



# Biodiversity Assessment Report

## Pacific Highway Upgrade through Wyong Town Centre

Prepared for Roads and Maritime Services  
September 2015





## EXECUTIVE SUMMARY

This biodiversity report provides an ecological impact assessment of the proposed upgrade of the Pacific Highway through Wyong Town Centre. The proposal includes duplication of the existing road to a two lane carriageway with central median in each direction, replacement of the existing Wyong River road ridge with new twin road bridges, including provision for pedestrians and cyclists, , upgrade of key intersections with McPherson Road, Church Street, Rose Street, Anzac Avenue, North Road and Cutler Drive, a new pedestrian overbridge from the highway connecting to Wyong Station, replacement of Rose Street rail bridge with a new bridge which is longer and higher, relocation of the bus interchange to the eastern side of the station, parking and property adjustments.

The scope of the study is to describe flora and fauna species and habitat within the study area, determine the likelihood of occurrence of threatened species and ecological communities of State or Federal conservation significance, assess the impacts of the proposal on them and recommend mitigation measures to avoid or minimise these impacts. This technical study will be used to inform a Review of Environmental Factors (REF) prepared under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The study area contains native vegetation in low to moderate condition including the Endangered Ecological Communities (EECs) Swamp Oak Floodplain Forest, River-Flat Eucalypt Forest on Coastal Floodplains and Freshwater Wetlands on Coastal Floodplains. Areas of weeds and exotics and landscaped/planted road verges also occur in the study area.

Approximately 6.4 hectares of vegetation would be removed to accommodate the proposed road widening and upgrade including 3.5 hectares of native vegetation, 2.2 hectares of which is EEC.

Assessments were undertaken for three endangered ecological communities, ten flora and twelve fauna species with potential to occur in the study area that are currently listed as threatened or migratory under state and federal legislation. It was concluded that the impact of the proposal on these communities and species would be minor, with the impacts determined not to be significant.

Recommendations to minimise the impacts of the proposal include the retention of remnant native vegetation, implementation of effective sediment and erosion control, stormwater controls, weed management and rehabilitation of affected habitat. With the adoption of specific mitigation measures, the overall impact of the proposal on biodiversity would be low.





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## ACRONYMS

Acronyms	Definition
cm	Centimetres
DEC	(Former) Department of Environment and Conservation (NSW)
DECC	(Former) Department of Environment Climate & Change (NSW)
DECCW	(Former) Department of Environment Climate Change & Water (NSW)
DIWA	Directory of Important Wetlands Australia
DoE	Department of the Environment (Commonwealth)
DSEWPaC	(Former) Department of Sustainability, Environment & Water Protection & Conservation (Commonwealth)
EEC	Endangered Ecological Community
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999</i>
ESU	Ecological Sampling Unit
FM Act	<i>Fisheries Management Act 1994</i>
ha	Hectare
km	Kilometres
KFH	Key Fish Habitat
KTP	Key Threatening Process
LEP	Local Environmental Plan
LGA	Local Government Area
m	Metres
MNES	Matters of National Environmental Significance
NPWS	National Parks and Wildlife Service (NSW)
NSW	New South Wales
OEH	Office of Environment and Heritage(NSW)
PCT	Plant Community Type
REF	Review of Environmental Factors
RMS	Roads and Maritime Services

Acronyms	Definition
ROTAP	Rare or Threatened Australian Plants
SEPP	State Environmental Planning Policy
SMEC	Snowy Mountains Engineering Corporation
TEC	Threatened Ecological Community
TSC Act	<i>Threatened Species Conservation Act 1995</i> (NSW)
WoNS	Weeds of National Significance

# 1 INTRODUCTION

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## 1.1 Background

Roads and Maritime Services (Roads and Maritime) proposes to upgrade the Pacific Highway through the Wyong Town Centre. The proposal involves widening the existing single lane road to a dual carriageway with two lanes in each direction and a central median.

The objectives of the proposal are to:

- Upgrade the Pacific Highway between Johnson Road and Cutler Drive intersections to provide consistent travel journey times that achieve Level of Service (LoS) C or better at opening and LoS D or better 20 years after opening, based on current traffic predictions and known land use changes
- Improve access to public transport and encourage active transport by providing appropriate facilities
- Have a best practice urban design outcome that considers social, heritage, commuter and business interactions
- Provide a road environment that maintains the town's identity while providing opportunities for future revitalisation and growth
- Ensure the road design is compatible with future public transport upgrades.

Roads and Maritime commissioned SMEC Australia to undertake ecological investigations into the proposal targeting threatened species, populations and ecological communities that potentially occur in the area.

## 1.2 Proposal description

Roads and Maritime propose to upgrade about 2.4 kilometres of the Pacific Highway through the town centre of Wyong, NSW. The planned upgrade extends from the Johnson Road intersection with the Pacific Highway to about 50 metres north of Cutler Drive. The proposal would generally involve the following:

- The current road would be widened to a two lane carriageway in each direction with central median between Johnson Road and north of Cutler Drive
- Replacement of the existing Wyong River road bridge with new twin road bridges over the Wyong River for northbound and southbound traffic including pedestrians and cyclists
- A shared cycle/pedestrian path provided along the Pacific Highway between Johnson Road and Cutler Drive
- Reconfiguration of on-road parking provisions throughout the proposal extents
- A pedestrian refuge across the highway is provided with the partial closure of Bakers Lane to vehicles at the Highway
- The Pacific Highway connection with Wyong Station is redefined at a higher level by a new pedestrian bridge link connecting the Pacific Highway to the existing Wyong Station pedestrian overbridge
- Upgrade of key Pacific Highway intersections at McPherson Road, Church Street, Rose Street, Anzac Avenue, North Road and Cutler Drive



- Intersection adjustments at River Road, Alison Road and Apex Park
- Replacement of the Rose Street rail overbridge with a new bridge that is longer and wider
- Upgrade of Howarth Street intersections at Rose Street and Warner Avenue
- Dedicated bus stops along the subject length of the Pacific Highway in both directions and relocation of bus layover facilities to the east of Wyong Station
- Provision of a dedicated area for disabled commuter parking and taxi services east of Wyong Station located close to station access lifts and stairs
- Provision of a dedicated rail commuter parking facility east of Wyong Station
- Improvements to River Road and South Tacoma Road that include pedestrian paths within the project extents and improved clearance heights under the Wyong River Pacific Highway road bridges
- Incorporating the existing palm trees, with the aim of retaining as many of the existing palm trees as reasonably practicable
- Demolition and removal of the locally heritage listed Station Master's Cottage and Warner Shops
- Property adjustments along the upgrade corridor
- Retaining walls at various locations and heights.

### 1.3 Study area

The proposal is located in Wyong town centre. It is located within the Wyong Shire Council local government area (LGA). The study area includes:

- A 2.4 kilometre section of the Pacific Highway through Wyong town centre from Johnson Road to Cutler Drive (including the bridge over the Wyong River)
- Six potential site compounds at the following locations:
  - Former Wyong Grove Primary School – Owen Avenue
  - Howarth Street north (Wyong Race Course)
  - Howarth Street south, corner Warner Avenue
  - South Tacoma Road, from McPherson Road north to river reserve
  - McPherson Road, vacant lots on southern side
  - Johnson Road, vacant lot on northern side.

The location of the proposal and study area is shown in Figure 1. The study area refers to those areas that would be directly affected during construction including locations of compound sites. The site compounds identified are indicative only and would be reviewed during detailed design and prior to commencement of construction. Any additional sites that are considered at a later stage would be subject to additional assessment as required.



**Figure 1: Location of the proposal**

## 1.4 Legislative context

### 1.4.1 Commonwealth legislation

#### ***Environment Protection and Biodiversity Conservation Act 1999***

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires that Commonwealth approval be obtained for certain actions, and establishes an assessment and approvals system for actions that have or are likely to have, a significant impact on Matters of National Environmental Significance (MNES). Matters of NES considered in this technical report include listed threatened species, populations and ecological communities as well as migratory species protected under international agreements. Particular consideration has been given to potential impacts on threatened biota that occur or could occur in the study area. Potential impacts are discussed in Section 4 and Appendix 6 of this technical report.

### 1.4.2 State legislation

#### ***Environmental Planning and Assessment Act 1979***

This technical report has been prepared to consider the potential environmental impact of the proposal, in keeping with the legislative requirements of Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The EP&A Act provides the statutory basis for planning and environmental assessment in New South Wales (NSW). This biodiversity specialist report is provided as part of the environmental assessment and technical considerations prepared to inform a Review of Environmental Factors (REF) for the proposal.

#### ***Threatened Species Conservation Act 1995***

The *Threatened Species Conservation Act 1995* (TSC Act) protects threatened flora and fauna species, endangered populations and ecological communities and their habitats within NSW. Particular attention has been given to potential impacts on threatened biota that occur or could occur in the study area. Potential impacts are discussed in Section 4 and Appendix 5 of this technical report.

#### ***Fisheries Management Act 1994***

The *Fisheries Management Act 1994* (FM Act) protects threatened species, populations and ecological communities of fish and marine vegetation, and other living resources of NSW waters.

The proposed activity has the potential to adversely impact upon aquatic and riparian environments. Under section 199 of the FM Act, Roads and Maritime is required to give written notification to the Minister for Fisheries for any reclamation or dredging work.

Key fish habitat (KFH) is identified across NSW in order to help achieve the objectives of the FM Act, which is to 'conserve key fish habitats'. 'Key fish habitat' is not defined under the FM Act, therefore the Fisheries NSW *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI 2013) was developed to clarify this issue. Section 3.5 and 4.12.1 consider the implications of this document.

Construction and demolition of bridges at Wyong River would have the potential to temporarily block fish passage. If this occurs, a permit in accordance with Section 220 of the FM would be required.

Potential impacts are discussed in Section 4 of this technical report with the full Aquatic Flora and Fauna Report (Watershed Ecology 2014) for the proposal provided in Appendix 7.

### ***Noxious Weeds Act 1993***

Under the *Noxious Weeds Act 1993*, public authorities are required to control noxious weeds which are likely to spread to adjoining land. Section 4.4 of this technical report considers weeds declared as noxious in the Wyong Shire Council LGA that occur within the study area.

### ***State Environmental Planning Policy No 14 (SEPP 14) - Coastal Wetlands***

The objective of SEPP 14 is to ensure that coastal wetlands are preserved and protected in the environmental and economic interests of the state. The SEPP requires that land clearing, drainage work or filling may only be carried out within these wetlands with the consent of the local council and the agreement of the Director-General of Planning and Infrastructure (P&I).

Section 4.11.2 of this technical report considers SEPP 14 wetlands in the Wyong LGA that occur close to the study area.

### ***State Environmental Planning Policy 44 (SEPP 44) - Potential koala habitat***

The objective of SEPP 44 is to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline. The SEPP requires the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat. The State Environmental Planning Policy (SEPP) 44 (Koala Habitat Protection) is considered in this report as areas identified under this SEPP may be impacted by the project. Sections 3.11 and 4.10 of this biodiversity assessment report includes an assessment of whether the study area contains koala habitat as defined by the policy.

## **1.5 Study purpose**

The key aims of this study are to:

- Undertake a review of published documentation and a desktop study of flora and fauna relevant to the study area, identifying species and communities that may be present
- Conduct a field survey (flora, fauna and aquatic habitat assessment) of the study area, with particular attention to impacts on species, populations and ecological communities listed under the TSC Act and the EPBC Act
- Identify and assess likely impacts to flora, fauna and aquatic habitats arising from the proposal
- Undertake assessments under Part 5 of the EP&A Act and the EPBC Act with tests of significance for threatened biota where required
- Identify measures for managing impacts on threatened biota during design, construction and operation.



## 2 METHODOLOGY

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### 2.1 Database searches and literature reviews

Desktop research was undertaken prior to the commencement of field surveys and included database searches and a review of relevant literature to determine if targeted surveys for specific species were required. Additionally these searches helped to identify threatened biota known or likely to occur in the study area.

The following databases and resources were investigated:

- NSW Office of Environment and Heritage (OEH) Atlas of NSW Wildlife Database, within a 10 kilometre radius of the site
- Commonwealth Protected Matters Report for all MNES documented within 10 kilometres of the site; MNES include threatened species, communities and migratory species which are listed under the EPBC Act (Department of the Environment)
- NSW Flora Online Search – Rare or Threatened Australian Plants (ROTAP) species (The Royal Botanic Gardens and Domain Trust, 2012)
- NSW Office of Environment and Heritage – Vegetation Types Database
- NSW Office of Environment and Heritage – Threatened species profiles
- Department of Primary Industry (DPI): Fishing and Aquaculture – Threatened and Protected Species, Hunter-Central Rivers CMA
- NSW Department of Primary Industries Noxious Weeds List, Wyong LGA
- Atlas of Groundwater Dependent Ecosystems (BOM)
- *Pacific Highway Upgrade Wyong Town Centre, Wyong: Preliminary Environmental Investigation* (Hills Environmental, 2013)
- *HW 10 Pacific Highway – Wyong Town Centre Ecological Assessment* (Parsons Brinckerhoff, 2013).

Survey methods were developed following a review of the OEH guidelines *Threatened Species Survey and Assessment: Guidelines for developments and activities* (working draft) (DEC, 2004).

### 2.2 Field survey

The study area is shown in Figure 1. A terrestrial flora and fauna habitat assessment was conducted on 28 March 2014. The survey included the study area along the Pacific Highway between Johnson Road and Cutler Drive. Additional surveys were undertaken on 7 October.

The field surveys undertaken by SMEC in March and October 2014 added to, and updated, previous flora and fauna surveys undertaken by Parsons Brinckerhoff and Niche Environment and Heritage in 2013.

Watershed Ecology were commissioned by SMEC to undertake aquatic surveys for the study area. Their report (*Aquatic Flora and Fauna Report for the Pacific Highway Upgrade through Wyong Town Centre*) was prepared for SMEC and the main outcomes have been incorporated into this report. The full Aquatic Flora and Fauna Report is provided in Appendix

7. Additional aquatic surveys were undertaken by écologique on behalf of SMEC to assess pylons of the existing Wyong River road bridge and remnant wooden piles from a previous bridge crossing.

### **2.2.1 Flora surveys**

Vegetation within the study area has not been mapped as part of the *Natural vegetation of the Wyong Local Government Area* (Bell 2008) (Figure 2). Patches of vegetation within the study are likely to have been too small to identify at the scale of the LGA wide mapping. However, Bell's vegetation community classification has been used to describe vegetation found during field survey of the study area. Field survey aimed to describe vegetation type and condition and identify any areas of higher quality vegetation habitat that could support threatened species that may occur in the study area.

The random meander technique was used over the whole site to record all species encountered as well as to target threatened species with a medium to high likelihood of occurring in the study area. Individual patches of vegetation or 'sites' were identified in the field based on obvious changes to vegetation structure and composition observed or by physical separation of different patches of vegetation by roads, railway line or urban development.

### **2.2.2 Fauna habitat assessment**

The fauna habitat assessment was conducted to assist in determining the likelihood of presence of threatened fauna species. Habitat characteristics considered include the presence of nectar-producing plants, hollow bearing trees, fallen logs, leaf litter and other ground debris, drainage lines, ponds, the structure of vegetation communities and the presence of fruiting/flowering plant species to assess the habitat suitability for a range of fauna species.

Using the random meander technique, searches were carried out for signs of fauna activity such as tracks, scats, scratches and notches on trees, as well as any opportunistic sightings, to identify the presence of common and threatened fauna species.

Additional targeted fauna surveys would be undertaken during spring to assess the likelihood that microbats are utilising the existing bridge structure as roosting habitat.

### **2.2.3 Aquatic survey**

Three aquatic ecosystems were considered in the survey, Wyong River and two unnamed wetland systems south of the study area (refer Figure 3 in Appendix 7). Three sites were accessed to assess the condition of the Wyong River and determine the potential for adverse risks associated with the proposal. Macroinvertebrate samples were taken at two of these sites. Habitat assessments were undertaken of the two wetland systems just outside the study area that were considered to be potentially vulnerable to off-site impacts associated with the proposal.

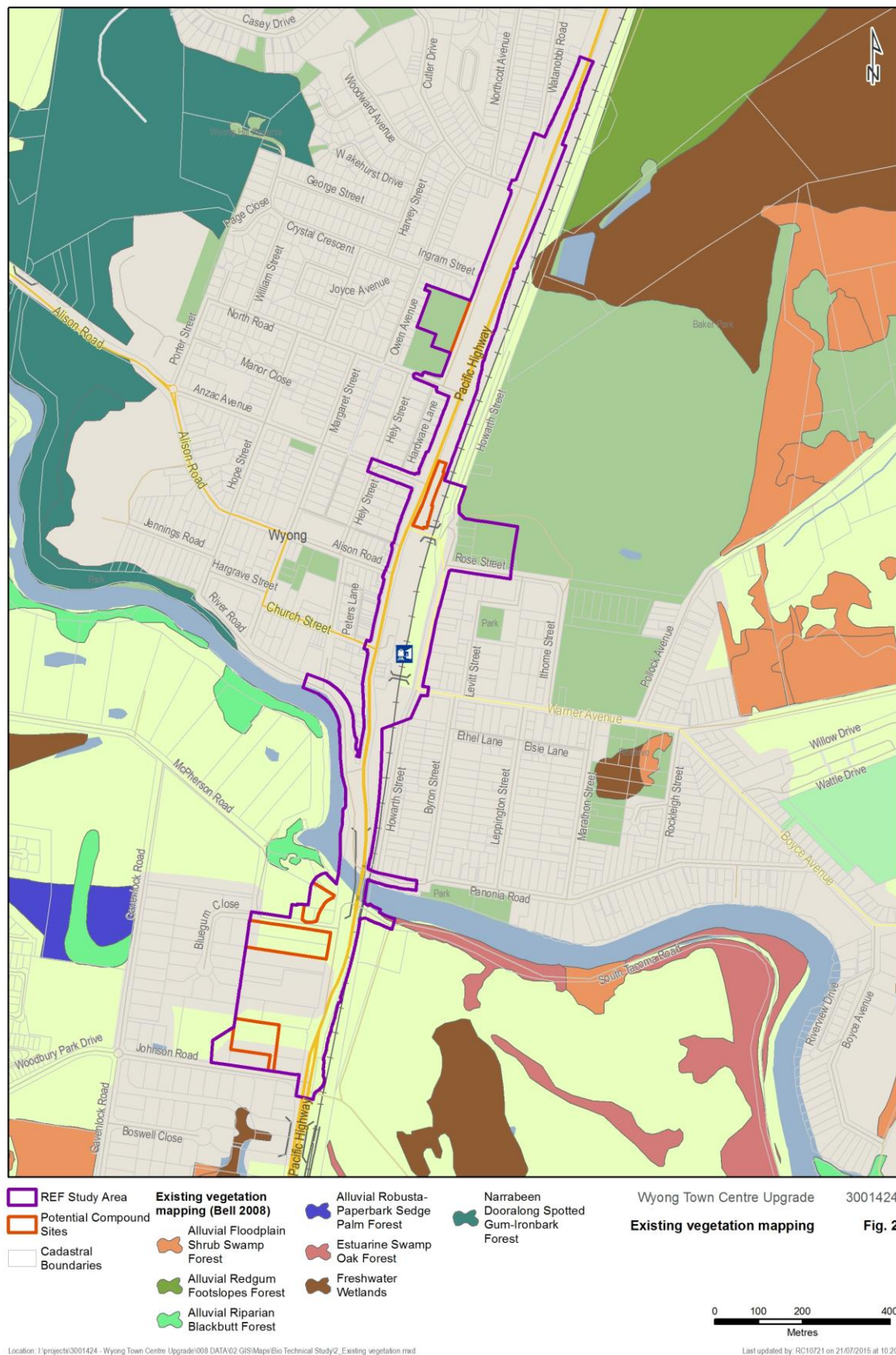
The conditions of the aquatic ecosystems in the study area were assessed using a modified version of the AUstralian RIVers Assessment System (AUSRIVAS) habitat assessment (Watershed Ecology, 2014). To assist in understanding the main drivers of site condition, HABSCORE was also used. It classifies stream habitat condition based on the variety and



quality of substrate, channel morphology, bank structure and riparian vegetation (Watershed Ecology, 2014).

Additional surveys to assess bridge pylons were undertaken by a boat based field assessment on the 26th May 2015. Turbidity levels, and hence visibility, were sufficient to enable the use of an underwater camera fitted with LED lamps to visually inspect the pylons from a 6 metre aluminium centre console work vessel. Video footage was captured from two of the eight bridge pylons (Pylon no. 3 and no. 6) and one remnant timber pylon for later desktop analysis.

The complete Aquatic Survey and Assessment and Wyong River bridge pylons biota survey for the proposal are provided in Appendix 7 and Appendix 8, respectively.



**Figure 2: Existing vegetation mapping (Bell 2008)**

## 2.3 Limitations

Limitations to the flora and fauna surveys, which may affect survey results, include:

- While fauna habitat assessments were undertaken, this technique is not an adequate substitute for fauna surveys. Fauna are capable of inhabiting sub-optimal habitat. In addition fragmentation, isolation or species density can all influence the presence and distribution of a particular species. Species likelihood of occurrence was informed by habitat characteristics and opportunistic sightings. No fauna trapping was undertaken. Results from survey undertaken by Parsons Brinckerhoff in 2013 have been incorporated into this report
- The flora surveys conducted in March and October 2014 allowed considerable validation of the existing surveys already undertaken in the study area. Plant communities identified in the field were then refined with nomenclature consistent with Bell (2008). Consideration has been given to the occurrence of areas of disturbance and associated clearing adjacent to the roadside in undertaking the assessments of significance concerning potential impacts on threatened species habitat
- Limitations of the aquatic survey are detailed in Section 1.5 and 4.1.1 of the Aquatic Survey and Assessment Report in Appendix 7.



