order streams. With a home range of approximentalely 0.4 hectares.
Isoodon obesulus obesulus **Southern Brown Bandicoot (eastern)**	EN	EN	Yes	Low	No	Nil	No – lacks required habitat.	The habitat assessment did not identify any suitable habitat features (i.e. intact heath understorey) for Southern Brown Bandicoot within the subject land or study area.	This species prefers sandy soils with scrubby vegetation and/or areas with low ground cover that are burn from time to time. A mosaic of post fire vegetation is important for this species.
Lathamus discolor **Swift Parrot**	CE	EN	Yes	Low	No	Nil	No – not mapped as important habitat by OEH.	The habitat assessment did not identify the presence of lerp within the subject land or study area. However, the species may be encountered in the area foraging during winter migratory efforts.	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/ undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
									grounds in NSW. This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.
Limicola falcinellus **Broad-billed Sandpiper**	-	V	Yes	Low	No	Nil	No – not mapped as important habitat by OEH.	The study area was over 2 kilometres from harbours, embayments, lagoons and sandbank, no potential habitat for foraging was found within the subject lands. Therefore minimal to no impact on the species will occur.	Occurs in sheltered parts of coasts, such as estuaries, harbours, embayments and lagoons, which have shell or sandbanks nearby.
Limosa limosa **Black-tailed Godwit**	-	V	Yes	Low	No	Nil	No – not mapped as important habitat by OEH.	Black-tailed Godwit forages in sheltered bays, estuaries, and lagoons, sometimes found in wet fields. Roosting on low banks of mud, sand and shell bars. None of these landforms are present in the study area. There is a small depression toward the western extent of the study area, but this is choked with dense vegetation and is 3 kilometres from any coastal esturary.	The Black-tailed Godwit is a migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the coast, and inland, it may occur around any of the large lakes in the western areas during summer, when the muddy shores are exposed.

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/ undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
Litoria aurea **Green and Golden Bell Frog**	V	EN	Yes	Medium	Yes	Nil	Yes – targeted surveys were undertaken, no species were found.	Green and Golden Bell Frogs have been recorded within 2 kilometres of the study area, but the few watercourses and waterbodies found within the subject land are choked with vegetation, have no connectivity to areas considered to be good habitat. The Green and Golden Bell frog prefers waterbodies that provide small amounts of vegetation that are unshaded and have nearby rocks to bask in the diurnal sun (Pyke & White 1996). These features were not displayed within any of the potential watercourses.	The species is found in marshes, dams and stream sides, particularly those containing bullrushes or spikerushes. Preferred habitat contains water bodies that are unshaded, are free of predatory fish, have a grassy area nearby and have diurnal sheltering sites nearby such as vegetation or rocks, although the species has also been recorded from highly disturbed areas including disused industrial sites, brick pits, landfill areas and cleared land. Breeding usually occurs in summer. Tadpoles, which take approximately 10-12 weeks to develop, feed on algae and other vegetative matter. Adults eat insects as well as other frogs, including juveniles of their own species.
Lophoictinia isura **Square-tailed Kite**	-	V	Yes	Low	No	Nil	No – classed as an ecosystem credit due to the absence of required	Square-tailed Kite will breed within large eucalypts located near waterbodies, or watercourses for foraging resources. None of the preferred vegetation types were discovered within the study area. One stick nest was	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by Eucalyptus longifolia, Corymbia maculata, E. elata,

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/ undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
							habitat.	discovered within the subject land but it did not support the correct breeding requirements for the species and was located next to a heavily trafficked highway, that was over 2-3 kilometres from any watercourse or waterbody.	or E. smithii. Individuals appear to occupy large hunting ranges of more than 100 km2. They require large living trees for breeding, particularly near water with surrounding woodland /forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.
Hieraaetus morphnoides **Little Eagle**	-	V	Yes	Low	No	Nil	No – classed as an ecosystem credit due to the absence of required habitat.	Little Eagle will breed on a watercourse or scrub mallee (Michael Morcombe 2002) for foraging resources. One stick nest was discovered within the subject land but it did not support the correct breeding requirements as it was too small for the species and was located next to a heavily trafficked highway.	The Little Eagle is most abundant in lightly timbered areas with open areas nearby providing an abundance of prey species. It has often been recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. The Little Eagle nests in tall living trees within farmland, woodland and forests.
Calidris ferruginea **Curlew Sandpiper**	CE	EN	Yes	Low	No	Nil	No – No important habitat mapped by OEH.	Suitable habitat was not present within the study area. No wetland, inland lakes or lagoons occurred within the study area. Farm dams may	Inhabits sheltered intertidal mudflats. Also non-tidal swamps, lagoons and lakes near the coast. Infrequently recorded inland.