## 3 EXISTING ENVIRONMENT

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### 3.1 Landscape context

The study area is located within the Wyong town centre, approximately 67 kilometres north of Sydney and 52 kilometres southwest of Newcastle. The study area lies in the Wyong Shire Council LGA and Hunter-Central Rivers Catchment Management Authority (CMA). Wyong River flows through the south of the study area in an easterly direction to Tuggerah Lakes (Figure 1).

The proposal study area has an elevation of between five metres and 20 metres. The site has been previously modified by the construction of the Pacific Highway and as a consequence is a relatively flat grade.

The proposal is located within the Wyong area within the larger Hornsby Plateau subdivision of the Sydney Basin and is comprised of consolidated sediments of the Triassic Hawkesbury and Narrabeen sandstone series. Extensive areas of unconsolidated alluvial soils also occur along major valleys and streams, and large deposits of Quaternary marine and Aeolian sands occur along the coastline.

The soil landscape as described in the *Soil Landscapes of the Gosford-Lake Macquarie 1:100,000 Sheet* (Murphy, 1993) identifies the proposal corridor as being part of the Central Coast Lowlands. This physiographic region is described as relatively low-lying terrain with low rises and alluvial plains.

The proposal would require ground engaging works encountering the Central Coast Lowlands to where there are soil landscapes associated with Woodburys Bridge, Gorokan and Wyong. The Gorokan soil landscapes are derived from the Terrigal formation of the Narrabeen Group of lithic and quartz sandstone, siltstone, claystone and conglomerate. The Woodburys Bridge soil landscape is a residual landscape formed on the Patonga Claystone formation. The Wyong soil landscape is generally poorly drained deltaic floodplains and alluvial flats. The geology of the Wyong soil landscape is identified as consisting of quaternary sediments.

### 3.2 Land use

The study area is located in the Wyong town centre. Land use in this urbanised area includes residential, industrial and commercial properties. The Pacific Highway is the major route through this regional centre and connects Wyong to other parts of the Central Coast.

The proposed compound sites have been previously cleared for residential, commercial or community purposes. Mature canopy trees have been retained within the former Wyong Grove Primary School grounds.

The site within the Wyong Racecourse is regularly maintained grassland adjacent to a parking lot and driveway.

The site on the corner of Howarth Street and Warner Avenue is vacant lot that has previously been cleared.

The sites south of the river on McPherson Road and South Tacoma Road contain buildings that are intended to be demolished as part of the proposal upgrade.

The site on Johnson Road is already cleared and disturbed. It is currently used for temporary stockpiling and storage activities.

To the east of the study area is the corridor associated with the Main Northern Railway. Wyong Station and the surrounding parking areas form part of the study area.

### **3.3 Vegetation communities**

Native vegetation in the study area comprises a mosaic of disturbed remnant alluvial forest dry sclerophyll forest and freshwater wetland on coastal lowlands and alluvial plain and landscaped areas on fill and imported soil.

The Natural vegetation of the Wyong Local Government Area vegetation mapping undertaken by Bell (2008) maps a range of vegetation types in close proximity to the study area (Figure 2). Patches of vegetation within the study are likely to have been too small to identify at the scale of the LGA-wide mapping. However, Bell's vegetation community classification has been used to describe vegetation found during field survey of the study area.

#### **3.3.1 Field survey results**

The following vegetation communities were identified during field survey:

- Narrabeen Dooralong Spotted Gum Ironbark Forest
- Estuarine Swamp Oak Forest
- Alluvial Redgum Foothills Forest
- Freshwater Wetland
- Alluvial Riparian Blackbutt Forest

Part of the study area is disturbed 'non-native' landscape. These areas are mostly mown exotic grassland.

Full descriptions of the vegetation communities present are provided in Appendix 1. Nomenclature of vegetation communities in Table 1 is consistent with the Natural Vegetation of the Wyong Local Government Area (Bell, 2008) and the NSW Plant Community Types Database (OEH, 2012).

There are three Endangered Ecological Communities listed under the NSW TSC Act in the study area:

- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions
- River Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner Bioregions
- Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

These are described further in Section 3.5. A vegetation community equivalence table is provided in Appendix 1 describing the relationship of Wyong vegetation communities (Bell, 2008), NSW Plant Community Types (OEH, 2012) and EECs.

None of the vegetation communities present within the study area are listed under the Commonwealth EPBC Act.


Although habitat within the study area is limited and fragmented due to the urbanised landscape, it is located on the fringes of the Racecourse Swamp, part of a complex of wetlands that drain into the Tuggerah Lakes catchment


The wetland is located north of Pollock Avenue and east of Wyong Golf Club and Wyong Racecourse. It lies on the opposite side of the railway line to the study area. The Wyong Regional Sporting Complex is located at the edge of the wetland and is likely to be contributing pollutants to the site. Livestock are permitted into parts of the wetland to access water and cars and rubbish have been dumped along the edges of the wetland (Asquith, 1997).


The study area has been divided into twelve sites representing each patch of vegetation in the study area. Sites are numbered 1-12 as per Table 1 and then described in relation to vegetation observed on the ground during field survey. A full list of species found at each site is provided in Appendix 2. The location of the 12 sites is shown in Figure 3.




**Table 1: Description of vegetation within each site**


Site	1
Location	North of Cutler Drive between Pacific Highway and Wattanobi Road
Condition	Low
Description	<p>Small roadside patch subject to pronounced edge effects. Flat to gently sloping coastal alluvial plains, Gorokan soil landscape.</p> <p>The site contains a couple of small patches of disturbed Estuarine Swamp Oak Forest with mostly landscaped understorey. The remainder of the site is cleared, mown parkland with a drainage swale running diagonally through the site and along the road verge.</p> <p>Swamp Oak (<i>Casuarina glauca</i>) is the dominant canopy species within the patches of remnant vegetation with the occasional planted eucalypt. The understorey is mainly planted with a mixture of natives and exotics including <i>Callistemon</i> and <i>Grevillea spp.</i>, Spiny-headed Mat-rush (<i>Lomandra longifolia</i>) and Commelina (<i>Commelina cyanea</i>).</p> <p>The remainder of the site is mown exotic grassland of Panic Veldtgrass (<i>Ehrharta erecta</i>), Couch (<i>Cynodon dactylon</i>) and Rhodes Grass (<i>Chloris guyana</i>) with <i>Cyperus spp.</i> and the native Broad-leaf Cumbungi (<i>Typha orientalis</i>) present in the drainage swales.</p> <p>Resilience low, unlikely to have viable soil seed bank due to past disturbance.</p>
NSW PCT	Swamp Oak Swamp Forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (BioMetric code: HU635, NSW plant community type: 1234).
Bell veg	Estuarine Swamp Oak Forest (MU3).
EEC	Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions.
Photo	


Site	2
Location	Apex Park and former primary school (compound site), adjoining Pacific Highway between Cutler Drive and North Road.
Condition	Low.
Description	<p>Roadside parkland subject to pronounced edge effects. Flat to gently sloping coastal alluvial plains, Gorokan soil landscape.</p> <p>The site contains disturbed Narrabeen Dooralong Spotted Gum Ironbark Forest with landscaped or cleared, mown understorey. A drainage swale runs along the road verge.</p> <p>Canopy trees reach about 20 metres in height and include Spotted Gum (<i>Corymbia maculata</i>), Red Ironbark (<i>Eucalyptus fibrosa</i>), Grey Ironbark (<i>Eucalyptus paniculata</i>) and Brush Box (<i>Lophostemon confertus</i>). A number of canopy trees have been planted. Smaller trees include Swamp Oak (<i>Casuarina glauca</i>) and Hickory Wattle (<i>Acacia implexa</i>). Parts of the site have a landscaped understorey with a range of native and exotic shrubs including Hibiscus and cultivated species of <i>Grevillea</i>, <i>Callistemon</i> and <i>Melaleuca</i>, with Spiny-headed Mat-rush (<i>Lomandra longifolia</i>) in the understorey.</p> <p>The remainder of the site is mown exotic grassland of Kikuyu (<i>Pennisetum clandestinum</i>), Couch (<i>Cynodon dactylon</i>) and Rhodes Grass (<i>Chloris guyana</i>) with Parrot's feather (<i>Myriophyllum aquaticum</i>) and the native Broad-leaf Cumbungi (<i>Typha orientalis</i>) present in the drainage swales.</p> <p>Resilience low, unlikely to have viable soil seed bank due to past disturbance.</p>
NSW PCT	Spotted Gum - Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin (BioMetric code: HU631, NSW plant community type: 1216).
Bell veg	Narrabeen Dooralong Spotted Gum Ironbark Forest (MU30).
EEC	n/a
Photo	


Site	3
Location	Eastern side of Pacific Highway, northern tip of study area between Pacific Highway and rail corridor.
Condition	Low
Description	<p>Linear roadside strip subject to pronounced edge effects. Flat to gently sloping coastal alluvial plains, Gorokan soil landscape.</p> <p>The site contains disturbed Estuarine Swamp Oak Forest with dense weeds in the understorey. Swamp Oak (<i>Casuarina glauca</i>) is the dominant species with a fairly closed canopy to about 10m tall with occasional <i>Melaleuca spp</i> and Water Gum (<i>Tristanopsis laurina</i>). The understorey is dominated by Lantana (<i>Lantana camara</i>), with Paspalum (<i>Paspalum dilatatum</i>) and Kikuyu (<i>Pennisetum clandestinum</i>) along the road verge.</p> <p>Resilience low, unlikely to have viable soil seed bank due to past disturbance.</p>
NSW PCT	Swamp Oak Swamp Forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (BioMetric code: HU635, NSW plant community type: 1234).
Bell veg	Estuarine Swamp Oak Forest (MU3).
EEC	Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions.
Photo	

Site	4
Location	Eastern side of Pacific Highway, northern part of study area between Pacific Highway and rail corridor.
Condition	Moderate
Description	<p>Linear roadside strip subject to pronounced edge effects. Flat to gently sloping coastal alluvial plains, Gorokan soil landscape.</p> <p>The site contains disturbed Alluvial Redgum Footslopes Forest with dense weeds in the understorey. Forest Red Gum (<i>Eucalyptus tereticornis</i>) is the dominant canopy species to about 12m in height, with <i>Melaleuca spp.</i>, Cheese Tree (<i>Glochidion ferdinandi</i>) and Blueberry Ash (<i>Elaeocarpus reticulatus</i>) present in the shrub layer. The understorey is dominated weeds including Lantana (<i>Lantana camara</i>) and Crofton Weed (<i>Ageratina adenophora</i>), with Paspalum (<i>Paspalum dilatatum</i>) and Parramatta Grass (<i>Sporobolus africanus</i>) along the road verge, although a few native species are still present in the ground layer such as Tall Saw-sedge (<i>Gahnia clarkei</i>), <i>Imperata cylindrica</i> (Blady Grass) and Harsh Ground Fern (<i>Hypolepis muelleri</i>).</p> <p>Resilience moderate, although heavily modified, there are some native species persisting in the ground layer. Evidence of limited viable native soil seed bank.</p>
NSW PCT	Forest Red Gum - Rough-barked Apple open forest on poorly drained lowlands of the Central Coast, Sydney Basin Bioregion (BioMetric code: HU546, NSW plant community type: 836).
Bell veg	Alluvial Redgum Footslopes Forest (MU15).
EEC	River Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner Bioregions.
Photo	





Site	5
Location	Eastern side of Pacific Highway, northern part of study area between Pacific Highway and rail corridor.
Condition	Moderate
Description	<p>Linear roadside strip subject to pronounced edge effects. Flat to gently sloping coastal alluvial plains, Gorokan soil landscape.</p> <p>The site contains disturbed Freshwater Wetland. The main species is Broad-leaf Cumbungi (<i>Typha orientalis</i>), with Slender Knotweed (<i>Persicaria decipiens</i>), Jointed Twig-rush (<i>Baumea articulata</i>) and Water Ribbon (<i>Triglochin procera</i>) also present. Weeds have a moderate cover through the wetland and are dense along the road verge. Exotic species include Coastal Morning Glory (<i>Ipomea cairica</i>), Largeleaf Pennywort (<i>Hydrocotyle bonariensis</i>), Coral Tree (<i>Erythrina x sykesii</i>) and Kikuyu (<i>Pennisetum clandestinum</i>) along the road verge.</p> <p>Resilience moderate, although heavily modified, there are some native species persisting in the ground layer. Evidence of limited viable native soil seed bank.</p>
NSW PCT	Coastal freshwater lagoons of the Sydney Basin and South East Corner (BioMetric code: HU533, NSW plant community type: 781).
Bell veg	Freshwater Wetlands (MU14).
EEC	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.
Photo	


Site	6
Location	Eastern side of Pacific Highway, northern part of study area between Pacific Highway and rail corridor.
Condition	Low
Description	<p>Linear roadside strip subject to pronounced edge effects. Flat to gently sloping coastal alluvial plains, Gorokan soil landscape.</p> <p>The site contains disturbed Estuarine Swamp Oak Forest with dense weeds in the understorey. Swamp Oak (<i>Casuarina glauca</i>) is the dominant canopy species to about 10m tall, with patchy native shrub cover including <i>Melaleuca spp.</i>, <i>Acacia spp.</i>, Tick Bush (<i>Kunzea ambigua</i>) and Lillypilly (<i>Acmena smithii</i>) occurring within the rail corridor fence. The understorey is dominated by Lantana (<i>Lantana camara</i>), with Camphor laurel (<i>Cinnamomum camphora</i>) also occurring. Weeds dominate the ground layer including Red Natal Grass (<i>Melinis repens</i>), African Love Grass (<i>Eragrostis curvula</i>) and Foxtail (<i>Pennisetum villosum</i>).</p> <p>Resilience low outside the rail corridor, unlikely to have viable soil seed bank due to past disturbance.</p>
NSW PCT	Swamp Oak Swamp Forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (BioMetric code: HU635, NSW plant community type: 1234).
Bell veg	Estuarine Swamp Oak Forest (MU3).
EEC	Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions.
Photo	


Site	7
Location	Town Centre median strip.
Condition	Low
Description	<p>Linear median strip subject to pronounced edge effects. Flat to gently sloping coastal alluvial plains, Woodbury's Bridge soil landscape.</p> <p>Strip of planted heritage listed Phoenix Palm (<i>Phoenix canariensis</i>) with landscaped garden consisting of mixed native cultivars and exotic species including Hibiscus (<i>Hibiscus sp.</i>), <i>Callistemon spp.</i> and Cootamundra Wattle (<i>Acacia baileyana</i>). Weeds including Mickey Mouse Plant (<i>Ochna serrulata</i>), Asparagus Fern (<i>Asparagus aethiopicus</i>) and Rhodes Grass (<i>Chloris gayana</i>) are growing scattered amongst the garden bed.</p> <p>Further north there is a row of planted Swamp Oak (<i>Casuarina glauca</i>) between the existing road and railway line</p> <p>Resilience low, man-made landscaped median.</p>
NSW PCT	n/a
Bell veg	n/a
EEC	n/a
Photo	




Site	8
Location	Eastern side of Pacific Highway, south of town centre between Pacific Highway and rail corridor, north of Wyong River.
Condition	Low
Description	<p>Narrow linear roadside strip subject to pronounced edge effects. Flat to gently sloping coastal alluvial plains, Woodbury's Bridge soil landscape.</p> <p>The site contains disturbed Estuarine Swamp Oak Forest with a weedy understorey. Swamp Oak (<i>Casuarina glauca</i>) is the dominant species with a fairly closed canopy to about 10m tall with occasional Brush Box (<i>Lophostemon confertus</i>) and a small patch of Spotted Gum (<i>Corymbia maculata</i>) in the middle of the site. The understorey is dominated by Paspalum (<i>Paspalum dilatatum</i>), Rhodes Grass (<i>Chloris gayana</i>) and Spiny-headed Mat-rush (<i>Lomandra longifolia</i>) along the road verge.</p> <p>Resilience low, unlikely to have viable soil seed bank due to past disturbance.</p>
NSW PCT	Swamp Oak Swamp Forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (BioMetric code: HU635, NSW plant community type: 1234).
Bell veg	Estuarine Swamp Oak Forest (MU3).
EEC	Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions.
Photo	

Site	9
Location	Parkland along Panonia and River Roads between the Wyong River and Pacific Highway.
Condition	Low-Moderate
Description	<p>Roadside parkland subject to pronounced edge effects. Flat to gently sloping coastal alluvial plains, Woodbury's Bridge soil landscape.</p> <p>The site contains disturbed Narrabeen Dooralong Spotted Gum Ironbark Forest with landscaped or cleared, mown or mulched understorey. Canopy trees reach about 25 metres in height and include Spotted Gum (<i>Corymbia maculata</i>), Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>), Grey Ironbark (<i>Eucalyptus paniculata</i>), Rough-barked Apple (<i>Angophora floribunda</i>) and Brush Box (<i>Lophostemon confertus</i>). Swamp Oak (<i>Casuarina glauca</i>) forms a sparse small tree layer.</p> <p>Parts of the site have a landscaped understorey with a range of native shrubs planted including Cheese Tree (<i>Glochidion ferdinandi</i>), <i>Callistemon spp.</i> and <i>Melaleuca spp.</i>. Other parts of the site, particularly along the river have a mix of naturally occurring native plants, planted native species, planted exotics and weeds. Native shrubs present include Gosford Wattle (<i>Acacia prominens</i>), Rusty Pomaderris (<i>Pomaderris ferruginea</i>) and Sydney Golden Wattle (<i>Acacia longifolia</i>) mixed with exotic Small-leaf Privet (<i>Ligustrum sinense</i>), Paddy's Lucerne (<i>Sida rhombifolia</i>) and African Olive (<i>Olea europaea subsp. cuspidate</i>). Groundcover in landscaped areas is mainly Spiny-headed Mat-rush (<i>Lomandra longifolia</i>). The native vine Common Silkpod (<i>Parsonsia straminea</i>) is present as are exotic vines including Madeira Vine (<i>Anredera cordifolia</i>) and Cape Ivy (<i>Delairea odorata</i>).</p> <p>Resilience moderate, most of the site is heavily modified, there are some native species persisting in the ground layer and naturally regenerating closer to the river. Evidence of limited viable native soil seed bank.</p>
NSW PCT	Spotted Gum - Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin (BioMetric code: HU631, NSW plant community type: 1216).
Bell veg	Narrabeen Dooralong Spotted Gum Ironbark Forest (MU30).
EEC	n/a
Photo	

Site	10
Location	Riparian vegetation around bridge between Wyong River and Panonia and South Tacoma Roads.
Condition	Low
Description	<p>The site contains disturbed Estuarine Swamp Oak Forest with a weedy understorey. Flat to gently sloping coastal alluvial plains, Wyong soil landscape.</p> <p>Swamp Oak (<i>Casuarina glauca</i>) is the dominant species with to about 8m tall. Green Wattle (<i>Acacia irrorata</i>) is present in the shrub layer north of the bridge, with Cheese Tree (<i>Glochidion ferdinandi</i>) more common south of the bridge.</p> <p>Common Reed (<i>Phragmites australis</i>) and Weeping Grass (<i>Microlaena stipoides</i>) are the main native understorey species with exotic mown grasses Couch (<i>Cynodon dactylon</i>) and Summer Grass (<i>Ehrharta erecta</i>) closer to the road verge north of the bridge.</p> <p>A range of exotic species are present in the mid and understorey of the more degraded vegetation south of the bridge including Wild Tobacco (<i>Solanum mauritianum</i>), Camphor laurel (<i>Cinnamomum camphora</i>), and Wandering Jew (<i>Tradescantia albiflora</i>).</p> <p>Resilience moderate, most of the site is heavily modified, there are some native species persisting in the ground layer and naturally regenerating. Evidence of limited viable native soil seed bank.</p>
NSW PCT	Swamp Oak Swamp Forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (BioMetric code: HU635, NSW plant community type: 1234).
Bell veg	Estuarine Swamp Oak Forest (MU3).
EEC	Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions.
Photo	

Site	11
Location	Western side of Pacific Highway, south of town centre between Pacific Highway and South Tacoma Road.
Condition	Low
Description	<p>Linear roadside strip subject to pronounced edge effects. Flat to gently sloping coastal alluvial plains, Wyong soil landscape.</p> <p>The site contains disturbed Alluvial Riparian Blackbutt Forest with a severely weedy understorey. Canopy trees reach about 30 metres in height and include Blackbutt (<i>Eucalyptus pilularis</i>), Rough-barked Apple (<i>Angophora floribunda</i>), Sydney Blue Gum (<i>Eucalyptus saligna</i>) and Spotted Gum (<i>Corymbia maculata</i>). Camphor laurel (<i>Cinnamomum camphora</i>) is also present in the canopy.</p> <p>The understorey is degraded with Coastal Morning Glory (<i>Ipomea indica</i>), Lantana (<i>Lantana camara</i>), Elephants Ears (<i>Colocasia esculenta</i>) and Rhodes Grass (<i>Chloris gayana</i>) being the most common weeds.</p> <p>There are two hollow bearing trees amongst the mature native canopy.</p> <p>Resilience low, viability of soil seed bank likely to be low due to past disturbance.</p>
NSW PCT	Closest match is Blackbutt - Rough-barked Apple - Turpentine - ferny tall open forest of the Central Coast ( NSW plant community type: 1564).
Bell veg	Alluvial Riparian Blackbutt Forest (MU43).
EEC	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.
Photo	



Site	12
Location	Eastern side of Pacific Highway, south of town centre between Pacific Highway and rail corridor, south of Wyong River.
Condition	Low
Description	<p>Narrow linear roadside strip subject to pronounced edge effects. Flat to gently sloping coastal alluvial plains, Wyong soil landscape.</p> <p>The site contains disturbed Estuarine Swamp Oak Forest with a weedy understorey. Swamp Oak (<i>Casuarina glauca</i>) is the dominant species to about 8m tall with Camphor laurel (<i>Cinnamomum camphora</i>), Small-leaved Privet (<i>Ligustrum sinense</i>) and Sweet Pittosporum (<i>Pittosporum undulatum</i>) also present. The understorey is dominated by Lantana (<i>Lantana camara</i>), Goldenrod (<i>Solidago canadensis</i>), Rhodes Grass (<i>Chloris gayana</i>) and Fleabane (<i>Conyza bonariensis</i>) along the road verge.</p> <p>Resilience low, unlikely to have viable soil seed bank due to past disturbance.</p>
NSW PCT	Swamp Oak Swamp Forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (BioMetric code: HU635, NSW plant community type: 1234).
Bell veg	Estuarine Swamp Oak Forest (MU3).
EEC	Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions.
Photo	

### ***Resilience of vegetation in the study area***

Ground-truthing during field surveys confirmed that the study area contains a mix of low to moderate condition remnant alluvial forest and wetland vegetation as well as disturbed landscapes including cleared areas, areas of vegetation dominated by weeds and landscaped parks and road verges.

Weed dominated areas comprise about 2.95 ha of the study area, in disturbed and landscaped sites. These areas have low resilience and little ecological value. Nine invasive species listed as Class 3 or 4 noxious weeds in the Wyong LGA (DPI, 2013) were identified in the study area:

- *Ageratina adenophora* (Crofton Weed)
- *Asparagus aethiopicus* (Asparagus Fern)
- *Asparagus asparagoides* (Bridal Creeper)
- *Asparagus plumosus* (Climbing Asparagus Fern)
- *Cortaderia selloana* (Pampas Grass)
- *Lantana camara* (Lantana)
- *Rubus fruticosus* (Blackberry)
- *Sagittaria platyphylla* (Sagittaria)
- *Senecio madagascariensis* (Fireweed).

Many of these weeds are also listed as Weeds of National Significance (see Table 3).



**Figure 3: Vegetation survey sites**



**Figure 3: Vegetation survey sites**



## **3.4 Fauna habitat**

### **3.4.1 Field survey results**

Habitats in the study area are highly modified as a result of development for commercial, residential, industrial or recreational uses and road and rail infrastructure. The study area can be divided into four fauna habitat types. Each of these habitat types is described below and represented in the images in Plates a) to d).

#### **a) Grassland with scattered canopy trees**

Apex Park is situated west of the Pacific Highway between North Road and Cutler Drive. The park is managed as grass or landscaped gardens below scattered canopy trees. Similar habitat occurs along River Road and Panonia Road on the banks of the Wyong River. This habitat type also occurs at four of the potential compound sites. Scattered canopy trees provide foraging opportunities for urban tolerant birds, arboreal mammals and the threatened Grey-headed Flying-fox when eucalypt species are in flower. The grassland in each of these sites, although varying in condition, provides foraging opportunities for birds. Limited shelter is available for reptiles and ground dwelling mammals. Hollows were observed in trees in the parks adjacent to the Pacific Highway and along the banks of the Wyong River.

#### **b) Wetland and drainage lines**

A small area of wetland dominated by Broad-leaf Cumbungi (*Typha orientalis*) occurs between the Pacific Highway and railway line towards the north of the study area (Figure 3). This small wetland provides potential habitat for two threatened species: the Wallum Froglet and Green and Golden Bell Frog. A stormwater drain connects this habitat to the SEPP 14 listed Wyong Racecourse Swamp to the east of the railway line, north of the Wyong Racecourse.

#### **c) Commercial district**

Wyong town centre has been highly modified to accommodate commercial and residential development. There are no native elements remaining. Some landscaping has been undertaken included several date palms. As these palms are heritage items they would be removed during construction and incorporated into the new town centre landscaping. These palms are likely to be only utilised by urban tolerant birds.

#### **d) Blackbutt gully**

South of the Wyong River, between the Pacific Highway and South Tacoma Road is a small drainage line with remnant vegetation resembling Alluvial Riparian Blackbutt Forest (Figure 3). Two hollow-bearing trees have been identified in this stand although there is no indication that these hollows are being utilised by any fauna species. The groundcover is heavily dominated by weeds.

## Plates: Fauna habitat types in the study area



## 3.5 Aquatic biodiversity

The study area is within the Hunter catchment which is the largest coastal catchment in NSW. Aquatic biodiversity values are associated with the following features.

### 3.5.1 Wyong River catchment

The catchment area of the Wyong River is about 439 square kilometres. The Wyong River originates in the Watagan Mountains and discharges into Tuggerah Lake on the Central Coast of NSW. Tuggerah Lake is the largest of three interconnected coastal lakes, which enters the Pacific Ocean via a single entrance at The Entrance. Tuggerah Lakes is listed on the Directory of Important Wetlands (Commonwealth Department of Environment). Associated with increasing human-induced disturbance, Tuggerah Lake has undergone and will continue to undergo significant disturbance.

Almost all of the permanent third order rivers and streams within Wyong LGA are considered to represent key fish habitat (KFH). In the study area, KFH is designated for the Wyong River (Section 3.6 of Appendix 7).

### 3.5.2 Wyong River at Wyong

The Wyong River is a major perennial river flowing in an eastwards direction, to the south of the Wyong town centre. The river is a lowland river, characterised by connecting wetlands.

The main aquatic habitats are 'run' (areas of moderately flowing water in the middle of the river) and 'pool' (still areas of water along the riverbanks). Shading is restricted to the margins of the Wyong River.

Within the proposal area, the Wyong River is about 55 metres wide. Further upstream, near Hope Street and River Road, the River is about 60 metres wide. Within the study area, the river has little or no major sedimentary deposits although the riverbanks have a high proportion of silt, sand and clay. The water column appears brown and opaque, indicating a high proportion of sediment is transported from the headwaters to the lower parts of the river. The riverbanks appear naturally stable with little evidence of erosion.

Fourteen macroinvertebrate taxa were found in the Wyong River which is considered to be relatively low (Watershed Ecology, 2014). The average SIGNAL value, which indicates water pollution and environmental quality through the presence and absence of invertebrates, was three, which is considered to be low but not surprising for a large river of this nature (Watershed Ecology, 2014). The high degree of sedimentation as evidenced by the opaque watercolour may be smothering interstitial spaces and lowering the oxygen concentrations in the water column, therefore restricting opportunities for a diverse and productive habitat.

The Wyong River has been classified as KFH. There are no restrictions to upstream or downstream fish passage within the study area. No threatened fish species are likely to occur in the Wyong River.

### **3.5.3 Unnamed creek**

There is a small unnamed creek just outside the study area that flows under the Pacific Highway about 150 metres south of Johnson Road.

This unnamed creek and its associated wetland appear to be subject to seasonal flows. Stream slope is low and flows are mostly rainfall dependent. Two arms flow through an industrial area before connecting and flowing under the Pacific Highway past the Pioneer Diary homestead. The creek was flowing slowly during the survey and appeared reasonably shallow. Much of the streambed is heavily vegetated with macrophytes. Detritus, or fine particulate organic matter, heavily covers the instream macrophytes and the stream substrate. Run-off and associated contaminants from impermeable surfaces in the industrial area appear to be contributing to stream condition. The riparian zone appears to be in good condition.

### **3.5.4 Wyong Racecourse Swamp**

The NSW Directory of Important Wetlands was searched for wetlands within the Lake Macquarie/Tuggerah Lakes catchment on 30 April 2014. No Ramsar wetlands are recorded within the catchment. However, six wetlands listed under the NSW Directory of Important Wetlands (DIWA) were found to occur in the Lake Macquarie/Tuggerah Lakes catchment. Of these, four wetlands occur within the Wyong LGA and two are directly downstream of the proposal (details are included in Appendix 7); the Wyong Racecourse Swamp and Tuggerah Lake.

The nearest wetland is Wyong Racecourse Swamp (Reference code: NSW 143). At its closest point, this wetland is 70 metres east of the proposal site and a culvert conveys flows under the railway line adjacent to the proposal site. Wyong Racecourse Swamp was considered in the survey as it could be vulnerable to off-site impacts associated with the

proposal. Site access was not possible as the area is private land. Therefore, only the findings of the desktop assessment are considered here.

Tuggerah Lake (code NSW 141), which is 2.6 kilometres east of the proposal or 6.5 kilometres downstream on the Wyong River. Potential impacts have been discussed in Section 4.3 of this report and Chapter 5 of Appendix 7. The Pioneer Dairy Wetlands are not listed in the DIWA but occur south of the Wyong River between the Pacific Highway and Tuggerah Lake.

Aquatic biodiversity values of the study area are further detailed in Section 4.3 of the Aquatic Flora and Fauna Report (Watershed Ecology, 2014) provided in Appendix 7.

### **3.5.5 Key fish habitat**

Key fish habitat (KFH) is identified across NSW in order to help achieve the objectives of the Fisheries Management Act, one of which is to 'conserve key fish habitats'. KFH includes all marine and estuarine habitats up to highest astronomical tide level (that reached by 'king' tides) and most permanent and semi-permanent freshwater habitats including rivers, creeks, lakes, lagoons, billabongs, weir pools and impoundments up to the top of the bank (DPI, 2011a). Small headwater creeks and gullies (first and second order streams) that only flow for a short period after rain, as well as farm dams constructed on such systems, are not included (DPI, 2011a). The Wyong River has been identified as KFH.

### **3.5.6 Bridge pylons**

The Wyong River road bridge is supported by 8 pylons, four (pylons 3 to 6) located in water over 6 m (deepest level measured being 6.7 m at tide of approximately 1.0 m). Pylons 1 and 2 are only marginally inundated whereas pylons 7 and 8 appear to be permanently inundated but relatively shallowly.

No threatened or protected species, or habitat for threatened or protected species (listed under relevant state and national environmental legislation) were detected in the study area, nor are expected to occur in the study area.

The pylons support abundant growth of barnacles which is consistent with common fouling invertebrate species found on pylons, jetties, boats, etc. The removal/replacement of the existing road pylons is not expected to impact on habitat of any importance to recreational or commercial fish species or other aquatic fauna of significance.

No seaweed, seagrass, saltmarsh, or mangrove occurs in the vicinity and therefore approval (i.e. permit to harm marine vegetation) under the FM Act is not required (écologique, 2015).

## **3.6 Threatened ecological communities**

There were no threatened or endangered ecological communities or populations listed under the FM Act within the study area.

Desktop searches identified sixteen threatened ecological communities listed under the TSC Act and/or EPBC Act within a 10 kilometre radius as occurring or potentially occurring in the study area:

- Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions



- Coastal Upland Swamp in the Sydney Basin Bioregion
- Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions
- Kincumber Scribbly Gum Forest in the Sydney Basin Bioregion
- Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Low woodland with heathland on indurated sand at Norah Head
- Lower Hunter Spotted Gum-Ironbark Forest in the Sydney Basin Bioregion
- Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions
- Quorrobolong Scribbly Gum Woodland in the Sydney Basin Bioregion
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Sydney Freshwater Wetlands in the Sydney Basin Bioregion
- Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions
- Umina Coastal Sandplain Woodland in the Sydney Basin Bioregion.

Three ecological communities listed under the TSC Act as endangered (EEC) were identified during field surveys and confirmed to be present within the study area: River-Flat Eucalypt Forest on Coastal Floodplains, Swamp Oak Floodplain Forest and Freshwater Wetlands on Coastal Floodplains (Figure 4). None of these EECs are currently listed under Commonwealth legislation.

The River-Flat Eucalypt Forest present in the study area has understorey similarities with Swamp Sclerophyll Forest on Coastal Floodplains EEC and these are often difficult to distinguish when assessing disturbed sites. However, due to the dominance of a mixed *Eucalyptus* and *Angophora* canopy, the lower abundance of *Casuarina* and *Melaleuca* species and the absence of *Eucalyptus robusta*, the vegetation is closer to the definition of River-Flat Eucalypt Forest.

There is some disturbed Narrabeen Dooralong Spotted Gum Ironbark Forest in the study area. This is a locally significant vegetation community (Bell, 2002), that in some parts of Wyong LGA potentially forms part of the Lower Hunter Spotted Gum Ironbark Forest (LHSGIF) EEC. The Narrabeen Dooralong Spotted Gum Ironbark Forest in the study area is not considered to meet the EEC definition, as although it occurs on Triassic Narrabeen group sediments, the dominant canopy species are *Corymbia maculata* and *Eucalyptus paniculata* with some *E. pilularis* and only the occasional *E. fibrosa* is present.

- ***Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions***

Associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. Typically occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes but may also occur in backbarrier landforms where floodplains adjoin coastal sandplains. Generally occur below 20 metres of elevation on level areas. They are dominated by herbaceous plants and have very few woody species. The structure and composition of the community varies both spatially and temporally depending on the water regime. Those that lack standing water most of the time are usually dominated by dense grassland or sedgeland vegetation, often forming a turf less than 0.5 metre tall and dominated by amphibious plants including *Paspalum distichum* (Water Couch), *Leersia hexandra* (Swamp Rice-grass), *Pseudoraphis spinescens* (Mud Grass) and *Carex appressa* (Tussock Sedge). Where they are subject to regular inundation and drying the vegetation may include large emergent sedges over one metre tall, such as *Baumea articulata*, *Eleocharis equisetina* and *Lepironia articulata*, as well as emergent or floating herbs such as *Hydrocharis dubia* (Frogbit), *Philydrum lanuginosum* (Frogsmouth), *Ludwigia peploides* subsp. *montevidensis* (Water Primrose), *Marsilea mutica* (Nardoo) and *Myriophyllum* spp. (Milfoils). As standing water becomes deeper or more permanent, amphibious and emergent plants become less abundant, while floating and submerged aquatic herbs become more abundant.

- **Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.**

Found on the coastal floodplains of NSW. It has a dense to sparse tree layer in which *Casuarina glauca* (Swamp Oak) is the dominant species northwards from Bermagui. Other trees including *Acmena smithii* (Lilly Pilly), *Glochidion* spp. (Cheese Trees) and *Melaleuca* spp. (Paperbarks) may be present as subordinate species, and are found most frequently in stands of the community northwards from Gosford. The composition of the ground stratum varies depending on levels of salinity in the groundwater.

Associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains. Generally occurs below 20 metres (rarely above 10 metres) elevation. The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees

- **River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.**

Found on the river flats of the coastal floodplains. It has a tall open tree layer of eucalypts, which may exceed 40 metres in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include *Eucalyptus tereticornis* (Forest Red Gum), *E. amplifolia* (Cabbage Gum), *Angophora floribunda* (Rough-barked Apple) and *A. subvelutina* (Broad-leaved Apple). A layer of small trees may be present, including *Melaleuca decora*, *M. styphelioides* (Prickly-leaved Teatree), *Backhousia myrtifolia* (Grey Myrtle), *Melia azaderach* (White Cedar), *Casuarina cunninghamiana* (River Oak) and *C. glauca* (Swamp Oak) with scattered shrubs also occurring.

The groundcover is composed of abundant forbs, scramblers and grasses including *Microlaena stipoides*, *Dichondra repens*, *Glycine clandestina*, *Oplismenus aemulus*,

*Desmodium gunnii*, *Pratia purpurascens*, *Entolasia marginata*, *Oxalis perennans* and *Veronica plebeia*. The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic shrubs, grasses, vines and forbs.

Associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. The community generally occurs below 50 metres in elevation, but may occur on localised river flats up to 250 metres above sea level. The structure of the community may vary from tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees. Typically forms mosaics with other floodplain forest communities and treeless wetlands, and often fringe treeless floodplain lagoons or wetlands with semi-permanent standing water.





### 3.7 Groundwater-dependent ecosystems

The Groundwater Dependent Ecosystems (GDEs) Atlas (BOM, 2014) identifies the Wyong River as having moderate potential for groundwater interaction where the Pacific Highway crosses the Wyong River.

The following terrestrial and wetland vegetation communities have been identified as high probability GDEs that occur in the study area (Kuginis *et al.* 2012):

- Freshwater Treeless Wetlands
- Blackbutt/ Rough-barked Apple/ Turpentine/ ferny tall open forest of the Central Coast
- Grey Ironbark/ Broad-leaved Mahogany/ Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast
- Swamp Oak swamp forest on coastal lowlands of the Central Coast and Lower North Coast
- Blackbutt/ Rough-barked Apple/ Turpentine/ ferny tall open forest of the Central Coast
- Spotted Gum/ Broad-leaved Mahogany/ Red Ironbark shrubby open forest.

These GDEs are equivalent to the vegetation communities identified in the study area referred to in Section 3.3.1.

### 3.8 Threatened species and endangered populations

#### **Flora**

Nineteen flora species and two endangered flora populations listed under the TSC Act have been recorded within 10 kilometres of the study area (OEH, 2013), twelve of which are also protected under the EPBC Act (Appendix 3). A further ten threatened flora species are identified as potentially occurring in the study area (DSEWPaC, 2103). Using a matrix based approach to determine the likelihood of occurrence (Appendix 4), the study area is considered to provide suitable habitat for ten of these species. Species that have a medium to high chance of occurring within the study area include:

- *Angophora inopina* (Charmhaven Apple)
- *Caladenia tessellata* (Thick Lip Spider Orchid)
- *Callistemon linearifolius* (Netted Bottle Brush)
- *Eucalyptus parramattensis* subsp. *parramattensis* (population)
- *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea)
- *Maundia triglochinoides*
- *Melaleuca biconvexa* (Biconvex Paperbark)
- *Rutidosis heterogama* (Heath Wrinklewort)
- *Tetradlea juncea* (Black-eyed Susan)
- *Thelymitra* sp. *adorata* (Wyong Sun Orchid)

None of the ten threatened flora species identified in the desktop assessment as having a medium to high likelihood of occurring were observed at the study area during the field survey.

A full list of flora recorded within the study area is provided in Appendix 2. Threatened flora records within one kilometre of the study area are shown in Figure 5.

## **Fauna**

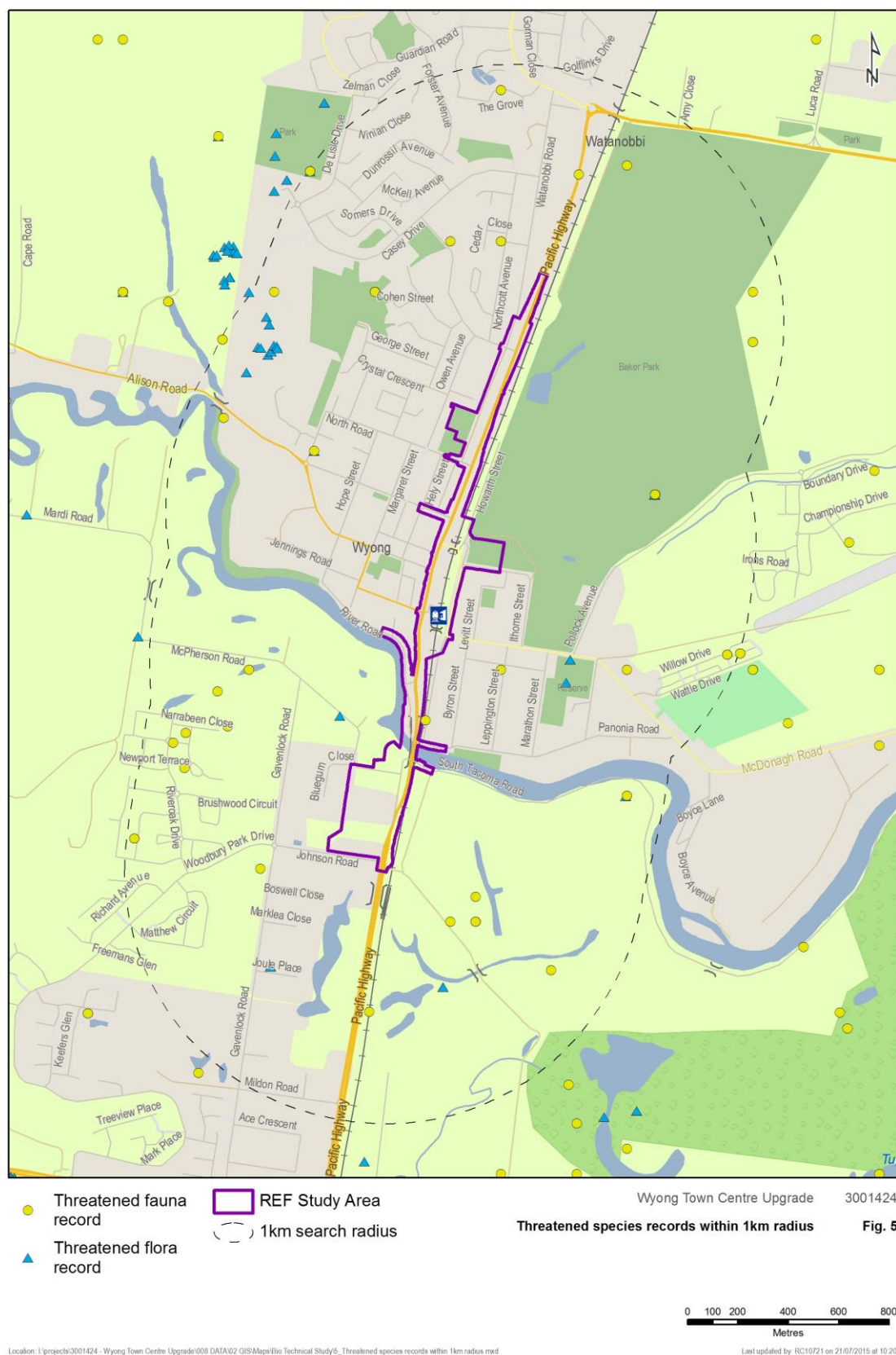
A total of 72 threatened fauna species have been recorded within 10 kilometres of the study area (OEH, 2014). Database searches identified a total of 98 species with the potential to occur within a 10 kilometre radius of the study area. Of these, 73 are listed as threatened under the TSC Act and 20 are listed as threatened under the EPBC Act (Appendix 3). Using a matrix based approach the likelihood of occurrence of these species was determined (Appendix 4). It was determined that the study area provides suitable habitat and availability of resources for 12 of these species. Threatened species that have a medium to high chance of occurring, or which have been observed within the study area include:

- *Crinia tinnula* (Wallum Froglet) – vulnerable TSC Act
- *Litoria aurea* (Green and Golden Bell Frog) – endangered TSC Act, vulnerable EPBC Act
- *Callocephalon fimbriatum* (Gang-gang Cockatoo) – vulnerable TSC Act
- *Calyptorhynchus lathami* (Glossy Black-Cockatoo) – vulnerable TSC Act
- *Glossopsitta pusilla* (Little Lorikeet) – vulnerable TSC Act
- *Ixobrychus flavicollis* (Black Bittern) – vulnerable TSC Act
- *Lathamus discolor* (Swift Parrot) – endangered TSC and EPBC Acts
- *Miniopterus schreibersii oceanensis* (Eastern Bentwing Bat) – vulnerable TSC Act
- *Mormopterus norfolkensis* (Eastern Freetail Bat) – vulnerable TSC Act
- *Myotis macropus* (Southern Myotis) – vulnerable TSC Act
- *Scoteanax rueppellii* (Greater Broad-nosed Bat) – vulnerable TSC Act
- *Pteropus poliocephalus* (Grey-headed Flying-fox) – vulnerable TSC and EPBC Acts.