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/ undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
								occasionally support visitations by individuals but would not support a population.	
Haliaeetus leucogaster **White-bellied Sea-Eagle**	-	V	Yes	Low	No	Nil	No – classed as an ecosystem credit due to the absence of required habitat.	White-bellied Sea-eagle nests on cliff ledge, headland or top of large tree near coast or river. Nests usually insight of water. None of the breeding requirements have been found within the study area. Forages along beaches, swamp, floodplains, mangroves and lagoons, breeding pairs scares around major coastal cities (Michael Morcombe 2002).	A migratory species that is generally sedentary in Australia, although immature individuals and some adults are dispersive. Found in terrestrial and coastal wetlands; favouring deep freshwater swamps, lakes and reservoirs; shallow coastal lagoons and saltmarshes. It hunts over open terrestrial habitats. Feeds on birds, reptiles, fish, mammals, crustaceans and carrion. Roosts and makes nest in trees.
Miniopterus australis **Little Bent-winged Bat**	-	V	Yes	Low	No	Nil	No – classed as an ecosystem credit due to the absence of required habitat.	The subject land did not contain any habitat features suitable for roosting (i.e. culverts, caves, tunnels or tree hollows). The species may utilise the subject land for foraging on occasion, travelling from higher quality habitats.	Occurs from Northern Queensland to the Hawkesbury River near Sydney. Roost sites encompass a range of structures including caves, tunnels and stormwater drains. Young are raised by the females in large maternity colonies in caves in summer.

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/ undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
									Shows a preference for well timbered areas including rainforest, wet and dry sclerophyll forests, Melaleuca swamps and coastal forests. The Little Bentwing bat forages for small insects (such as moths, wasps and ants) beneath the canopy of densely vegetated habitats.
Miniopterus orianae oceanensis **Large Bent-winged Bat**	-	V	Yes	Low	No	Nil	No – classed as an ecosystem credit due to the absence of required habitat.	The subject land did not contain any habitat features suitable for roosting (i.e. culverts, caves, tunnels or tree hollows). The species may utilise the subject land for foraging on occasion, travelling from higher quality habitats.	Occurs from Victoria to Queensland, on both sides of the Great Dividing Range. Forms large maternity roosts (up to 100,000 individuals) in caves and mines in spring and summer. Individuals may fly several hundred kilometres to their wintering sites, where they roost in caves, culverts, buildings, and bridges. They occur in a broad range of habitats including rainforest, wet and dry sclerophyll forest, paperbark forest and open grasslands. Has a fast, direct flight and forages for flying insects (particularly moths) above the tree canopy and along waterways.

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/ undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
Myotis macropus **Southern Myotis**	-	V	Yes	Low	No	Nil	No – no required habitat found within study area.	Southern Myositis colonies will roost in caves, bridges, tree hollows or tunnels. None of the watercourses or waterbodies within the subject land had habitat connectivity to the species breeding requirements. All water bodies were choked with vegetation limiting foraging efforts.	Scattered, mainly coastal distribution extending to South Australia along the Murray River. Roosts in caves, mines or tunnels, under bridges, in buildings, tree hollows, and even in dense foliage. Colonies occur close to water bodies, ranging from rainforest streams to large lakes and reservoirs. They catch aquatic insects and small fish with their large hind claws, and also catch flying insects.
Neophema chrysogaster **Orange-bellied Parrot**	CE	CE	Yes	Low	No	Nil	No	The Orange-bellied Parrot requires sheltered habitats, no more than 3 kilometres from the coast, these include; bays, lagoons, estuaries, coastal dunes and saltmarshes, none of which are present within the subject land, closest records are near Shellharbour, some 15 kilometres away near wetlands and saltmarshes.	A single breeding population of fewer than 200 individuals occurs in a narrow coastal strip of south-west Tasmania. Adult birds depart Tasmania for the mainland in February. The first adults begin leaving the mainland for Tasmania in September with the last birds having departed by November. It is a coastal species inhabiting saltmarshes, sedgeplains, coastal dunes, pastures, shrublands and moorlands, generally within 10 km of the coast.