No threatened species were identified during the current field investigations. Fauna surveys conducted by Parsons Brinckerhoff in 2013 identified the Eastern Freetail Bat within the study area. Microbat species that have been recorded within the 10 kilometres of the study area are unlikely to be utilising the bridge structure as roosting habitat as they prefer to roost in tree hollows or caves. However, additional surveys have been recommended to determine if any of these species are present.

A full list of fauna recorded within the study area is provided in Appendix 2. Threatened fauna records within one kilometre of the study area are shown in Figure 5.

No threatened aquatic fauna were observed utilising the habitat within the study area and none are considered likely to occur (Watershed Ecology, 2014; écologique, 2015).



**Figure 5: Threatened species records within 1kilometre radius**

### 3.9 Migratory species

A total of 38 migratory fauna species have been recorded within 10 kilometres of the study area (OEH, 2014). Database searches identified a total of 54 species with the potential to occur within a 10 kilometre radius of the study area. Of these, 14 are listed as threatened under the TSC Act and eight are listed as threatened under the EPBC Act (Appendix 3). Using a matrix based approach the likelihood of occurrence of these species was determined (Appendix 4). The study area provides suitable habitat and resources for three of these species. Migratory species that have a medium to high chance of occurring, or which have been observed within the study area include:

- *Apus pacificus* (Fork-tailed Swift)
- *Haliaeetus leucogaster* (White-bellied Sea-Eagle)
- *Hirundapus caudacutus* (White-throated Needletail).

No migratory species were identified during the current field investigations. Fauna surveys conducted by Parsons Brinckerhoff in 2013 identified the White-bellied Sea-Eagle within the study area.

### 3.10 Critical habitat

The subject site is not registered as critical habitat under NSW or Commonwealth legislation.

### 3.11 Wildlife connectivity corridors

The study area lies within an urbanised part of Wyong Shire. Residential, industrial and commercial properties occupy the majority of the study area. Remnant vegetation exists in recreational areas and roadside landscaping. Developments surrounding the study area have previously severed vegetation links through the area. Part 5 of the Wyong Shire Council *Settlement Strategy* (Wyong Shire Council, 2013) does not identify Wyong town centre as part of any 'green corridor'.

Within the majority of the study area fauna habitat connectivity is limited to canopy trees and open grassland. Roads, railways lines, buildings and fences create barriers to the movement of fauna within and through the study area. This habitat is generally suitable only for species that have been able to adapt to the urban environment. These species are generally common within the study area and throughout the region, and includes several exotic species.

The Wyong Racecourse Swamp is considered to be a 'nationally important wetland' by the Commonwealth Government (Watershed Ecology, 2014). This wetland is connected to the study area by a concrete drain under the railway line. The drain originates close to residential properties so does not provide a link to other areas of suitable habitat that may be utilised by species occupying the swamp.

A narrow strip of riparian vegetation is present along the north and south banks of the Wyong River through the study area. Roads have been constructed along parts of the river within 10 metres of the river bank, which is likely to reduce the opportunity for fauna to utilise the riparian vegetation as a corridor for movement.

### 3.12 Koala habitat

Potential koala habitat is defined by the SEPP as 'areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15 per cent of the total number of trees in the upper and lower strata of the tree component'.

In Wyong LGA koala habitat is defined as any area that has at least 15 per cent of trees in the upper and lower strata comprised of *Eucalyptus tereticornis* (Forest red gum), *Eucalyptus microcorys* (Tallowwood), *Eucalyptus punctata* (Grey gum), *Eucalyptus haemastoma* (Broad leaved scribbly gum) and *Eucalyptus robusta* (Swamp mahogany). Most koala habitat on the Central Coast has been cleared, and the remaining habitat is highly fragmented and disjunct (DECC, 2008b).

Only one of the feed tree species listed for Wyong LGA was identified within the study area; *Eucalyptus tereticornis*. This species was identified in ESUs 4, 10 and 12. General canopy cover in the study area is low, therefore, it is not considered to be potential koala habitat.



## 4 POTENTIAL IMPACTS

Impacts occur as a result of direct intervention or changes arising from indirect changes to the biophysical and ecological processes that support biodiversity values within the study area. For this proposal, the biodiversity values of the study area would be affected by a variety of indirect and direct impacts throughout the construction and operation phases of the proposal.

The potential impacts associated with this proposal and identified in this chapter consider:

- Direct and indirect impacts to biodiversity
- The scale (local and regional), timing, frequency and duration of activities that may result in impacts during construction and operational phases of the proposal
- The significance of the impact, including reasoning from the assessments of significance (AoS) included in the appendices
- Other anthropogenic activities that influence cumulative impacts to biodiversity in the area.

### 4.1 Loss of vegetation/habitats

The proposal would result in the clearing of 6.40 hectares of vegetation ranging in quality from highly disturbed to moderate condition. The proposal would result in the removal of an estimated 2.2 hectares of EEC, 1.2 hectares of other low to moderate condition native vegetation and 3 hectares of modified vegetation.

**Table 2: Summary of area of vegetation to be cleared**

Vegetation	TSC Act	EPBC Act	Area to be cleared <sup>1</sup>	Total area in the Locality (10km) <sup>2</sup>
Narrabeen Dooralong Spotted Gum Ironbark Forest	N	N	1.2 ha	2898 ha
Estuarine Swamp Oak Forest	Y	N	1.7 ha	320 ha
Alluvial Redgum Footslopes Forest	Y	N	0.2 ha	20 ha
Freshwater Wetland	Y	N	0.14 ha	171 ha
Alluvial Riparian Blackbutt Forest	Y	N	0.2 ha	1,309 ha
Disturbed landscape/plantation	-	-	2.9 ha	-
<b>Total</b>			<b>6.4 ha</b>	

1 Area to be cleared based on construction impact area within the study area.

2 Based on mapped extent within 10 km radius (Bell 2008, LHCCREMS 2003).

The proposed clearing of vegetation associated with the proposal would result in the loss or degradation of habitat including:



- Direct and potential indirect impacts on alluvial and wetland plant communities with local, regional and state conservation significance (including three EECs)
- Loss of habitat for threatened species known or likely to occur in the study area including a small wetland that may be suitable for the Wallum Froglet and Green and Golden Bell Frog
- Minor loss of structural diversity suitable as shelter and/or nutritional resource to a range of fauna species known to occur, or potentially occurring within the study area
- Removal of hollow bearing trees that may provide habitat for small arboreal mammals, microchiropteran bats and woodland birds
- Removal of the bridge over Wyong River that may provide roosting habitat for microbats
- Loss of nectar-producing trees. The removal of some eucalypt species from parks and roadside vegetation would occur. This would remove potential foraging habitat for the Grey-headed Flying-fox, some microchiropteran bats and woodland birds including the threatened Little Lorikeet and Swift Parrot.

Vegetation removal would occur early in the construction phase of the proposal, and may be staged in accordance with construction limitations. Clearing within the site would be undertaken in accordance with the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA Environment Branch, 2011) in order to minimise disturbance to surrounding flora and fauna habitat.

Assessments of Significance have been undertaken to address potential impacts on threatened and migratory species and habitat identified in Sections 3.8 and 3.9 (Appendices 5 and 6).

## 4.2 Wildlife connectivity and habitat fragmentation

The proposal is unlikely to result in the severing of any wildlife corridors through the study area or at a regional scale. Vegetation occurs as isolated fragments in a disturbed urban environment. No wildlife corridors have been identified within the proposal area (Wyong Council, 2014).

The existing riparian corridor along the banks of the Wyong River is narrow due to previous land clearing for urban development and roads. The proposal provides an opportunity to enhance the riparian corridor through weed removal and revegetation.

## 4.3 Hydrology and drainage

The surface and ground water levels and flows within the proposal study area and their potential for change as a result of the proposal were investigated in a *Hydrology and Hydraulics Assessment Report* prepared by SMEC for Roads and Maritime. The report outlines that large flood events have the potential to increase sedimentation of aquatic ecosystems; particularly wetlands. The project is unlikely to have any negative impact on groundwater (SMEC 2014).

The proposal has the potential to alter hydrological flows in two areas:



- Wyong River
- Under the railway and into Racecourse Swamp

Modelling has found that in a Probable Maximum Flood (PMF) event there would be changes to the flow of Wyong River under the proposed twin bridges. The new bridges would be at a higher level above the water than the previous road bridge, removing the blockage caused by the old structure during flood events. Furthermore, the piers of the new twin bridges would be aligned with the existing rail bridge, improving flows through this part of the river. As a result of the increased flow from less restriction, flood levels upstream of the bridge would be lower as the water would move more quickly downstream (SMEC, 2014).

North of the Wyong town centre the catchments drain into channels along Apex Park and then into culverts under the highway. The existing culverts at the railway line act as a bottleneck for this flow. Flood flows collect in the narrow drainage channel between the road and railway and eventually discharge through the railway culverts (SMEC, 2014). These culverts eventually flow in the Racecourse Swamp.

As part of the current proposal, the drainage channel would be relocated further to the west to accommodate the highway widening. The highway drainage culverts have been supplemented in order to ensure that there would be no flooding impacts upstream (west of the highway), with upstream impacts confined to the Apex Park corridor. Downstream of the railway line, there is no impact upon the flood level. Therefore, water flows into the Racecourse Swamp are not expected to be affected by the current proposal.

The Pioneer Dairy Wetlands located to the east of the railway line south of the river would not be impacted as a result of the proposal.

Potential changes to aquatic habitat are discussed below in Section 4.4.

## 4.4 Aquatic habitat

This Section 4.4 is mainly summarised from the report *Aquatic Flora and Fauna Report for the Pacific Highway Upgrade through Wyong Town Centre* prepared by Watershed Ecology in May 2014 (Appendix 7).

Potential impacts of the proposed activity include degradation of aquatic habitat, changes to hydrology and the enhancement of Key Threatening Processes. KTPs are discussed in Section 4.9

### 4.4.1 Degradation of aquatic habitat

The proposal would require construction activities within the riparian zone and within the Wyong River itself and would have the potential to impact on Key Fish Habitat (KFH). Construction would also occur upstream of the Racecourse Swamp and the Pioneer Dairy wetland.

The following impacts on aquatic habitat during construction have the potential to occur if mitigation measures are not imposed:

- Degradation of water quality through increased sedimentation from the proposal
- Loss of invertebrates from Wyong Bridge piers

- Loss of macrophytes and riparian vegetation
- Elimination of instream and riparian habitat
- Obstruction of aquatic fauna passage in the Wyong River.

The instream habitats in the proposal area are not expected to undergo a significant change in condition due to the proposal. However, environmental controls would be applied to mitigate against any residual risk to aquatic environments.

The removal/replacement of the existing road pylons is not expected to impact on habitat of any importance to recreational or commercial fish species or other aquatic fauna of significance. No seaweed, seagrass, saltmarsh, or mangrove occurs in the vicinity (écologique, 2015).

#### **4.4.2 Changed hydrology**

As noted in Section 4.3 , the proposal would result in changes to hydrology at the Wyong River and north of the town centre.

The proposed realignment of the piers for the new Wyong River bridges would not have a negative impact on fish passage during operation. The changes in hydrology in flood events is otherwise unlikely to have an impact on aquatic habitat in the Wyong River.

At its closest point, the Racecourse Swamp wetland is situated 70 metres east of the proposal site and a culvert connects flows under the railway line adjacent to the proposal site. While the proposal site is not directly within Racecourse Swamp, surface flows from the culvert would originate from the Pacific Highway within the proposal site. Since wetlands typically retain sediment, any increases in sediment-laden waters from the proposal site would require management to abate the adverse environmental risks to wetland condition. The proposal would have the potential to result in increased sedimentation conveyance during construction and increased pollutant run-off during operation as a result of the increased road surface area.

### **4.5 Injury and mortality**

Habitat clearing to accommodate the proposal may lead to increased incidences of fauna interactions with vehicles and hence injury or mortality. Although the existing road network already poses an injury/mortality threat to native fauna it is likely that the risk would be higher during construction, particularly during habitat removal when fauna may be forced to relocate. This risk is most relevant to frogs, if present, and small native skinks, as it is unlikely that there would be any resident native arboreal or ground-dwelling mammals within the study area due to lack of suitable habitat. Once constructed, it is anticipated the proposal would facilitate an increase in traffic volumes through the study area, which could increase the likelihood of vehicle strike in the long term compared to the existing road.

### **4.6 Weeds**

Nine species of Class 3 and 4 noxious weeds listed within the Wyong LGA or Weeds of National Significance (WoNS) have been identified in the study area (Table 3).

**Table 3: Noxious weeds recorded in the study area**

Scientific Name	Common Name	Class	Legal requirements
<i>Ageratina adenophora</i>	Crofton Weed	4, WoNS	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed.
<i>Asparagus aethiopicus</i>	Asparagus Fern	4	The plant must not be sold, propagated or knowingly distributed.
<i>Asparagus asparagoides</i>	Bridal Creeper	4	The plant must not be sold, propagated or knowingly distributed.
<i>Asparagus plumosus</i>	Climbing Asparagus Fern	4	The plant must not be sold, propagated or knowingly distributed.
<i>Cortaderia selloana</i>	Pampas Grass	3, WoNS	The plant must be fully and continuously suppressed and destroyed and the plant must not be sold, propagated or knowingly distributed.
<i>Lantana camara</i>	Lantana	WoNS	Not listed as a noxious weed in Wyong LGA.
<i>Rubus fruticosus</i>	Blackberry	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed.
<i>Sagittaria platyphylla</i>	Sagittaria	4, WoNS	The plant must not be sold, propagated or knowingly distributed.
<i>Senecio madagascariensis</i>	Fireweed	4, WoNS	The plant must not be sold, propagated or knowingly distributed.

Mechanical vegetation removal, earthworks, vehicle movements and increased human activity during construction has the potential to facilitate the spread of weeds. The overall risk of such spread is considered to be generally low due to the already disturbed nature of the site and the management measures proposed. This includes undertaking weed control works and habitat enhancement following construction of the proposal in accordance with the *Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA projects* (RTA Environmental Branch 2011).

## 4.7 Pests and pathogens

Although vegetation in the study area did not appear to be obviously affected by dieback, the study area may be potentially contaminated with *Phytophthora cinnamomi*. Infection of native plants by *P. cinnamomi* is listed as a key threatening process both in NSW and nationally. Evidence of *P. cinnamomi* induced die-back has been identified in several vegetation classes including coastal heaths and woodlands (DECC 2008b). Ongoing loss of understorey species infested with *Phytophthora* can indirectly affect threatened fauna species through the loss of cover, food resources and nesting habitat (DECC 2008b). Activities associated with

this proposal have the potential risk of introducing or spreading *P. cinnamomi* to the study area so a precautionary approach to managing this disease should be taken.

Although vegetation in the study area did not appear to be obviously affected by Myrtle rust, the study area is potentially contaminated. DPI has mapped Wyong LGA as a 'red' management zone, where the fungus is considered to be widely distributed. Myrtle rusts are serious pathogens which affect plants belonging to the family Myrtaceae including Australian natives like bottle brush (*Callistemon* spp.), tea tree (*Melaleuca* spp.) and eucalypts (*Eucalyptus* spp.). These occur throughout the study area. Infection of native plants by Myrtle rust can indirectly affect threatened fauna species through the loss of cover, food resources and nesting habitat.

Six introduced species were observed during field investigations; the Mallard (*Anas platyrhynchos*), Common Myna (*Acridotheres tristis*), Rock Dove (*Columba livia*), European Rabbit (*Oryctolagus cuniculus*), Brown Hare (*Lepus europaeus*) and Black Rat (*Rattus rattus*). The study area is also likely to provide habitat for other introduced fauna. The proposal is unlikely to increase the presence of introduced fauna in the study area.

There is a small area of potential Green and Golden Bell Frog habitat within the study area. This species is susceptible to the amphibian chytrid fungus. Due to the disturbed nature of the site it is likely that the disease has been previously introduced. Development activities associated with this proposal have the potential risk of introducing or spreading chytrid to the study area so a precautionary approach to managing this disease should be taken.

The Mosquito Fish (*Gambusia holbrooki*) is an exotic pest in NSW and is recorded as occurring in the Wyong catchment of the Hunter Central CMA. This species thrives in shallow slow flowing water bodies and can tolerate a wide range of temperatures and water quality. Mosquito fish can reproduce several times a year throughout the warmer months and local populations can grow rapidly (DPI 2013). The proposed works are unlikely to affect the presence of this species, however, 'predation by *Gambusia holbrooki*', a key threatening process under Schedule 3 of the TSC Act (refer to Section 5.1.3 of Appendix 7), may be enhanced.

## **4.8 Noise, vibration and light**

It is unlikely the proposal would result in significant changes to existing levels of noise, vibration and light from the existing road network and surrounding urbanised environment such that there would be a significant impact to native fauna species.

There is potential for some resident and visiting native fauna to temporarily avoid habitats directly adjacent to the proposal during construction, with bat species being particularly sensitive to any change in street lighting that may be associated with road upgrades.

## **4.9 Key threatening processes**

The following key threatening process (KTPs) listed under the EPBC, TSC or FM Acts are considered relevant to the proposal:

- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands (TSC Act)

- Installation and operation of instream structures and other mechanisms that alter natural regimes of rivers and streams (FM Act)
- Land clearance (EPBC Act)  
Clearing of native vegetation (TSC Act)
- Competition and land degradation by rabbits (EPBC Act)  
Competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*) (TSC Act)
- Infection of amphibians with chytrid fungus resulting in chytridiomycosis (EPBC Act)  
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis (TSC Act)
- Invasion and establishment of exotic vines and scramblers (TSC Act)
- Invasion, establishment and spread on Lantana (*Lantana camara*) (TSC Act)
- Invasion by native plant communities by exotic perennial grasses (TSC Act)
- Invasion of native plant communities by African Olive (*Olea europaea* L. subsp. *cuspidate*) (TSC Act)
- Predation by the Plague Minnow (*Gambusia holbrooki*) (TSC Act)
- The introduction of fish to fresh waters within a river catchment outside their natural range (FM Act)
- Removal of large woody debris from New South Wales rivers and streams (FM Act)
- Degradation of native riparian vegetation along New South Wales watercourses (FM Act)

These are discussed in more detail in the following sections.

#### **4.9.1 Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands**

The proposal would not result in the alteration of any natural flow regimes. Drainage lines that would be modified by the proposal have been altered by previous development. There is likely to be minimal change to the flows from the study area into the Racecourse Swamp.

Wyang River has been modified by the installation of the Wyong Weir and fishway upstream of the study area. The weir was constructed in 1968 and contributes to the town water supply (DPI, 2006). It is likely that other changes have been made to flows throughout the Wyong River catchment for agriculture and to accommodate urban development.

Excavation may be required between McPherson Road and the Wyong River to provide suitable drainage during flooding events. These works would not alter the existing flow of the Wyong River (SMEC 2014). Replacement of the bridge over Wyong River would cause some temporary disruption to flow during the construction period.

#### **4.9.2 Clearing of native vegetation**

The proposal would result in the clearing of 6.40 hectares of vegetation ranging in quality from highly disturbed to moderate condition. This includes 3.5 ha of native vegetation. Highly modified areas in low condition are weed dominated or existing planted or landscaped road verges.

#### **4.9.3 Competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*)**

The final determination for this KTP states that grazing and burrowing by rabbits can result in erosion and significant changes to the landscape. Competition for food resources and displacement from burrows is not relevant as no native ground dwelling mammals are likely to utilise this site. Grazing by rabbits may reduce regrowth of vegetation post-construction and limit revegetation through landscape plantings.

#### **4.9.4 Infection of frogs by amphibian chytrid causing the disease chytridiomycosis**

Chytridiomycosis is a fatal disease of amphibians and is caused by the chytrid *Batrachochytrium dendrobatidis* (NSW Scientific Committee 2002). It is potentially fatal to all native species of amphibian. The Green and Golden Bell Frog is susceptible to chytridiomycosis and has potential to occur in the study area. As the study area and surrounding landscape are highly disturbed, it is likely that the chytrid fungus is already present within the study area so would not be introduced or spread by the proposal.

#### **4.9.5 Invasion and establishment of exotic vines and scramblers**

The final determination for this KTP states that exotic vines and scramblers may act as transformer species by altering the nature of the environment where they become dominant (NSW Scientific Committee 2006a). Exotic vines and scramblers may smother existing vegetation, both in the ground layer and canopy. This alters the light climate in the invaded community and may suppress regeneration of native species. This KTP is relevant to the study area as bridal creeper (*Asparagus asparagoides*), madeira vine (*Anredera cordifolia*), coastal morning glory (*Ipomea cairica*), potato vine (*Acetosa sagittata*) and moth vine (*Araujia serrifera*) occur. If not properly managed these exotic species could spread further throughout remnant native vegetation in the study area.

#### **4.9.6 Invasion, establishment and spread on Lantana (*Lantana camara*)**

The final determination for this KTP states that *Lantana camara* readily invades disturbed sites and communities. Various types of sclerophyll woodlands, sclerophyll forests, rainforests and dry rainforests are all susceptible to lantana establishment, although in communities with a naturally dense canopy, Lantana colonisation may be heavily dependent upon, and limited to, disturbance zones, edges, and canopy breaks. There is a strong correlation between lantana establishment and disturbance with critical factors being disturbance-mediated increases in light and available soil nutrients (NSW Scientific Committee 2003a). Lantana is present in the study area and thus this KTP is relevant to the proposal. If not properly managed, this exotic species could spread further throughout the study area.

#### **4.9.7 Invasion of native plant communities by exotic perennial grasses**

The final determination for this KTP states that the characteristics of vigorous growth, prolific seed production and effective seed dispersal enable many exotic perennial grasses to compete strongly with, or in some places displace, native vegetation (NSW Scientific Committee 2006b). Exotic perennial grasses may also change the fuel load in plant communities. The changed structure and fire regimes of the habitat are likely to adversely



affect both native vertebrate and invertebrate fauna. This KTP may be relevant because there are a number of exotic perennial grass species listed in the final determination that were recorded within the study area including Kikuyu (*Pennisetum clandestinum*) and African Lovegrass (*Eragrostis curvula*). If not properly managed these exotic species could spread further throughout remnant native vegetation in the study area.

#### **4.9.8 Invasion of native plant communities by African Olive (*Olea europaea* L. subsp. *cuspidate*)**

The final determination for this KTP states that African Olive is a highly persistent and long lived tree which fundamentally alters ecosystem structure through the formation of a dense mid-canopy in native vegetation communities. The dense canopy structure of African Olive creates deep shade at the ground level, preventing the growth of native grasses and herbs. This species produces large crops of small black fruits which are readily consumed and dispersed by a range of native and introduced birds (NSW Scientific Committee 2010). African Olive is present in the study area and thus this KTP is relevant to the proposal. If not properly managed this exotic species could spread further throughout the study area and adjoining lands.

#### **4.9.9 Predation by the plague minnow (*Gambusia holbrooki*)**

*Gambusia holbrooki* (Plague Minnow, also known as Mosquito Fish) is a small freshwater fish that is an aggressive and voracious predator. It is known to prey upon eggs and tadpoles of Green and Golden Bell Frog and is linked to the decline of several bell frog species. Predation by *Gambusia holbrooki* is listed as a key threatening process because it adversely affects two or more threatened species and it could cause species that are not threatened to become threatened.

*Gambusia* prefer warm still or slow flowing water. However they are extremely tolerant of any water conditions, and can withstand temperature ranges from -4°C (water under ice) to 44°C. They prefer freshwater but can live in saltier water and are commonly found in estuaries (NSW NPWS 2003). The works are not expected to introduce the Mosquito Fish to any aquatic ecosystem as their flows and morphology would remain unchanged.

#### **4.9.10 Instream structures and other mechanisms that alter natural flow**

Instream structures that modify natural flow include dams, weirs, canals, navigation locks, floodgates, culverts, flow regulators, levee banks, erosion control structures, and causeways. Mechanisms that alter natural flow regimes include the operation of the above structures as well as water extraction, pumping and diversion, and sand and gravel extraction.

Alteration to natural flow regimes can occur by reducing or increasing flows; altering the seasonality of flows; changing the frequency, duration, magnitude, timing, predictability and variability of flow events; altering surface and subsurface water levels; changing the rate of rise or fall of water levels; and by altering water temperatures.

#### **4.9.11 The introduction of fish to fresh waters within a river catchment outside their natural range**

At least 11 non-native species currently have self-sustaining populations in NSW waterways. Fish introduced to waters outside their natural range can impact on native flora and fauna in



a number of ways including predation, competition for resources, habitat degradation and by the spread of diseases. Several threatened species are affected by this threatening process.

One of these species, the plague minnow, occurs in the Tuggerah Lakes catchment.

#### **4.9.12 Removal of large woody debris from NSW rivers and streams**

Large woody debris provides important habitat and shelter for native fish and other aquatic organisms in the rivers of NSW. Snags are often used for breeding and resting locations and they provide shelter from predators. The removal of large woody debris adversely affects several threatened species.

Since the Wyong River is a large, lowland river, and it flows into Tuggerah Lake, large woody debris would occur in the River and the Lake. On the other hand, Racecourse Swamp and the unnamed Creek would not support large woody debris.

The Proposal does not require the removal of instream habitat.

#### **4.9.13 Degradation of native riparian vegetation along NSW watercourses**

Riparian vegetation is vegetation on land that adjoins, directly influences or is influenced by, a body of water. Riparian vegetation is found alongside creeks and rivers, areas around lakes, wetlands and on river floodplains. It is part of a healthy functioning ecosystem and has numerous ecological benefits. Riparian vegetation is degraded by the complete removal or modification of native plants by processes such as clearing, gravel extraction, cropping, livestock grazing, trampling and introduction of, or invasion by, non-native species. Riparian vegetation degradation along NSW watercourses has been listed as a KTP because of its negative impacts on threatened species, populations and ecological communities listed under the FM Act.

Degradation of riparian vegetation adversely affects several species that are listed as vulnerable and or endangered under the FM Act. However, the occurrence of any threatened species is unlikely as the urban area would not support the environmental requirements of these biota.

### **4.10 Koala habitat**

SEPP 44 concerns the protection of koala habitat through proper conservation and management of areas of natural vegetation that provide habitat for koalas. Determination of the likelihood of the presence of core koala habitat is made by an appropriately qualified professional based on evidence of koala usage, or areas of native vegetation that provide potential habitat. No individuals, or characteristic scratching or scats, were identified during the flora and fauna habitat survey. Only one tree species listed as a feed tree for the koala in the Wyong LGA was identified in the study area; *Eucalyptus tereticornis*.

There is no evidence to suggest a resident koala population exists within the study area. Core koala habitat is defined by the SEPP as 'an area of land with a resident population of koalas, evidenced by attributes such as breeding females'. It has therefore been concluded that there is no core koala habitat located within the study area and the project is unlikely to have an impact on core koala habitat.

The study area does not contain habitat critical to the survival of the koala according to the Draft EPBC referral guidelines for the vulnerable koala (DoE 2013).

#### **4.11 Cumulative impacts**

The proposal area has been the subject of a long history of anthropogenic change. This includes obvious historical impacts that have altered or changed the biophysical and ecological process supporting biodiversity in the area. These changes, as well as those still operating, can contribute to overall cumulative impacts upon species, populations and communities also affected by this proposal. In this regard, cumulative impacts identified in this section are those which are obviously associated with other nearby development and may combine to result in cumulative impacts on species, populations and communities also affected by this proposal.

The main impact of the proposal would be the removal of low quality vegetation and street trees. The existing urban development in the locality and the quality of this vegetation already limit its value as flora and fauna habitat. While the proposal would entail further removal of habitat, it would not cause loss of connectivity with proximate habitat areas. Therefore, the impact of habitat clearing in this context is likely to be negligible.

Other major developments occurring in the Wyong Shire include the upgrade of the M1 Pacific Motorway and the rezoning of Warnervale Town Centre, both of which involve the clearing of large areas of native vegetation. This gradual removal of habitat is likely to have long term adverse impacts on flora and fauna in the region.

The proposal has been designed to accommodate a future upgrade to the Main Northern Rail Corridor through Wyong town centre. This corridor is directly adjacent to the study area and would contribute to alteration of the natural landscape. Substantial hydrological modifications are likely to result if the railway line expands across existing drainage channels in the Wyong Shire.

#### **4.12 Other sensitive ecological sites protected by State or local planning instruments**

##### **4.12.1 Key fish habitat**

The Wyong River has been identified as KFH. The proposal would require the demolition of the existing Pacific Highway bridge over the Wyong River and construction of new twin bridges. These activities would result in temporary disruption to flows as old pylons are removed and new pylons are constructed. These actions would not disrupt fish passage in the Wyong River.

##### **4.12.2 State Environmental Planning Policy 14 (SEPP 14) – Coastal Wetlands**

With the exception of Racecourse Swamp and Tuggerah Lake, surface flows from the proposal would not affect the remaining wetlands east of the proposal as they are surrounded by urban areas and/or are not directly connected to the area.

The western part of Tuggerah Lake, near the mouth of the Wyong River, is a designated SEPP 14 wetland. For this wetland, any adverse impacts would be diffuse with a significant time-lag. Much of Tuggerah Lake is surrounded by an urban environment meaning that the condition of the Lake and the SEPP 14 wetland has been historically adversely affected by existing and ongoing development activities.

Racecourse Swamp is 70 metres east of the northern part of the proposal. A culvert connects flows under the railway line adjacent to the proposal site. While the proposal site is not directly within Racecourse Swamp, the potential for adverse impacts as a result of construction of the proposal and operation cannot be discounted. To abate the potential for adverse impacts to these wetlands, water quality measures would need to be implemented during all stages of construction.

Further detail on the statutory requirements relating to SEPP 14 is provided in the REF.

#### **4.12.3 Directory of Important Wetlands Australia**

The nearest wetland is Wyong Racecourse Swamp (see Section 3.5.4) and downstream of the Proposal is Tuggerah Lake (code NSW 141). Potential impacts to these wetlands have been discussed in Section 4.3 of this report and Chapter 5 of Appendix 7.

## 5 MITIGATION MEASURES

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### 5.1 Recommended mitigation measures

#### 1. Minimise loss of native vegetation to the proposed development activities in the study area.

- Where possible, retain native vegetation in the study area, particularly vegetation that is classified as an EEC.
- Ensure that construction access tracks, compound facilities and construction areas along the road verge are sited in previously cleared/disturbed areas, wherever possible.
- Vegetation clearing would be undertaken in accordance with the RMS Biodiversity Guidelines (RTA, 2011).
- Offsetting for impacts on EEC vegetation should be investigated in accordance with the Roads and Maritime *Guideline for Biodiversity Offsets* (RMS, 2011).

#### 2. Manage threats to threatened species habitat.

- Implement a Site Erosion and Sediment Control Plan or Soil Water Management Plan, in accordance with the Blue Book (Landcom 2004).
- Manage stormwater to ensure that the existing hydrology of wetlands within and adjoining the proposal area is maintained, including periodic drying to prevent colonisation by *Gambusia holbrooki*.

#### 3. Minimise risk of establishment and spread of invasive species due to the proposed development activities in the study area.

- Install no-go zones to control the movement of vehicles, and human traffic, around areas of native vegetation.
- Declared noxious weeds would be managed according to requirements under the *Noxious Weeds Act 1993* and Guide 6 (Weed Management) and Guide 10 (Aquatic Habitats and Riparian Zones) of the Roads and Maritime *Biodiversity Guidelines* (RTA, 2011).
- Undertake weed control in accordance with the Roads and Maritime *Biodiversity Guidelines* (RTA, 2011).

#### 4. Minimise risk of introduction of diseases that may cause decline of threatened biota due to the proposed development activities in the study area.

- Implement controls on the movement of vehicles, and human traffic into native vegetation.
- Pathogens (eg Chytrid, Myrtle Rust and Phytophthora) are to be managed in accordance with Guide 7 (Pathogen Management) of the Roads and Maritime *Biodiversity Guidelines* (RTA, 2011); *Statement of Intent 1: Infection of native plants by Phytophthora cinnamomi (for Phytophthora)* (DECC, 2008b); *Myrtle Rust response 2010–11: Preventing spread of Myrtle Rust in bushland* (DPI, 2010) and *Interim management plan for Myrtle Rust in bushland* (OEH, 2011).

## **5. Minimise impact on native fauna and their habitat.**

- Restrict use of pesticides particularly near watercourses and immediately before or during wet weather.
- Retain mature and hollow bearing trees, including eucalypts, where possible.
- Retain nectar producing trees and shrubs, where possible.
- Undertake surveys for microbats that may be roosting under the bridge prior to demolition (during detailed design and pre-clearing).
- If bats are found, a bat management plan would be developed and implemented prior to commencement of construction, including reassessment of the impact of the proposal on the species present.
- Investigate options for providing microbat roosting habitat in the new bridge structure, where required.
- Undertake post-construction revegetation and restoration in accordance with Roads and Maritime *Biodiversity Guidelines* (RTA, 2011).
- If unexpected threatened fauna or flora species are discovered, stop works immediately and follow the Roads and Maritime Unexpected Threatened Species Finds Procedure in the Roads and Maritime *Biodiversity Guidelines – Guide 1 (Pre-clearing process)* (RTA, 2011).
- WIRES should be consulted if any injured fauna are encountered.
- Fauna handling must be carried out in accordance with the requirements the Roads and Maritime *Biodiversity Guidelines - Guide 9 (Fauna Handling)* (RTA, 2011).

## **6. Minimise impacts upon aquatic habitat.**

- Consideration of operational water quality controls, particularly south of Cutler Drive would be undertaken during detailed design.
- Establish erosion and sediment control measures, including in-stream control structures, prior to works commencing and retain them until ground is stable or turbidity levels match adjoining river water.
- Temporary limit of work fencing is to be established for riparian vegetation to limit the clearing as much as possible.
- Measures to manage fish passage on the Wyong River during construction would be included in the CEMP.
- If blockage of fish passage on the Wyong River is required, a permit in accordance with Section 220 of the *Fisheries Management Act 1994* must be obtained.
- Revegetation of the riparian zone would incorporate plantings of locally indigenous mature trees, bushes and grasses where possible and would be undertaken as early as possible.
- Appropriate bank protection would be installed on the Wyong River underneath the new bridges where revegetation is unlikely to be suitable.
- Removal of waste material and rubbish accumulated in and around aquatic habitat after construction.

## **7. Management of erosion and sediment control.**

- A progressive erosion and sediment control plan is to be prepared for the works in accordance with the current *Managing Urban Storm Water: Soils and Construction* (Volume 1- Blue Book) (Landcom, 2004), Volume 2A (DECC, 2008b) and Volume 2D (DECC, 2008c) and Roads and Maritime specification “G38 Soil and Water Management”.
- Erosion and sediment control measures are to be implemented to prevent sediment moving off-site and sediment laden water entering any water course, drainage lines, drain inlets or fauna habitat.
- Specific consideration of erosion and sediment controls should be made during construction to prevent any indirect impacts on adjacent SEPP 14 wetlands.
- Erosion and sedimentation controls are to be checked and maintained on a regular basis (including clearing of sediment from behind barriers) and records kept and provided on request.
- Erosion and sediment control measures are not to be removed until the works are complete and areas are stabilised.
- Rehabilitate disturbed areas as soon as practical, through progressive landscaping to stabilise bare areas and to take advantage of optimal growing conditions.





## 6 SIGNIFICANCE ASSESSMENTS

### 6.1 Summary of assessments

A summary of the findings of assessments of significance for all species listed under the TSC and EPBC Acts which were found to occur, or have potential to occur, in the study area is provided in Table 4 and Table 5, respectively. The comprehensive details of the assessments of significance in accordance with the requirements of Part 5 of the EP&A Act for each threatened species or community are provided in Appendix 5. Details associated with impacts of the proposal on threatened species and communities of National Environmental Significance (NES) are provided in Appendix 6. The matrix used to determine the likelihood of occurrence is provided in Appendix 4.

Previous surveys have identified the threatened Eastern Freetail Bat (*Mormopterus norfolkensis*) and migratory White-bellied Sea-eagle (*Haliaeetus leucogaster*) within the study area. The study area contains potential habitat for 10 threatened flora species, 12 threatened fauna species and three migratory species listed under the TSC and/or EPBC Act (Appendix 3).

Assessments of significance were undertaken based on the following assumptions: the road widening and associated ancillary works would result in the loss of approximately 6.40 hectares of vegetation, including 3.5 hectares of native vegetation and 2.2 hectares of which is EEC. There would be no vegetation clearing in compound sites and mitigation measures are to be fully implemented.

The results of the assessments of significance determined that no species, populations or ecological communities listed under the TSC Act or EPBC Act are likely to be subject to a significant impact as a result of the proposal if all mitigation measures are adopted (Section 5).

**Table 4: Summary of the findings of significance assessments under the EP&A Act**

Threatened species, population or communities	Significance assessment question <sup>1</sup>							Likely significant impact?
	a	b	c	d	e	f	g	
<i>Crinia tinnula</i> (Wallum Froglet)	N	X	X	N	N	N	Y	No
<i>Litoria aurea</i> (Green and Golden Bell Frog)	N	X	X	N	N	N	Y	No
<i>Callocephalon fimbriatum</i> (Gang-gang Cockatoo)	N	X	X	N	N	N	Y	No
<i>Calyptorhynchus lathamii</i> (Glossy Black-Cockatoo)	N	X	X	N	N	N	Y	No
<i>Glossopsitta pusilla</i> (Little Lorikeet)	N	X	X	N	N	N	Y	No
<i>Ixobrychus flavicollis</i> (Black Bittern)	N	X	X	N	N	N	Y	No
<i>Lathamus discolor</i> (Swift Parrot)	N	X	X	N	N	N	Y	No
<i>Miniopterus schreibersii oceanensis</i> (Eastern Bentwing Bat)	N	X	X	N	N	N	Y	No

Threatened species, population or communities	Significance assessment question <sup>1</sup>							Likely significant impact?
	a	b	c	d	e	f	g	
<i>Mormopterus norfolkensis</i> (Eastern Freetail Bat)	N	X	X	N	N	N	Y	No
<i>Myotis macropus</i> (Southern Myotis)	N	X	X	N	N	N	Y	No
<i>Scoteanax rueppellii</i> (Greater Broad-nosed Bat)	N	X	X	N	N	N	Y	No
<i>Pteropus poliocephalus</i> (Grey-Headed Flying-Fox)	N	X	X	N	N	N	Y	No
Freshwater Wetlands on Coastal Floodplains	X	X	N	N	N	N	Y	No
River-Flat Eucalypt Forest on Coastal Floodplains	X	X	N	N	N	Y	Y	No
Swamp Oak Floodplain Forest	X	X	N	N	N	Y	Y	No
<i>Angophora inopina</i> (Charmhaven Apple)	N	X	X	N	N	N	Y	No
<i>Caladenia tessellata</i> (Thick Lip Spider Orchid)	N	X	X	N	N	N	Y	No
<i>Callistemon linearifolius</i> (Netted Bottle Brush)	N	X	X	N	N	N	Y	No
<i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i> (population)	X	N	X	N	N	N	Y	No
<i>Grevillea parviflora</i> subsp. <i>parviflora</i> (Small-flower Grevillea)	N	X	X	N	N	N	Y	No
<i>Maundia triglochinoides</i>	N	X	X	N	N	N	Y	No
<i>Melaleuca biconvexa</i> (Biconvex Paperbark)	N	X	X	N	N	N	Y	No
<i>Rutidosia heterogama</i> (Heath Wrinklewort)	N	X	X	N	N	N	Y	No
<i>Tetradlea juncea</i> (Black-eyed Susan)	N	X	X	N	N	N	Y	No
<i>Thelymitra</i> sp. <i>adorata</i> (Wyang Sun Orchid)	N	X	X	N	N	N	Y	No

**Table 5: Summary of the findings of significance assessments under EPBC Act**

Threatened species, or communities	Significance assessment criteria <sup>2,3</sup>									Likely significant impact?
	i	ii	iii	iv	v	vi	vii	viii	ix	
<i>Litoria aurea</i> (Green and Golden Bell Frog)	N	N	N	X	N	N	N	N	N	No
<i>Apus pacificus</i> (Fork-tailed Swift)	N	N	N	-	-	-	-	-	-	No
<i>Haliaeetus leucogaster</i> (White-bellied Sea-Eagle)	N	N	N	-	-	-	-	-	-	No
<i>Hirundapus caudacutus</i> (White-throated Needletail)	N	N	N	-	-	-	-	-	-	No
<i>Lathamus discolor</i> (Swift Parrot)	N	N	N	X	N	N	N	N	N	No
<i>Pteropus poliocephalus</i> (Grey-headed Flying-fox)	N	N	N	X	N	N	N	N	N	No
<i>Angophora inopina</i> (Charmhaven Apple)	N	N	N	X	N	N	N	N	N	No
<i>Caladenia tessellata</i> (Thick Lip Spider Orchid)	N	N	N	X	N	N	N	N	N	No
<i>Grevillea parviflora</i> subsp. <i>parviflora</i> (Small-flower Grevillea)	N	N	N	X	N	N	N	N	N	No
<i>Melaleuca biconvexa</i> (Biconvex Paperbark)	N	N	N	X	N	N	N	N	N	No
<i>Rutidosis heterogama</i> (Heath Wrinklewort)	N	N	N	X	N	N	N	N	N	No
<i>Tetraloche juncea</i> (Black-eyed Susan)	N	N	N	X	N	N	N	N	N	No
<i>Thelymitra adorata</i> (Wyang Sun Orchid)	N	N	N	X	N	N	N	N	N	No

Notes for Table 4 and Table 5: Y= Yes (negative impact), N= No (no or positive impact), X= not applicable, ?= unknown impact.