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/ undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
Ninox strenua **Powerful Owl**	-	V	Yes	Low	No	Nil	No – classed as an ecosystem credit due to the absence of required habitat.	Living or dead trees with hollows greater than 20cm diameter are required for breeding habitat. The study area and subject land do not provide suitable roosting habitat for Powerful Owl. The species may utilise the study area for opportunistic foraging	The Powerful Owl occupies wet and dry eucalypt forests and rainforests. It may inhabit both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm. It has a large home range of between 450 and 1450 ha.
Pandion cristatus **Eastern Osprey**	-	V	Yes	Low	No	Nil	No – mapped as not important habitat from OEH.	Eastern Osprey requires breeding habitat near the sea, nests are located within view of the coastline on headlands coastal cliffs and estuaries with close proximity to the coast. Generally builds nests in dead	Found in coastal waters, inlets, estuaries and offshore islands. Occasionally found 100 km inland along larger rivers. It is water-dependent, hunting for fish in clear, open water. The Osprey occurs in

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/ undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
								trees. None of the breeding habitat features were found within the study area.	terrestrial wetlands, coastal lands and offshore islands. It is a predominantly coastal species, generally using marine cliffs as nesting and roosting sites. Nests can also be made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea.
Petaurus norfolcensis **Squirrel Glider**	-	V	Yes	Low	No	Nil	No – no required habitat found within study area.	Squirrel glider prefers Blackbutt-Bloodwood forest with a heath understorey and an acacia midstorey. The species requires hollow abundant vegetation for refuge or breeding sites, no hollows were discovered within the study area.	Generally occurs in dry sclerophyll forests and woodlands but is absent from dense coastal ranges in the southern part of its range. Requires abundant hollow-bearing trees and a mix of eucalypts, banksias and acacias. Within a suitable vegetation community at least one species should flower heavily in winter and one species of eucalypt should be smooth barked.
Phascolarctos cinereus **Koala**	V	V	Yes	Low	No	Nil	No – no required habitat found within	The small patch of Forest Red Gum vegetation has poor connectivity to its surrounds isolated by the heavily trafficked highway and the	In NSW the Koala mainly occurs on the central and north coasts with some populations in the western region. Koalas feed almost

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/ undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
							study area.	Nien-Tien Temple, the understorey is made up of dense lantana. The closest Koala record is in Cordeaux Heights approximately 4 kilometres away and is over 10 years old.	exclusively on eucalypt foliage, and their preferences vary regionally. Primary feed trees include Eucalyptus robusta, E. tereticornis, E. punctata, E. haemostoma and E. signata. They are solitary with varying home ranges.
Pteropus poliocephalus **Grey-headed Flying-fox**	V	V	Yes	Low	No	Nil	No – classed as an ecosystem credit due to the absence of required habitat.	Grey-headed Flying fox is a nomadic species. No camps (communal breeding/roosting sites) were identified during the habitat assessment although there is a known camp within 5 kilometres of the study area, The study area did not contain the preferred vegetation needed for foraging. The proposed development is unlikely to significantly impact on foraging resources within the area.	Occurs along the NSW coast, extending further inland in the north. This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Roosts in large colonies, commonly in dense riparian vegetation.
Sminthopsis leucopus **White-footed Dunnart**	EN	EN	Yes	Low	No	Nil	No – no required habitat found within study area	White-footed Dunnart requires vegetation with an open understorey, fallen timber and ground debris. The study area displayed minimal areas where these attributes had aligned. There has been no recorded	The White-footed Dunnart is found in a range of different habitats across its distribution, including coastal dune vegetation, coastal forest, tussock grassland and sedge land, heathland,

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/ undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
								sightings of the species within 10 kilometres of the study area.	woodland and forest. They shelter in bark nests in hollows understanding or fallen timber, burrows in the ground, piles of logging debris, in the 'skirts' of grass trees *Xanthorrhoea* spp. and cycads *Macrozamia* spp. and rock crevices
Tyto novaehollandiae **Masked Owl (Breeding)**	-	V	Yes	Low	No	Nil	No – classed as an ecosystem credit due to the absence of required habitat.	The Masked owl breeds in moist eucalypt forests and woodlands, the species relies on medium sized hollows with close proximity to open habitat, for foraging, no hollows were found near the farmlands, grasslands to the western extent of the study area. The Masked owl has a home range of approximately 500 – 100 hectares. The study area's invasive footprint would have minimal to no impact on the species foraging resources.	The Masked Owl is found in range of wooded habitats that provide tall or dense mature trees with hollows suitable for nesting and roosting. It is mostly seen in open forests and woodlands adjacent to cleared lands. Prey includes hollow-dependent arboreal marsupials and terrestrial mammals.
Anthochaera phrygia **Regent Honeyeater (Important**	-	V	Yes	Low	No	Nil	No - No mapped as not important habitat by	No vegetation within the subject land is suitable for nesting/breeding habitat. Furthermore, there are only four known key breeding	Regent Honeyeaters are semi-nomadic, occurring in temperate eucalypt woodlands and open forests. Most records are from box-

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/ undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
areas)							OEH.	regions remaining: north-east Victoria (Chiltern area), and in NSW at Bundarra-Barraba, Capertee Valley and the Hunter Valley districts (Commonwealth of Australia 2016). The subject land is not designated within these important habitat areas. Key foraging eucalypt species utilised for foraging were also absent from the study area.	ironbark eucalypt forest associations and wet lowland coastal forests. Nectar and fruit from mistletoes are also eaten. This species usually nest in tall mature eucalypts and sheoaks.
Xenus cinereus **Terek Sandpiper**	CE	CE	Yes	Low	No	Nil	No - No mapped as not important habitat by OEH.	The Terek Sandpiper has two main breeding sites both of which are located on the central coast of NSW. The Terek Sandpiper favours estuaries, embayments and lagoons all of which are not found within the study area.	Mainly found on saline intertidal mudflats in sheltered estuaries, embayments, harbours and lagoons.
Callocephalon fimbriatum **Gang-gang Cockatoo (Breeding)**	-	V	Yes	Low	No	Nil	No - No supportive habitat found within the study area.	Breeding habitat for the species consists of old-growth or mature eucalyptus forest and woodlands with hollows at least 10 cm in diameter, 9 m above the ground. No hollow-bearing trees containing hollows large enough to support breeding occur within the study area (DPE 2017b, DPE	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/ undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
								2018).	open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed.

Appendix 3 Flora

Appendix 3.1 BAM plot field data

Table A. 3 Flora species recorded in the study area from BAM plots

Scientific name	Common name	Plot 1				Plot 2				Plot 3				Plot 4			
		N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum
Acacia mearnsii	Black Wattle									N	20	10	C				
Ageratina adenophora	Crofton Weed									E	1	10	G				
Allocasuarina littoralis	Forest SheOak					N	3	2	M								
Araujia sericifera	Moth Vine	HTE	0.1	5	G	HTE	0.1	1	G	HTE	2	40	G				
Aster subulatus	Wild Aster													E	0.1	20	G
Bidens pilosa	Cobbler's Pegs	E	1	50	G												
Bolboschoenus fluviatilis	Marsh Club-rush													N	5	50	G
Carex appressa	Tall Sedge									N	20	10	G	N	75	100	G
Casuarina glauca	Swamp Oak	N	90	100	C												
Celtis sinensis	Chinese Celtis	E	0.5	2	M	E	10	30	M								
Cenchrus clandestinus	Kikuyu	E	0.5	10	G					HTE	5	20	G				
Centaurium erythraea	Common Centaury													E	0.1	20	G
Centella asiatica	Indian Pennywort													N	0.1	30	G