1. Significance Assessment Questions as set out in the *Threatened Species Conservation Act 1995/ Environmental Planning and Assessment Act 1979*.
  - a in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,
  - b in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,
  - c in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
    - (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
    - (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,
  - d in relation to the habitat of a threatened species, population or ecological community:
    - (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
    - (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
    - (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,
  - e whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

- f whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,
  - g whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.
2. **An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:**
- i. lead to a long-term decrease in the size of a population;
  - ii. reduce the area of occupancy of the species;
  - iii. fragment an existing population into two or more populations;
  - iv. adversely affect habitat critical to the survival of a species;
  - v. disrupt the breeding cycle of a population;
  - vi. modify, destroy, remove isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
  - vii. result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat.
  - viii. Introduce disease that may cause the species to decline;
  - ix. Interfere substantially with the recovery of the species.
3. **An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:**
- i. Lead to a long-term decrease in the size of an important population of a species;
  - ii. reduce the area of occupancy of an important population\*;
  - iii. fragment an existing important population into two or more populations;
  - iv. adversely affect habitat critical to the survival of a species;
  - v. disrupt the breeding cycle of an important population.
  - vi. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
  - vii. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.
  - viii. Introduce disease that may cause the species to decline.
  - ix. Interfere substantially with the recovery of the species.
- \*Important Population as determined by the *Environment Protection and Biodiversity Conservation Act 1999*, is one that for a vulnerable species:
- is likely to be key source populations either for breeding or dispersal
  - is likely to be necessary for maintaining genetic diversity
  - is at or near the limit of the species range.
4. **An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:**
- i. substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species
  - ii. result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or
  - iii. seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

## 7 CONCLUSION

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### 7.1 Overview of key findings

The key findings of this report are as follows.

#### **Flora**

- Native vegetation in the construction impact area has been identified as Endangered Ecological Community, including Swamp Oak Floodplain Forest, River-Flat Eucalypt Forest on Coastal Floodplains and Freshwater Wetlands on Coastal Floodplains.
- No threatened flora species have been identified in the study area, however, there is potential habitat for ten threatened flora species including *Angophora inopina*, *Caladenia tessellata*, *Eucalyptus parramattensis* subsp. *parramattensis* (population), *Grevillea parviflora* subsp. *parviflora*, *Maundia triglochinos*, *Melaleuca biconvexa*, *Prostanthera askania*, *Rutidosis heterogama*, *Tetratheca juncea* and *Thelymitra sp. adorata*.

#### **Fauna**

- The study area contains low to moderate quality habitat, with a combination of highly disturbed alluvial forest and freshwater wetland vegetation.
- Potential habitat is available within the study area for 12 threatened fauna species including the Wallum Froglet, Green and Golden Bell Frog, Gang-gang Cockatoo, Glossy Black-Cockatoo, Little Lorikeet, Black Bittern, Swift Parrot, Eastern Bentwing Bat, Eastern Freetail Bat, Southern Myotis, Greater Broad-nosed Bat and Grey-headed Flying-fox. The Eastern Freetail Bat has been identified within the study area during previous surveys.
- Three migratory species, the Fork-tailed Swift, White-bellied Sea-eagle and White-throated Needletail have also been identified as having habitat in the study area. The White-bellied Sea-eagle has been identified within the study area during previous surveys.
- Mitigation measures have been recommended to minimise impact upon native fauna.

#### **Aquatic habitat**

- The Wyong River has been classified as key fish habitat. There are no restrictions to upstream or downstream fish passage within the study area. No threatened fish species are likely to occur in the Wyong River.
- Racecourse Swamp wetland (a SEPP 14 listed wetland) is situated 70 metres east of the proposal site and a culvert connects flows under the railway line adjacent to the proposal site. A small area of wetland (not listed) occurs within the study area.
- The removal/replacement of the existing road pylons is not expected to impact on habitat of any importance to recreational or commercial fish species or other aquatic fauna of significance.

#### **Potential Impacts**

The proposal would result in vegetation clearing, with a 'worst case assessment' of:



- A loss of approximately 3.5 hectares of native vegetation (in low or moderate condition) for road widening and construction.
- A loss of approximately 2.9 hectares of low quality exotic vegetation for road widening, construction and compound site access.
- A loss of approximately 2.2 hectares of EEC including 1.7 hectares of Swamp Oak Floodplain Forest, 0.4 hectares of River-Flat Eucalypt Forest on Coastal Floodplains and 0.14 hectares of Freshwater Wetlands on Coastal Floodplains.

## 7.2 Recommendations

The construction of the proposed Pacific Highway Upgrade through Wyong Town Centre has the potential to cause impacts upon native vegetation that is EEC and habitat that is suitable for threatened fauna and flora, as outlined in Section 7.1. There is potential for additional impacts if the range of mitigation measures recommended in Section 5 are not fully adopted. These measures have been specifically developed to limit the risks associated with the proposed roadworks.

Impacts can be mitigated through the retention of EECs and remnant vegetation where possible, adequate sediment and erosion control, retention of hollow-bearing trees, locating compound sites and stockpile sites in already disturbed areas and suitable site restoration (including revegetation) following construction. Ongoing ecological risks that need to be managed include:

- Accidental construction incursions into areas of high ecological significance
- Any additional impacts to areas not identified in the concept design
- Degradation of vegetation, local waterways and riparian areas.

The development and implementation of mitigation measures would help reduce the risk of further impacts occurring during the construction and operational phases of this proposal. As such, the overall impact of the proposal on threatened and non-threatened biodiversity is considered to be low.

Although the Assessments of Significance for the three EECs concluded that there would not be a significant impact on these EECs and a Species Impact Statement is not required, it is recommended that Roads and Maritime consider offsetting impacts on Swamp Oak Floodplain Forest in accordance with the *Guidelines for Biodiversity Offsets* (RMS, 2011) as greater than one hectare of this EEC in moderate to good condition is potentially affected by the proposal.

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## 9 APPENDICES

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### Appendix 1: Vegetation community descriptions

*The following vegetation descriptions come from The Natural Vegetation of the Wyong Local Government Area (Bell 2002).*

#### **Narrabeen Dooralong Spotted Gum Ironbark Forest**

Narrabeen Dooralong Spotted Gum-Ironbark Forest is a relatively wide ranging vegetation type of the dryer Narrabeen Sandstone landscapes, characterised by Spotted Gum (*Corymbia maculata*), the Ironbarks (*Eucalyptus paniculata* subsp. *paniculata*, *Eucalyptus siderophloia*), and *Eucalyptus umbra*. In some locations, other canopy representatives may include *Eucalyptus propinqua* (Jilliby Valley), *Eucalyptus pilularis* (Wyong), and *Eucalyptus acmenoides* (major undulating valleys). Understorey vegetation is typically grassy in nature, including species such as *Entolasia stricta*, *Themeda australis*, *Imperata cylindrica* var. *major*, and *Microlaena stipoides* var. *stipoides*, with scattered shrubs of *Daviesia ulicifolia* and *Podolobium ilicifolium*.

#### **Estuarine Swamp Oak Forest**

Estuarine Swamp Oak Forest occurs in slightly higher ground adjacent to tidal estuaries. Swamp Oak (*Casuarina glauca*) clearly dominates this community, with an understorey of sedges and rushes such as *Juncus kraussii* subsp. *australiensis* and *Baumea juncea*, and the herb *Apium prostratum*.

#### **Alluvial Redgum Footslopes Forest**

Very little of the Alluvial Redgum Footslopes Forest remains within the Shire due to past clearing activities. This community generally occurs along the footslopes of the major valleys on gently undulating land and buffers the moister forest types that line the creeks. Forest Red Gum (*Eucalyptus tereticornis*) and Cabbage Gum (*Eucalyptus amplifolia* subsp. *amplifolia*) are the characteristic canopy species present, generally occurring over a grassy or occasionally sedge understorey. A small tree layer of *Melaleucas* and *Callistemon salignus* is normally also present. The small number of sites available for sampling in this type have meant that the diagnostic species list shows a high level of variation attributed to disturbance and the small size of remnants.

#### **Freshwater Wetlands**

Bodies of Freshwater Wetlands occur sporadically across the coastal floodplains, and support a range of wetland species dependant on condition, water levels and disturbance history. Such areas are often difficult to adequately survey, and consequently no differentiation has been attempted within this group.

#### **Alluvial Riparian Blackbutt Forest**

Alluvial Riparian Blackbutt Forest typically occurs as narrow bands along the edges of major creeks, such as lower Wallarah Creek and the Wyong River. Blackbutt (*Eucalyptus pilularis*) is characteristic in this unit, often forming monospecific stands. Weed invasion and other



forms of disturbance such as frequent fire are problematic in this type due to the narrow width of most stands. Additional survey is required in this community to more adequately understand its relationship to other similar vegetation.

**Table 6: Vegetation community equivalences**

Wyong vegetation community (Bell 2008).	NSW Plant Community Type (OEH 2012)	Endangered Ecological Community (TSC Act)	Statewide Class (Keith 2004)
Narrabeen Dooralong Spotted Gum Ironbark Forest (MU30).	Spotted Gum - Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin.	N/A.	Hunter Macleay Dry Sclerophyll Forests.
Estuarine Swamp Oak Forest (MU3).	Swamp Oak Swamp Forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion.	Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions.	Coastal Floodplain Wetlands.
Alluvial Redgum Foothills Forest (MU15).	Forest Red Gum - Rough-barked Apple open forest on poorly drained lowlands of the Central Coast, Sydney Basin.	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.	Coastal Floodplain Wetlands.
Freshwater Wetlands (MU14).	Coastal freshwater lagoons of the Sydney Basin and South East Corner.	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.	Coastal Freshwater Lagoons.
Alluvial Riparian Blackbutt Forest (MU43).	Blackbutt - Rough-barked Apple - Turpentine - ferny tall open forest of the Central Coast.	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.	



## Appendix 2: Flora and fauna species recorded onsite during field survey

**Table 7: Flora species recorded during March 2014 and October 2014 field survey**

<i>Species name</i>	<i>Common name</i>	1	2	3	4	5	6	7	8	9	10	11	12
<i>Acacia baileyana</i> *	Cootamundra Wattle							x					
<i>Acacia implexa</i>	Hickory Wattle		x						x				
<i>Acacia irrorata</i>	Green Wattle								x				
<i>Acacia longifolia</i>	Sydney Golden Wattle						x			x	x	x	x
<i>Acacia prominens</i>	Gosford Wattle									x	x		
<i>Acer sp.*</i>											x		
<i>Acetosa sagittata</i> *	Turkey Rhubarb										x		
<i>Acmena smithii</i>	Lilly Pilly				x		x						
<i>Agapanthus praecox</i> *	African Lily									x			
<i>Ageratina adenophora</i> *+	Crofton Weed			x	x							x	x
<i>Anagallis arvensis</i> *	Scarlet Pimpernel	x	x										
<i>Angophora floribunda</i>	Rough-barked Apple		x							x	x	x	
<i>Anredera cordifolia</i> *	Madeira Vine									x			
<i>Araujia sericifera</i> *	Moth Vine									x		x	
<i>Asparagus aethiopicus</i> *	Asparagus Fern							x		x			
<i>Asparagus asparagoides</i> *	Bridal Creeper						x				x		
<i>Asparagus plumosus</i> *	Climbing Asparagus Fern										x		
<i>Avena sp.*</i>	Wild Oats									x			
<i>Baumea articulata</i>	Jointed Twig-rush					x							

Species name	Common name	1	2	3	4	5	6	7	8	9	10	11	12
<i>Bidens pilosa</i> *	Cobblers Pegs	x	x				x						
<i>Breynia oblongifolia</i>	Coffee Bush									x	x	x	
<i>Briza maxima</i> *	Quaking Grass		x		X								
<i>Briza minor</i> *	Shivery Grass		x		x								
<i>Callistemon salignus</i>	Willow Bottlebrush									x			
<i>Callistemon rigidus</i>	Stiff Bottlebrush	x	x										
<i>Callistemon citrinus</i>	Crimson Bottlebrush							x					
<i>Carex inversa</i>												x	
<i>Casuarina glauca</i>	Swamp Oak	x	x		x				x	x	x	x	x
<i>Cayratia clematidea</i>	Native Grape							x			x		
<i>Chenopodium album</i> *	Fat Hen						x						
<i>Chloris guyana</i> *	Rhodes Grass	x	x				x	x	x	x	x	x	x
<i>Cinnamomum camphora</i> *	Camphor laurel	x			x		x				x	x	x
<i>Colocasia esculenta</i> *	Elephants Ears											x	
<i>Commelina cyanea</i>	Native Wandering Jew	x	x			x	x			x	x		
<i>Conyza bonariensis</i> *	Flaxleaf Fleabane	x	x				x						x
<i>Cortaderia selloana</i> *+	Pampas Grass						x						x
<i>Corymbia citriodora</i>	Lemon-scented Gum	x											
<i>Corymbia maculata</i>	Spotted Gum		x						x	x		x	
<i>Cynodon dactylon</i> *	Couch	x	x	x			x			x	x	x	
<i>Cyperus congestus</i> *		x	x										
<i>Cyperus eragrostis</i> *	Umbrella Sedge	x	x									x	
<i>Daucus carota</i> *	Wild Carrot	x	x									x	
<i>Delairea odorata</i> *	Cape Ivy									x	x		
<i>Dichondra repens</i>	Kidney Weed					x						x	
<i>Ehrharta erecta</i> *	Panic Veldtgrass	x	x					x		x	x		
<i>Elaeocarpus reticulatus</i>	Blueberry Ash				x								

Species name	Common name	1	2	3	4	5	6	7	8	9	10	11	12
<i>Eragrostis curvula</i>	African Lovegrass						x						
<i>Erythrina x sykesii</i> *	Coral Tree					x	x			x	x		
<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark		x							x	x		
<i>Eucalyptus fibrosa</i>	Red Ironbark		x										
<i>Eucalyptus paniculata</i>	Grey Ironbark		x					x		x	x		
<i>Eucalyptus pilularis</i>	Blackbutt		x									x	
<i>Eucalyptus racemosa</i>	Narrow-leaved Scribbly Gum		x										
<i>Eucalyptus saligna</i>	Sydney Blue Gum	x										x	
<i>Eucalyptus tereticornis</i>	Forest Red Gum				x						x		x
<i>Eustrephus latifolius</i>	Wombat Berry											x	
<i>Gahnia clarkei</i>	Tall Saw-sedge				x								
<i>Glochidion ferdinandi</i>	Cheese Tree		x		x		x	x		x	x	x	
<i>Glycine clandestina</i>												x	
<i>Gomphrena celosioides</i> *	Gomphrena Weed	x	x										
<i>Grevillea robusta</i>	Silky Oak	x											x
<i>Hibiscus sp.</i> *								x					
<i>Hydrocotyle bonariensis</i> *	Largeleaf Pennywort	x	x			x							
<i>Hypochaeris radicata</i> *	Catsear	x	x										
<i>Hypolepis muelleri</i>	Harsh Ground Fern				x	x	x					x	
<i>Imperata cylindrica</i>	Blady Grass			x	x						x	x	x
<i>Indigofera australis</i>	Australian Indigo							x					
<i>Ipomoea cairica</i> *	Coastal Morning Glory								x	x	x	x	
<i>Ipomoea indica</i> *	Morning Glory					x	x		x				
<i>Kennedia rubicunda</i>	Dusky Coral Pea											x	
<i>Kunzea ambigua</i>	Tick Bush				x		x						
<i>Lantana camara</i> *+	Lantana			x	x		x			x	x	x	x
<i>Ligustrum lucidum</i> *	Large-leaf Privet												x



Species name	Common name	1	2	3	4	5	6	7	8	9	10	11	12
<i>Ligustrum sinense</i> *	Small-leaved Privet						x			x	x		x
<i>Lilium formosanum</i> *	Formosa Lily				x								
<i>Lolium perenne</i> *	Perennial Ryegrass				x						x		
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	x	x						x	x	x	x	
<i>Lonicera japonica</i> *	Japanese Honeysuckle						x					x	
<i>Lophostemon confertus</i>	Brush Box	x	x						x	x			
<i>Melaleuca styphelioides</i>	Prickly-leaved Tea Tree				x						x		
<i>Melaleuca ericifolia</i>	Swamp Paperbark			x									
<i>Melaleuca linariifolia</i>	Flax-leaved Paperbark		x		x	x							
<i>Melaleuca nodosa</i>	Prickly-leaved Paperbark			x						x			
<i>Melinis repens</i> *	Red Natal Grass						x						
<i>Microlaena stipoides</i>	Weeping Grass		x							x	x	x	
<i>Modiola caroliniana</i> *	Red-flowered Mallow									x	x		
<i>Muellerina celastroides</i>											x		
<i>Myriophyllum aquaticum</i> *	Parrots Feather	x	x										
<i>Nothoscordum gracile</i> *	Onion Weed	x	x										
<i>Ochna serrulata</i> *	Mickey Mouse Plant							x					
<i>Olea europaea subsp. cuspidate</i> *	African Olive									x			
<i>Onopordum acanthium</i> *	Scotch Thistle						x						
<i>Panicum effusum</i>	Hairy Panic	x											
<i>Parsonsia straminea</i>	Common Silkpod				x					x			
<i>Paspalum dilatatum</i> *	Paspalum	x	x	x	x		x		x	x	x	x	
<i>Pennisetum clandestinum</i> *	Kikuyu Grass	x	x	x	x	x	x			x	x	x	
<i>Pennisetum villosum</i> *	White Foxtail						x						
<i>Persicaria decipiens</i>	Slender Knotweed	x	x			x							
<i>Phoenix canariensis</i> *	Canary Island Date Palm										x	x	
<i>Phragmites australis</i>	Common Reed					x				x	x		

Species name	Common name	1	2	3	4	5	6	7	8	9	10	11	12
<i>Phyllanthus gunnii</i> *	Scrubby Spurge						x					x	
<i>Pittosporum revolutum</i>	Wild Yellow Jasmine											x	
<i>Pittosporum undulatum</i>	Native Daphne	x								x			x
<i>Plantago lanceolata</i> *	Plantain						x			x			
<i>Pomaderris ferruginea</i>	Rusty Pomaderris									x			
<i>Pratia purpurascens</i>	Whiteroot									x			
<i>Pteridium esculentum</i>	Common Bracken						x				x		
<i>Rapanea variabilis</i>	Muttonwood											x	
<i>Rubus fruticosus</i> *	Blackberry			x	x		x						x
<i>Sagittaria platyphylla</i> *+	Sagittaria											x	
<i>Senecio madagascariensis</i> *+	Fireweed	x	x										
<i>Senna pendula</i> *	Cassia						x					x	
<i>Setaria pumila</i> *	Pale Pigeon Grass	x	x				x			x	x	x	
<i>Sida rhombifolia</i> *	Paddy's Lucerne						x		x	x	x	x	
<i>Solanum mauritianum</i> *	Wild Tobacco Bush										x	x	x
<i>Solanum nigrum</i> *	Black-berry Nightshade									x		x	
<i>Solidago canadensis</i> *	Goldenrod												x
<i>Sonchus oleraceus</i> *	Common Sowthistle						x						
<i>Sporobolus africanus</i> *	Parramatta Grass	x	x		x							x	
<i>Stenotaphrum secundatum</i> *	Buffalo Grass	x	x										
<i>Syncarpia glomulifera</i>	Turpentine						x				x		
<i>Tradescantia fluminensis</i> *	Wandering Jew									x	x		
<i>Triglochin procera</i>	Water Ribbons					x							
<i>Trifolium repens</i> *	White Clover	x	x										
<i>Tristaniopsis laurina</i>	Water Gum			x	x								
<i>Typha orientalis</i>	Broadleaf Cumbungi	x	x		x	x							
<i>Verbena bonariensis</i> *	Purpletop					x	x						

<i>Species name</i>	<i>Common name</i>	1	2	3	4	5	6	7	8	9	10	11	12
<i>Watsonia meriana</i> *	Wild Watsonia									x			

\* denotes introduced species, + denotes weed of national significance (WONS)

**Table 8: Fauna species recorded during field surveys**

Scientific Name	Common Name	Survey	
		SMEC 2014	PB 2013
Amphibians			
<i>Crinia signifera</i>	Common Eastern Froglet		x
<i>Litoria fallax</i>	Eastern Dwarf Tree Frog		x
<i>Litoria peronii</i>	Peron's Tree Frog		x
Aves			
<i>Acanthiza pusilla</i>	Brown Thornbill		x
<i>Anas castanea</i>	Chestnut Teal	x	x
<i>Anas platyrhynchos</i> *	Mallard		x
<i>Anas superciliosa</i>	Pacific Black Duck		x
<i>Anhinga novaehollandiae</i>	Australasian Darter		x
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	x	
<i>Cacatua sanguinea</i>	Little Corella		x
<i>Chenonetta jubata</i>	Australian Wood Duck	x	x
<i>Columba livia</i> *	Rock Dove	x	x
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo Shrike		x
<i>Corvus coronoides</i>	Australian Raven	x	x
<i>Cracticus tibicen</i>	Australian Magpie	x	x
<i>Dacelo novaeguineae</i>	Laughing Kookaburra	x	x
<i>Egretta novaehollandiae</i>	White-faced Heron	x	x
<i>Elanus axillaris</i>	Black-shouldered Kite		x
<i>Eolophus roseicapillus</i>	Galah	x	x
<i>Glossopsitta concinna</i>	Musk Lorikeet		x
<i>Grallina cyanoleuca</i>	Magpie-lark	x	x
<i>Haliaeetus leucogaster</i>	White-bellied Sea-eagle ^		x
<i>Haliastur sphenurus</i>	Whistling Kite	x	x
<i>Hirundo neoxena</i>	Welcome Swallow	x	x
<i>Malurus cyaneus</i>	Superb Fairy-wren	x	x
<i>Manorina melanocephala</i>	Noisy Miner	x	x
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant		x
<i>Ocyphaps lophotes</i>	Crested Pigeon	x	x
<i>Pardalotus punctatus</i>	Spotted Pardalote		x
<i>Pelecanus conspicillatus</i>	Australian Pelican	x	x
<i>Phalacrocorax carbo</i>	Great Cormorant	x	x
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant	x	x
<i>Phalacrocorax varius</i>	Pied Cormorant		x
<i>Psophodes olivaceus</i>	Eastern Whipbird	x	x
<i>Rhipidura leucophrys</i>	Willie Wagtail	x	x
<i>Sturnus tristis</i> *	Common Myna	x	x
<i>Threskiornis molucca</i>	Australian White Ibis	x	

Scientific Name	Common Name	Survey	
		SMEC 2014	PB 2013
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	x	x
<i>Vanellus miles</i>	Masked Lapwing	x	x
<i>Zosterops lateralis</i>	Silvereye		x
<b>Reptiles</b>			
<i>Lampropholis delicata</i>	Dark-flecked Garden Sunskink	x	
<i>Physignathus lesueurii</i>	Eastern Water Dragon	x	
<b>Mammals</b>			
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat		x
<i>Lepus europaeus</i> *	Brown Hare		x
<i>Mormopterus norfolkensis</i>	Eastern Freetail Bat #		x
<i>Oryctolagus cuniculus</i> *	Rabbit	x	
<i>Rattus rattus</i> *	Black Rat		x
<i>Trichosurus vulpecula</i>	Common Brushtail Possum		x
<i>Vespadelus vulturnus</i>	Little Forest Bat		x
<b>Fish</b>			
<i>Anguilla reinhardtii</i>	Long-finned Eel		x

Note: \* = introduced species, ^ = migratory species, # = threatened species

## Appendix 3: Flora and fauna species with the potential to occur in the study site.

Note: List of threatened species, populations, or ecological communities which may be affected directly or indirectly by the Proposal is derived from searches of the following databases as well as conducted March 2014. Likelihood of occurrence is based on the matrix in Appendix 4.

1. NSW Office of Environment and Heritage (OEH) Atlas of NSW Wildlife Database.
2. Protected Matters Report that documents all Matters of National Environmental Significance (MNES) within 10 km of site (Department of Sustainability, Environment, Water, Population and Communities 2013).
3. Department of Environment and Conservation (now OEH) Endangered Ecological Community and Threatened Species Profiles (OEH, 2013).
4. NSW Flora Online Search – Rare or Threatened Australian Plants (ROTAP) species (The Royal Botanic Gardens and Domain Trust 2013).

**Table 9: Threatened species with potential to occur and assessment of likelihood of occurrence**

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<b>FAUNA</b>						
<b>Amphibians (8)</b>						
<i>Crinia tinnula</i>	Wallum Froglet	V		64	Found in a wide range of habitats, usually associated with acidic swamps on coastal sand plains. They typically occur in sedgeland and wet heathlands. They can also be found along drainage lines within other vegetation communities and disturbed areas, and occasionally in swamp sclerophyll forests. Breeds in swamps with permanent water as well as shallow ephemeral pools and drainage ditches. Shelter under leaf litter, vegetation, other debris or in burrows of other species. Shelter sites are wet or very damp and often located near the water's edge.	<b>Moderate: could possibly occur</b>



Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V		Distributed through the Sydney Basin sandstone country in woodland, open woodland and heath vegetation, breeding habitat is generally soaks or pools within first or second order streams, but also 'hanging swamp' seepage lines and where small pools form from the collected water. Spend the majority of time in non-breeding habitat up to 300 m away and burrows in soil surface or leaf litter.	Low: unlikely to occur
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	14	Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast. It inhabits marshes, dams and stream-sides, particularly those containing bullrushes ( <i>Typha</i> spp.) or spikerushes ( <i>Eleocharis</i> spp.)	<b>Moderate: could possibly occur</b>
<i>Litoria brevipalmata</i>	Green-thighed Frog	V		12	Occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain. It prefers wetter forests in the south of its range, but extends into drier forests in northern NSW and southern Queensland.	Low: unlikely to occur
<i>Litoria littlejohni</i>	Littlejohn's Tree Frog, Heath Frog	V	V		Restricted to sandstone woodland and heath communities at mid to high altitude. It forages both in the tree canopy and on the ground, and it has been observed sheltering under rocks, leaf litter and low vegetation in heath based forests and woodland. It is not known from coastal habitats.	Low: unlikely to occur
<i>Mixophyes balbus</i>	Stuttering Frog	E	V	36	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor. Feed on insects and smaller frogs.	Low: unlikely to occur

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Mixophyes iteratus</i>	Giant Barred Frog	E	E	11	Found along freshwater streams with permanent or semi-permanent water, generally (but not always) at lower elevation. Moist riparian habitats such as rainforest or wet sclerophyll forest are favoured for the deep leaf litter that they provide for shelter and foraging, as well as open perching sites on the forest floor. Will also sometimes occur in other riparian habitats, such as those in drier forest or degraded riparian remnants, and even occasionally around dams.	Low: unlikely to occur
<i>Pseudophryne australis</i>	Red-crowned Toadlet	V		1	Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter.	Low: unlikely to occur
<b>Reptiles (2)</b>						
<i>Hoplocephalus bitorquatus</i>	Pale-headed Snake	V		1	Highly cryptic species that can spend weeks at a time hidden in tree hollows. Found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest. In drier environments, it appears to favour habitats close to riparian areas.	Low: unlikely to occur
<i>Hoplocephalus stephensii</i>	Stephens' Banded Snake	V		2	Rainforest and eucalypt forests and rocky areas up to 950 m in altitude.	Low: unlikely to occur

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<b>Birds (50)</b>						
<i>Actitis hypoleucos</i>	Common Sandpiper		M		The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. Has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties.	Low: unlikely to occur
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	E	14	Inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. NSW the distribution is very patchy and mainly confined to the two main breeding areas at Capertee Valley and the Bundarra-Barraba region and surrounding fragmented woodlands. Birds are also found in drier coastal woodlands and forests. Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-oak. These habitats have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. Nectar and fruit from the mistletoes are also eaten during the breeding season.	Low: unlikely to occur

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Apus pacificus</i>	Fork-tailed Swift		M	8	In NSW, the Fork-tailed Swift is recorded in all regions. Mostly occur over inland plains but sometimes above foothills or in coastal areas. Prefer dry, open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. Also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes. They sometimes occur above rainforests, wet sclerophyll forest or open forest or plantations of pines. The Fork-tailed Swift is an aerial eater, flying anywhere from 1 m to 300 m above the ground to forage.	<b>Moderate: could possibly occur</b>
<i>Ardea alba</i>	Great Egret, White Egret		M		Has been reported in a wide range of wetland habitats (for example inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial). These include swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs. The species usually frequents shallow waters.	Low: unlikely to occur
<i>Ardea ibis</i>	Cattle Egret		M	52	Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. High numbers have been observed in moist, low-lying poorly drained pastures with an abundance of high grass. It uses predominately shallow, open and fresh wetlands including meadows and swamps with low emergent vegetation and abundant aquatic flora. They have sometimes been observed in swamps with tall emergent vegetation. Often forages away from water on low lying grasslands, improved pastures and croplands. The species roosts in trees, or amongst ground vegetation in or near lakes and swamps.	<b>Moderate: could possibly occur</b>

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E	7	Inhabits temperate freshwater wetlands and occasionally estuarine reedbeds, with a preference for permanent waterbodies with tall dense vegetation. The species prefers wetlands with dense vegetation, including sedges, rushes and reeds. Freshwater is generally preferred, although dense saltmarsh vegetation in estuaries and flooded grasslands are also used by the species.	Low: unlikely to occur
<i>Burhinus grallarius</i>	Bush Stone-curlew	E		6	Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber.	Low: unlikely to occur
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper		M	62	In Australasia, the Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation.	Low: unlikely to occur
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V		4	In summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas. Favours old growth attributes for nesting and roosting.	<b>Moderate: could possibly occur</b>
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	V		40	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak ( <i>Allocasuarina littoralis</i> ) and Forest Sheoak ( <i>A. torulosa</i> ) are important foods. Dependent on large hollow-bearing eucalypts for nest sites.	<b>Moderate: could possibly occur</b>

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Charadrius bicinctus</i>	Double-banded Plover		M		Found on littoral, estuarine and fresh or saline terrestrial wetlands and also saltmarsh, grasslands and pasture. It occurs on muddy, sandy, shingled or sometimes rocky beaches, bays and inlets, harbours and margins of fresh or saline terrestrial wetlands such as lakes, lagoons and swamps, shallow estuaries and rivers.	Low: unlikely to occur
<i>Chthonicola sagittata</i>	Speckled Warbler	V		1	Lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area.	Insufficient suitable habitat available. Low: unlikely to occur
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V		25	Inhabits most of mainland Australia except the treeless deserts and open grasslands. It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	Low: unlikely to occur
<i>Dasyornis brachypterus</i>	Eastern Bristlebird		E		Inhabits low dense vegetation in a broad range of habitat types including sedgeland, heathland, swampland, shrubland, sclerophyll forest and woodland, and rainforest. It occurs near the coast, on tablelands and in ranges. The Eastern Bristlebird is found in habitats with a variety of species compositions, but are defined by a similar structure of low, dense, ground or understorey vegetation.	Low: unlikely to occur



Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E		36	Mainly found on shallow, permanent, freshwater terrestrial wetlands, and surrounding marginal vegetation, including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters, as well as extending into adjacent grasslands, paddocks and open savannah woodlands. They also forage within or around estuaries and along intertidal shorelines, such as saltmarshes, mudflats and sandflats, and mangrove vegetation. They mainly forage in shallow, still water, preferring open wetlands, and taking a variety of prey, including eels and other fish, frogs, turtles, snakes, and invertebrates (such as crabs and insects). In NSW, Storks usually nest in a tall, live and isolated paddock tree, but also in other trees, including dead trees and paperbarks, or even lower shrubs within wetlands.	Low: unlikely to occur
<i>Falco subniger</i>	Black Falcon	V		1	The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions.	Low: unlikely to occur
<i>Gallinago hardwickii</i>	Latham's Snipe		M	19	In Australia, Latham's Snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies).	Low: unlikely to occur
<i>Glossopsitta pusilla</i>	Little Lorikeet	V		15	Mostly occur in dry, open eucalypt forests and woodlands. Have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. Nest in small hollows (entrance approx. 3 cm) of Eucalyptus spp.	<b>Moderate: could possibly occur</b>

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Grantiella picta</i>	Painted Honeyeater	V		3	Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus <i>Amyema</i> .	Low: unlikely to occur
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle		M	58	Inhabits coastal and inland riverine areas with large areas of open water. Breeding habitat is located near water and predominantly within tall open forest and woodland. The nest is a large structure made of sticks. Foraging habitat is large areas of open water as well as open terrestrial habitats such as grasslands. They forage either from a perch or whilst in flight.	Previously recorded in the study area. <b>High: Highly likely to occur/does occur</b>
<i>Hieraaetus morphnoides</i>	Little Eagle	V		8	Distributed throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. Occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Requires tall living trees for building a large stick nest and preys on birds, reptiles and mammals and occasionally carrion.	Low: unlikely to occur
<i>Hirundapus caudacutus</i>	White-throated Needletail		M	27	Predominantly aerial within Australia, however they have been recorded roosting in trees in both forests and woodlands within dense foliage either in the canopy or within hollows. This species breeds in northern Asia. And migrates south between September-October.	Low: unlikely to occur

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Hydroprogne caspia</i>	Caspian Tern		M	75	The Caspian Tern is mostly found in sheltered coastal embayments (harbours, lagoons, inlets, bays, estuaries and river deltas) and those with sandy or muddy margins are preferred. They also occur on near-coastal or inland terrestrial wetlands that are either fresh or saline, especially lakes (including ephemeral lakes), waterholes, reservoirs, rivers and creeks. They also use artificial wetlands, including reservoirs, sewage ponds and saltworks.	Low: unlikely to occur
<i>Irediparra gallinacea</i>	Comb-crested Jacana	V		5	Inhabit permanent freshwater wetlands, either still or slow-flowing, with a good surface cover of floating vegetation, especially water-lilies, or fringing and aquatic vegetation.	Low: unlikely to occur
<i>Ixobrychus flavicollis</i>	Black Bittern	V		22	Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves.	Record of the species within the study area. <b>Moderate: could possibly occur</b>
<i>Lathamus discolor</i>	Swift Parrot	E	E	38	In NSW mostly occurs on the coast and south west slopes, occurring in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany, Spotted Gum, Red Bloodwood, Mugga Ironbark and White Box.	<b>Moderate: could possibly occur</b>
<i>Lophoictinia isura</i>	Square-tailed Kite	V		1	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.	Low: unlikely to occur

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Merops ornatus</i>	Rainbow Bee-eater		M	4	Preference for open forests and woodlands, shrublands, and various cleared or semi-cleared habitats, including farmland, close to permanent water. It also occurs in inland and coastal sand dune systems. Breeding occurs from August to January, nesting in enlarged chambers at the end of long burrow or tunnel excavated in flat or sloping ground.	Low: unlikely to occur
<i>Monarcha melanopsis</i>	Black-faced Monarch		M		Found along the coast of eastern Australia, becoming less common further south. This species of bird usually inhabits dense gullies of rainforest, sclerophyll forests and eucalypt woodlands along the coastal regions from Victoria to Cape York and is migratory over much of its range.	Low: unlikely to occur
<i>Monarcha trivirgatus</i>	Spectacled Monarch		M		Usually in rainforest, mangroves, moist gloomy gullies of dense eucalyptus forest.	Low: unlikely to occur
<i>Myiagra cyanoleuca</i>	Satin Flycatcher		M		Summer breeding range from Qld to Tas, winter migration to NE Qld. Satin Flycatchers inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands often near wetlands or watercourses, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests.	Low: unlikely to occur
<i>Ninox connivens</i>	Barking Owl	V		2	Occurs throughout NSW, where it inhabits dry open sclerophyll forests and woodlands, favouring dense riparian stands of eucalypts or casuarinas along watercourses or around wetlands, where there are many large trees suitable for roosting or breeding.	Low: unlikely to occur

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Ninox strenua</i>	Powerful Owl	V		63	Is endemic to eastern and south-eastern Australia, being widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered, mostly historical records on the western slopes and plains in NSW. Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. They require large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. Powerful Owls nest in large tree hollows (at least 0.5m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old.	Low: unlikely to occur
<i>Numenius madagascariensis</i>	Eastern Curlew		M	20	The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass.	Low: unlikely to occur
<i>Numenius minutus</i>	Little Curlew, Little Whimbrel		M		When resting during the heat of day, the Little Curlew congregates around pools, river beds and water-filled tidal channels, and shallow water at edges of billabongs. The Little Curlew is most often found feeding in short, dry grassland and sedgeland, including dry floodplains and blacksoil plains, which have scattered, shallow freshwater pools or areas seasonally inundated.	Low: unlikely to occur
<i>Numenius phaeopus</i>	Whimbrel		M	1	The Whimbrel is often found on the intertidal mudflats of sheltered coasts. It is also found in harbours, lagoons, estuaries and river deltas, often those with mangroves, but also open, unvegetated mudflats. It is occasionally found on sandy or rocky beaches, on coral or rocky islets, or on intertidal reefs and platforms.	Low: unlikely to occur

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Pandion cristatus</i>	Eastern Osprey	V		7	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water. Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea.	Low: unlikely to occur
<i>Petroica phoenicea</i>	Flame Robin	V		1	Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgelands at high altitudes. In winter, birds migrate to drier more open habitats in the lowlands (i.e. valleys below the ranges, and to the western slopes and plains). Often occurs in recently burnt areas; however, habitat becomes unsuitable as vegetation closes up following regeneration. In winter lives in dry forests, open woodlands and in pastures and native grasslands, with or without scattered trees.	Low: unlikely to occur
<i>Plegadis falcinellus</i>	Glossy Ibis		M	3	Preferred habitat for foraging and breeding are fresh water marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation.	Low: unlikely to occur
<i>Pluvialis fulva</i>	Pacific Golden Plover		M	26	In non-breeding grounds in Australia this species usually inhabits coastal habitats, though it occasionally occurs around inland wetlands. Pacific Golden Plovers usually occur on beaches, mudflats and sandflats (sometimes in vegetation such as mangroves, low saltmarsh such as <i>Sarcocornia</i> , or beds of seagrass) in sheltered areas including harbours, estuaries and lagoons, and also in evaporation ponds in saltworks.	Low: unlikely to occur

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Pluvialis squatarola</i>	Grey Plover		M	5	In non-breeding grounds in Australia, Grey Plovers occur almost entirely in coastal areas, where they usually inhabit sheltered embayments, estuaries and lagoons with mudflats and sandflats, and occasionally on rocky coasts with wave-cut platforms or reef-flats, or on reefs within muddy lagoons.	Low: unlikely to occur
<i>Ptilinopus magnificus</i>	Wompoo Fruit-Dove	V		1	Occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests.	Low: unlikely to occur
<i>Ptilinopus regina</i>	Rose-crowned Fruit-Dove	V		1	Rose-crowned Fruit-doves occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful.	Low: unlikely to occur
<i>Ptilinopus superbus</i>	Superb Fruit-Dove	V		4	Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees.	Low: unlikely to occur
<i>Rhipidura rufifrons</i>	Rufous Fantail		M		A summer breeding migrant to SE Australia. They occur in the undergrowth of rainforests/wetter Eucalypt forests/gullies. Preference for deep shade, and is often seen close to the ground. Feeds on insects, in the middle and lower levels of the canopy. Constructs a small compact cup nest, suspended from a tree fork about 5 m from the ground.	Low: unlikely to occur
<i>Rostratula australis</i>	Australian Painted Snipe		E, M		Inhabits shallow inland wetlands, either freshwater or brackish water bodies. Nests on the ground amongst tall reed-like vegetation near water, and feeds near the water's edge and on mudflats.	Low: unlikely to occur



Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Stercorarius parasiticus</i>	Arctic Jaeger		M	1	An inhabitant of oceans, coastal regions, boreal forest, grassland and tundra. The parasitic jaeger breeds both on islands and on mainland coasts, and outside of the breeding season is found mostly at sea	Low: unlikely to occur
<i>Stipiturus mallee</i>	Mallee Emu-wren		E	1	The Mallee Emu-wren mostly inhabits Triodia grasslands that grow up to 1 m in height on low sand dunes, with or without an overstorey of low woodland that is dominated by mallee eucalypts such as Eucalyptus incrassata or E. dumosa, usually 2–4 m in height, Callitris verrucosa, and low shrubs of the genera Acacia, Allocasuarina, Baeckea, Banksia, Hakea, Leptospermum and Melaleuca.	Low: unlikely to occur
<i>Tyto novaehollandiae</i>	Masked Owl	V		25	Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-range of 500 to 1000 hectares. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting	Low: unlikely to occur
<i>Tyto tenebricosa</i>	Sooty Owl	V		48	Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Roosts by day in the hollow of a tall forest tree or in heavy vegetation; hunts by night for small ground mammals or tree-dwelling mammals such as the Common Ringtail Possum or Sugar Glider. Nests in very large tree-hollows.	Low: unlikely to occur

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<b>Mammals (20)</b>						
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V		2	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable. Also feeds on insects throughout the year; this feed source may be more important in habitats where flowers are less abundant such as wet forests. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum dreys or thickets of vegetation, (e.g. grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks.	Low: unlikely to occur
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	2	Roosts in disused mine shafts, caves, overhangs and disused Fairy Martin nests for shelter and to raise young. It also possibly roosts in the hollows of trees. Occurs in low to mid-elevation dry open forest and woodlands, preferably with extensive cliffs, caves or gullies. Largely restricted to the interface of sandstone escarpment (for roost habitat) and relatively fertile valleys (for foraging habitat).	Low: unlikely to occur

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	E	18	It is found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Uses a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.	Low: unlikely to occur
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V		35	Found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania. This species is found in tall, mature, wet forest and the species have been recorded roosting in stem holes in Eucalyptus and in buildings. Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	Low: unlikely to occur
<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot (eastern)	E	E	1	NSW distribution almost exclusively restricted to coastal fringe. Habitats including heathland, shrubland, sedgeland, heathy open forest and woodland and are usually associated with infertile, sandy and well drained soils, but can be found in a range of soil types. Within these vegetation communities they typically inhabit areas of dense ground cover.	Low: unlikely to occur
<i>Kerivoula papuensis</i>	Golden-tipped Bat	V		14	Found in rainforest and adjacent wet and dry sclerophyll forest up to 1000m. Also recorded in tall open forest, Casuarina-dominated riparian forest and coastal Melaleuca forests. Roost mainly in abandoned hanging Yellow-throated Scrubwren and Brown Gerygone nests, also in tree hollows, dense foliage and epiphytes; located in rainforest gullies on small first- and second-order streams. Specialist feeder on small web-building spiders.	Low: unlikely to occur

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Miniopterus australis</i>	Little Bentwing-bat	V		53	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats	Low: unlikely to occur
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing Bat	V		81	Occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Hunt in forested areas, catching moths and other flying insects above the tree tops. Cumberland dry sclerophyll forests are identified as a potential vegetation type used by this species.	<b>Moderate: could possibly occur</b>
<i>Mormopterus norfolkensis</i>	Eastern Freetail Bat	V		44	Inhabits dry eucalypt forest and coastal woodlands, along with riparian zones in rainforest and wet sclerophyll forest. Forages above the forest canopy or at forest edges. Known to roost in tree hollows but occasionally found in buildings.	<b>High: Highly likely to occur/does occur</b>
<i>Myotis macropus</i>	Southern Myotis	V		32	Found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Generally roost in groups of 10 - 15 close to water in caves, mine Shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage.	<b>Moderate: could possibly occur</b>
<i>Petaurus australis</i>	Yellow-bellied Glider	V		89	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils.	Low: unlikely to occur