Scientific name	Common name	Plot 1				Plot 2				Plot 3				Plot 4			
		N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum
Conyza bonariensis	Fleabane													E	0.1	5	G
Corymbia maculata	Spotted Gum					N	20	8	C								
Cupaniopsis anacardioides	Tuckeroo	N	0.1	1	M												
Cynodon dactylon	Couch													N	5	30	G
Cyperus brevifolius	Mullumbimby Couch													E	1	20	G
Dichondra repens	Kidney Weed	N	0.1	40	G	N	0.5	20	G	N	0.5	50	G				
Ehrharta erecta	Panic Veldt Grass					HTE	1	30	G								
Einadia hastata	Berry Saltbush	N	0.1	10	G												
Eucalyptus tereticornis	Forest Red Gum					N	15	3	C								
Geitonoplesium cymosum	Scrambling Lily					G	0.1	1	G								
Gratiola spp.	Hedgehyssop													N	0.1	50	G
Hypochaeris radicata	Catsear													E	0.1	10	G
Juncus kraussi	Common Rush													N	2	30	G
Lantana camara	Lantana	HTE	15	50	M	HTE	10	30	M	HTE	20	20	M				
Ligustrum sinense	Small-leaved Privet					HTE	0.1	2	M	HTE	0.1	3	M				
Lycium ferocissimum	African Boxthorn													HTE	2	30	M
Microlaena stipoides	Weeping Grass	N	1	30	G					N	25	200	G				

Scientific name	Common name	Plot 1				Plot 2				Plot 3				Plot 4			
		N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum
Ochna serrulata	Mickey Mouse Plant					E	3	20	G								
Olea europaea subsp. *cuspidata*	African Olive					HTE	8	20	M								
Oplismenus aemulus var. *aemulus*	Basket Grass					N	0.1	10	G								
Pandorea pandorana	Wonga Wonga Vine					N	1	10	G	N	0.5	30	G				
Paspalum dilatatum	Paspalum													HTE	15	50	G
Phalaris aquatica	Bulbous Canary-grass									E	0.1	5	G	E	1	20	G
Pittosporum undulatum	Sweet Pittosporum					N	10	10	M	N	0.1	3	M				
Plantago lanceolata	Lamb's Tongues													E	0.2	40	G
Ranunculus spp.	Buttercup													-	0.1	30	G
Rubus fruticosus sp. agg.	Blackberry									HTE	5	20	M	HTE	20	10	M
Rumex crispus	Curled Dock													E	2	10	G
Sida rhombifolia	Paddy's Lucerne					E	1	50	G	E	0.1	10	G				
Tagetes minuta	Stinking Roger																
Trifolium repens var. *repens*	White Clover													EE	0.1	50	G

Scientific name	Common name	Plot 1				Plot 2				Plot 3				Plot 4			
		N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum
Typha orientalis	Cumbungi													N	2	10	G
Verbena bonariensis	Purpletop									E	0.1	2	G	E	1	10	G

Appendix 4 Fauna

Table A. 4 Fauna species recorded at the subject land

Common name	Scientific name
Mammals	
European Hare	*Lepus europaeus*
Birds	
Australian Raven	*Corvus coronoides*
Eastern Whipbird	*Psophodes olivaceus*
Brown Treecreeper	*Climacteris picumus*
Letter-winged Kite	*Elanus scriptus*
Rufous Whistler	*Pachycephala rufiventris*
Rainbow Lorrikeet	*Trichoglossus haematodus*
Spotted turtle-dove	*Streptopelia chinensis*
Noisy Miner	*Manorina melanocephala*
Striated Pardalote	*Pardalotus striatus*
Australian Magpie	*Cracticus tibicen*
Welcome Swallow	*Hirundo neoxena*
White-browned Scrubwren	*Sericornis frontalis*
Amphibians	
Eastern Froglet	*Crinia signifera*

Appendix 5 Plates

Plate 1 **Planted native vegetation – monoculture of Swamp Oak**

Plate 2 Planted **native vegetation adjacent to the Princes motorway**