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Petaurus norfolcensis</i>	Squirrel Glider	V		120	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey.	Low: unlikely to occur
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V		Habitats occupied include: loose piles of large boulders containing subterranean holes and passageways; cliffs (usually over 15m high) with mid-level ledges and with some caves and/or ledges covered by overhangs; and isolated rock stacks, usually sheer-sided and often girdled with fallen boulders.	Low: unlikely to occur
<i>Phascolarctos cinereus</i>	Koala	V	V	15	Inhabits a range of eucalypt forest and woodland communities. Adequate floristic diversity, availability of feed trees (primarily Eucalyptus tereticornis and E. viminalis) and presence of mature trees very important.	Low: unlikely to occur
<i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo (SE mainland)		V		Inhabits coastal heaths and dry and wet sclerophyll forests, with sandy loam soils. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. Require dense vegetation for shelter and access to fungi. It is mainly nocturnal, hiding by day in dense vegetation - however, during the winter months animals may forage during daylight hours.	Low: unlikely to occur
<i>Pseudomys gracilicaudatus</i>	Eastern Chestnut Mouse	V		2	In NSW the Eastern Chestnut Mouse is mostly found, in low numbers, in heathland and is most common in dense, wet heath and swamps. In the tropics it is more an animal of grassy woodlands. Optimal habitat appears to be in vigorously regenerating heathland burnt from 18 months to four years previously.	Low: unlikely to occur

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Pseudomys novaehollandiae</i>	New Holland Mouse		V	2	In NSW, known from Royal National Park (NP) and the Kangaroo Valley; Kuringai Chase NP; and Port Stephens to Evans Head near the Queensland border. Coastal heath vegetation undergoing early to mid-successional regeneration, as a result of habitat disturbances (e.g. fire, mining, clearing) appears to be preferred habitat in many areas.	Low: unlikely to occur
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	52	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are commonly found in gullies, close to water, in vegetation with a dense canopy. They travel up to 50 km to forage, on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines.	<b>Moderate: could possibly occur</b>
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat	V		4	Inhabits eucalypt rainforest, sclerophyll forest and open woodland vegetation. Availability of tree hollows is important for access to roosting sites.	Low: unlikely to occur
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V		53	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings. Forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6m. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species.	<b>Moderate: could possibly occur</b>
<b>Insects (1)</b>						
<i>Petalura gigantea</i>	Giant Dragonfly	E		1	Live in permanent swamps and bogs with some free water and open vegetation.	Low: unlikely to occur

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<b>Fish (5)</b>						
<i>Macquaria australasica</i>	Macquarie Perch	(E)	E		The Macquarie Perch is a riverine, schooling species. It prefers clear water and deep, rocky holes with lots of cover. As well as aquatic vegetation, additional cover may comprise of large boulders, debris and overhanging banks.	Low: unlikely to occur
<i>Mogurnda adspersa</i>	Purple spotted gudgeon		E		A benthic species, usually found in slow – moving rivers creeks and wetlands. Often among weeds, rocks or snags.	Low: unlikely to occur
<i>Nannoperca oxleyana</i>	Oxleyan pygmy perch	(E)	E		Mostly occur in swamps, creeks, and lakes of coastal 'wallum' (Banksia dominated coastal heath). These waters are usually acidic with low salinity and low conductivity and darkly stained. Prefer slow moving or still waters with dense vegetation (e.g. sedges or undercut, root – filled banks fringed with submerged riparian vegetation.	Low: unlikely to occur
<i>Pristis zijsron</i>	Green sawfish	(X)	V		Green sawfish live on muddy or sandy-mud soft bottom habitats in inshore areas. They also enter estuaries, where they have been found in very shallow water.	Low: unlikely to occur
<i>Prototroctes maraena</i>	Australian Grayling		V		The Australian Grayling is diadromous, spending part of its lifecycle in freshwater and at least part of the larval and/or juvenile stages in coastal seas. Adults (including pre spawning and spawning adults) inhabit cool, clear, freshwater streams with gravel substrate and areas alternating between pools and riffle zones.	Low: unlikely to occur



Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<b>FLORA</b>						
<b>Threatened Ecological Communities (16)</b>						
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	V	P		Coastal Saltmarsh occurs in the intertidal zone on the shores of estuaries and lagoons that are permanently or intermittently open to the sea. It is frequently found as a zone on the landward side of mangrove stands.	Low: unlikely to occur
Coastal Upland Swamp in the Sydney Basin Bioregion	E		K		Coastal Upland Swamps occur primarily on impermeable sandstone plateaux with shallow groundwater aquifers in the headwaters and impeded drainage lines of streams, and on sandstone benches with abundant seepage moisture. The Coastal Upland Swamp is generally associated with soils that are acidic and vary from yellow to grey mineral sandy loams with a shallow organic horizon to highly organic spongy black peats with pallid subsoils.	Low: unlikely to occur
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E		K		Associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. Typically occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes but may also occur in backbarrier landforms where floodplains adjoin coastal sandplains. Generally occur below 20 m elevation on level areas.	<b>High: occurs in the study area</b>
Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions	E		K		Hunter Lowland Redgum Forest occurs on the Permian sediments of the Hunter Valley floor.	Low: unlikely to occur

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
Kincumber Scribbly Gum Forest in the Sydney Basin Bioregion		CE		K	Occurs on gently undulating areas on sandy soils of the Erina soil landscape, derived from sandstones of the Triassic Narrabeen group.	Low: unlikely to occur
Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions		E	CE	P	Occurs on sand dunes and on soil derived from underlying rocks.	Low: unlikely to occur
Low woodland with heathland on indurated sand at Norah Head		E		K	Occurs on indurated (hardsetting) sand with a range of local variation in drainage conditions. Restricted to swales behind higher aeolian dunes.	Low: unlikely to occur
Lower Hunter Spotted Gum-Ironbark Forest in the Sydney Basin Bioregion		E		K	Occurs principally on Permian geology in the central to lower Hunter Valley. The community is strongly associated with, though not restricted to, the yellow podsolic and solodic soils of the Lower Hunter soil landscapes of Aberdare, Branxton and Neath.	Medium: could possibly occur
Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions		E	CE	K	Lowland Rainforest may be associated with a range of high-nutrient geological substrates, notably basalts and fine-grained sedimentary rocks, on coastal plains and plateaux, footslopes and foothills. In the north of its range, Lowland Rainforest is found up to 600m above sea level, but in the Sydney Basin bioregion it is limited to elevations below 350 m.	Low: unlikely to occur
Quorrobolong Scribbly Gum Woodland in the Sydney Basin Bioregion		E		K	Occupies gentle slopes and rises on a residual sand deposit overlying the Permian clay sediments of the Hunter Valley floor.	Low: unlikely to occur
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions		E		K	Associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Generally occurs below 50 m elevation, but may occur on localised river flats up to 250 m above sea level.	<b>High: occurs in the study area</b>

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions		E		K	Associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains. Generally occurs below 20 m (rarely above 10 m) elevation.	<b>High: occurs in the study area</b>
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions		E		K	Associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Generally occurs below 20 m (though sometimes up to 50 m) elevation.	<b>Medium: could possibly occur</b>
Sydney Freshwater Wetlands in the Sydney Basin Bioregion		E		K	Largely restricted to freshwater swamps in swales and depressions on sand dunes and low nutrient sandplains such as those of the Warriewood and Tuggerah soil landscapes.	Low: unlikely to occur
Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions		E		K	The community is found on a range of substrates, although stands on sandstone are infrequent and small.	Low: unlikely to occur
Umina Coastal Sandplain Woodland in the Sydney Basin Bioregion		E		K	Occurs on sandy soils (iron podzols) of the Woy Woy Soil Landscape which are distinguished from the humus podsols generally associated with foothill talus slopes further away from the coast on which Angophora costata predominates.	Low: unlikely to occur
<b>Flora (30)</b>						
<i>Acacia bynoeana</i>	Bynoe's Wattle	E	V	32	Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple.	Low: unlikely to occur

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Angophora inopina</i>	Charmhaven Apple	V	V	2674	Occurs most frequently in four main vegetation communities: (i) Eucalyptus haemastoma–Corymbia gummifera–Angophora inopina woodland/forest; (ii) Hakea teretifolia–Banksia oblongifolia wet heath; (iii) Eucalyptus resinifera–Melaleuca sieberi–Angophora inopina sedge woodland; (iv) Eucalyptus capitellata–Corymbia gummifera–Angophora inopina woodland/forest. OEH threatened species database also lists Swamp Oak Forest as potential habitat.	<b>Medium: could possibly occur</b>
<i>Asterolasia elegans</i>		E	E		Occurs on Hawkesbury sandstone. Found in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest. The canopy at known sites includes Turpentine, Smooth-barked Apple, Sydney Peppermint, Forest Oak and Christmas Bush.	Low: unlikely to occur
<i>Caladenia porphyrea</i>		E			Grows in coastal sclerophyll forest on sandy soils.	Low: unlikely to occur
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	E	V	2	Requires low, dry sclerophyll woodland with a heathy or sometimes grassy understorey on clay loams or sandy soils, specifically in dry, low Brittle Gum (Eucalyptus mannifera), Inland Scribbly Gum (E. rossii) and Allocasuarina spp. woodland with a sparse understorey and stony soil.	<b>Medium: could possibly occur</b>
<i>Callistemon linearifolius</i>	Netted Bottle Brush	V		4	Grows in dry sclerophyll forest on the coast and adjacent ranges.	<b>Medium: could possibly occur</b>
<i>Corunastylis</i> sp. Charmhaven (NSW896673)		CE		10	It occurs within low woodland to heathland with a shrubby understorey and ground layer. Dominants include Black She-oak (Allocasuarina littoralis), Prickly Tea-tree (Leptospermum juniperinum), Prickly-leaved Paperbark (Melaleuca nodosa), Narrow-leaved Bottlebrush (Callistemon linearis) and Zig-zag Bog-rush (Schoenus brevifolius).	Low: unlikely to occur

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Cryptostylis hunteriana</i>	Leafless Tongue-orchid	V	V	15	Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum ( <i>Eucalyptus sclerophylla</i> ), Silvertop Ash ( <i>E. sieberi</i> ), Red Bloodwood ( <i>Corymbia gummifera</i> ) and Black Sheoak ( <i>Allocasuarina littoralis</i> ); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid ( <i>C. subulata</i> ) and the Tartan Tongue Orchid ( <i>C. erecta</i> ).	No suitable habitat in the study area. Low: unlikely to occur
<i>Diuris praecox</i>	Rough Doubletail	V	V	1	Grows on hills and slopes of near-coastal districts in open forests which have a grassy to fairly dense understorey.	Low: unlikely to occur
<i>Epacris purpurascens</i> var. <i>purpurascens</i>		V		1	Found in a range of habitat types, most of which have a strong shale soil influence.	Low: unlikely to occur
<i>Eucalyptus camfieldii</i>	Camfield's Stringybark	V	V	7	Occurs mostly in small scattered stands in exposed situations on sandstone plateaus, ridges and slopes near the coast, often on the boundary of tall coastal heaths or low open woodland. Requires shallow sandy soils.	Low: unlikely to occur
<i>Eucalyptus oblonga</i>	<i>Eucalyptus oblonga</i> population at Bateau Bay, Forrester's Beach and Tumby Umbi in the Wyong local government area	EP		1	Normally found on in dry open forest with infertile sandy soils on sandstone. The population at Bateau Bay occurs on coastal sands.	Low: unlikely to occur

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i>	Eucalyptus parramattensis C. Hall. subsp. parramattensis in Wyong and Lake Macquarie local government areas	EP		111	This species is associated with low moist areas alongside drainage lines and adjacent to wetlands. It is often found in woodland on sandy soils. The endangered population occurs on sandy alluvium within a floodplain community which also supports Eucalyptus robusta (Swamp mahogany), E. tereticornis (Forest Red Gum), E. gummifera (Sydney Bloodwood) as well as Melaleuca (Paperbark) species.	<b>Medium: could possibly occur</b>
<i>Genoplesium baueri</i>	Yellow Gnat-orchid	E	E		Grows in dry sclerophyll forest and moss gardens over sandstone.	Low: unlikely to occur
<i>Genoplesium insignis</i>	Variable Midge Orchid	E		2	Grows in patches of Themeda australis (Kangaroo Grass) amongst shrubs and sedges in heathland and forest. Associated vegetation at Chain Valley Bay is described as dry sclerophyll woodland dominated by Eucalyptus haemastoma (Scribbly Gum), Corymbia gummifera (Red Bloodwood), Angophora costata (Smooth-barked Apple) and Allocasuarina littoralis (Black She-oak).	Low: unlikely to occur
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V	V	124	Sporadically distributed throughout the Sydney Basin with the main occurrence centred around Picton, Appin and Bargo (and possibly further south to the Moss Vale area). Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. Often occurs in open, slightly disturbed sites such as along tracks. In Sydney it has been recorded from Shale Sandstone Transition Forest however, other communities occupied include, in Sydney Sandstone Ridgetop Woodland at Wedderburn and in Cooks River / Castlereagh Ironbark Forest at Kemps Creek.	<b>Medium: could possibly occur</b>

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Maundia triglochinoides</i>		V		18	Grows in swamps, lagoons, dams, channels, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients. Associated with wetland species e.g. Triglochin procerum.	<b>High: Likely to occur</b>
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	V	406	The species may occur in dense stands forming a narrow strip adjacent to watercourses, in association with other Melaleuca species or as an understorey species in wet forest. Biconvex Paperbark is only found in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	<b>High: Likely to occur</b>
<i>Pelargonium sp. Striatellum</i> (G.W.Carr 10345)	Omeo Stork's-bill	E	E		This species occurs in Victoria and New South Wales. Normally located in habitat just above high water mark of ephemeral lakes and can colonise exposed lake beds.	Low: unlikely to occur
<i>Posidonia australis</i>	Strapweed	(EP)			Found within the protected waters of coastal bays and estuaries and coastal lakes that are subject to frequent tidal flushing.	Low: unlikely to occur
<i>Prostanthera askania</i>	Tranquility Mintbush	E	E	52	Occurs adjacent to, but not immediately in, drainage lines on flat to moderately steep slopes formed on Narrabeen sandstone and alluvial soils derived from it. Occurs in moist sclerophyll forest and warm temperate rainforest communities, and the ecotone between them. These communities are generally tall forests with a mesic understorey; Sydney Blue Gum Eucalyptus saligna and Turpentine Syncarpia glomulifera are usually present, though canopy species present can be highly variable.	Low: unlikely to occur



Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Prostanthera junonis</i>	Somersby Mintbush	E	E		The species is restricted to the Somersby Plateau. It occurs on both the Somersby and Sydney Town soil landscapes on gently undulating country over weathered Hawkesbury sandstone within open forest/low woodland/open scrub. It occurs in both disturbed and undisturbed sites.	Low: unlikely to occur
<i>Pultenaea glabra</i>	Smooth Bush-pea, Swamp Bush-pea	V	V		Grows in swamp margins, hillslopes, gullies and creekbanks and occurs within dry sclerophyll forest and tall damp heath on sandstone.	Low: unlikely to occur
<i>Rhizanthella slateri</i>	Eastern Underground Orchid	V	E		Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest.	Low: unlikely to occur
<i>Rutidosia heterogama</i>	Heath Wrinklewort	V	V	128	Grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides.	<b>Medium: could possibly to occur</b>
<i>Senna acclinis</i>	Rainforest Cassia	E		1	Grows in or on the edges of subtropical and dry rainforest.	Low: unlikely to occur
<i>Streblus pendulinus</i>	Siah's Backbone, Sia's Backbone, Isaac Wood		E		Found in warmer rainforests, chiefly along watercourses. The altitudinal range is from near sea level to 800 m above sea level. The species grows in well developed rainforest, gallery forest and drier, more seasonal rainforest.	Low: unlikely to occur
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	E	V	34	Occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	Low: unlikely to occur

Scientific Name	Common Name	TSC Act (FM Act)	EPBC Act	Records	Habitat requirements	Likelihood of occurrence
<i>Tetradlea juncea</i>	Black-eyed Susan	V	V	189	Usually found in low open forest/woodland with a mixed shrub understorey and grassy groundcover. However, it has also been recorded in heathland and moist forest. The majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape. While some studies show the species has a preference for cooler southerly aspects, it has been found on slopes with a variety of aspects. It generally prefers well-drained sites below 200m elevation and annual rainfall between 1000 - 1200mm. The preferred substrates are sandy skeletal soil on sandstone, sandy-loam soils, low nutrients; and clayey soil from conglomerates, pH neutral.	<b>Medium: could possibly occur</b>
<i>Thelymitra sp. adorata</i>	Wyong Sun Orchid	CE	CE	18	Occurs from 10-40 m a.s.l. in grassy woodland or occasionally derived grassland in well-drained clay loam or shale derived soils. The vegetation type in which the majority of populations occur (including the largest colony) is a Spotted Gum - Ironbark Forest with a diverse grassy understorey and occasional scattered shrubs.	<b>Medium: could possibly occur</b>

**Note:** V = Vulnerable, E = Endangered, EP = Endangered Population, CE = Critically Endangered, X = presumed extinct, K = known, P = predicted

## Appendix 4: Risk matrix – likelihood of occurrence based on desktop and ground-truthing

	Likelihood of Occurrence based on further investigations e.g. on-ground						
	Descriptions	Species not identified and suitable habitat occurs > 10 km away from the Study area	Species not identified but suitable habitat occurs within 1 km of the Study area	Species not identified and no suitable habitat occurs within the Study area	Species not identified but partially disturbed or degraded habitat occurs within the Study area	Species not identified but suitable habitat occurs within the Study area	Species identified and suitable habitat occurs within the Study area
<b>Likelihood of Occurrence - based on desktop assessments</b>		F	E	D	C	B	A
<b>Expected to occur during the Project or beyond the Project (i.e. recent records exist in high numbers)</b>	A	M	M	H	H	H	H
<b>Could occur during the Project or beyond the Project (i.e. recent records exists)</b>	B	L	M	M	H	H	H
<b>Possible under exceptional circumstances (i.e. recent records exists but low in number)</b>	C	L	L	M	M	H	H
<b>Unlikely to occur during the Project (i.e. old records but low in number)</b>	D	L	L	L	M	M	H
<b>Very unlikely to occur during the Project (i.e. only old records)</b>	E	EL	L	L	L	M	M
<b>Extremely rare or previously unknown to occur (i.e. no records)</b>	F	EL	EL	L	L	L	M

Risk extremely Low (EL): extremely unlikely to occur	Risk Low (L): unlikely to occur	Risk Medium (M): could possibly occur	Risk High (H): Highly likely to occur/does occur
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# Appendix 5: EP&A Act assessments of significance

## **NOTE:**

The following tests associated with the assessment of significant effect on threatened species, populations or ecological communities, or their habitats have been undertaken in accordance with the requirements of Part 5 of the Environmental Planning and Assessment Act 1979 ('Act').

These assessments, under Part 5 of the Act, may have been undertaken with prescribed designated mitigation measures that form part of the 'Action Proposed'<sup>1</sup> for the 'Development'<sup>2</sup>. The effect of which is that these mitigation measures become a mandatory obligation based on Consent Authority approval to proceed.

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<sup>1</sup> Action Planned is as detailed in Part 5 of the Environmental Planning and Assessment Act 1979

<sup>2</sup> 'Development' has the same meaning as determined under Section 4 of the Environmental Planning and Assessment Act 1979

### **Ecological Community: Swamp Oak Floodplain Forest**

<b>Criterion</b>	<b>(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<b>(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<b>(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</b>  <b>(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction</b>
<b>Response</b>	The study area contains some Swamp Oak Floodplain Forest (SOFF) Endangered Ecological Community.  Vegetation would be removed as part of the proposal and is permanent.  The local occurrence of this ecological community is about 23 hectares, that is the area of Swamp Oak Floodplain Forest within the study area and outside the study area but contiguous with SOFF in the study area. Clearing of up to 1.7 hectares is approximately 7% of the local occurrence of the EEC.
<b>Conclusion</b>	The proposed activity is not likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.
<b>Criterion</b>	<b>(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.</b>
<b>Response</b>	The study area contains some Swamp Oak Floodplain Forest Endangered Ecological Community. About 1.7 hectares of the EEC is likely to be cleared as a result of the proposal.  The local occurrence of this ecological community is about 73 hectares, that is the area of Swamp Oak Floodplain Forest within the study area and outside the study area but contiguous with SOFF in the study area.  Vegetation and habitat removal is permanent and can also result in increased edge effects and indirect impacts to remaining areas of vegetation if mitigation measures are not adequately implemented.  A range of mitigation measures would be implemented to prevent indirect impacts on this EEC.

<b>Conclusion</b>	The proposed activity is unlikely likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.
<b>Criterion</b>	<p><b>(d) in relation to the habitat of a threatened species, population or ecological community:</b></p> <p><b>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed</b></p>
<b>Response</b>	<p>The study area contains some Swamp Oak Floodplain Forest Endangered Ecological Community.</p> <p>The remaining area of this ecological community is thought to be less than 10,000 hectares in NSW, or less than 30% of its original range. Clearing of up to 1.7 hectares is approximately 0.02% of the remaining area of the EEC.</p> <p>Vegetation and habitat removal is permanent and can also result in increased edge effects and indirect impacts to remaining areas of vegetation if mitigation measures are not adequately implemented.</p>
<b>Conclusion</b>	The proposed activity would remove or modify a small area of Swamp Oak Floodplains Forest habitat.
<b>Criterion</b>	<b>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action</b>
<b>Response</b>	<p>Habitat removal is permanent.</p> <p>Habitat to be removed is in an already fragmented, urbanised area. The 1.7 hectares of SOFF to be removed by the proposal is located on the road verge in narrow strips of modified vegetation between the existing Pacific Highway running through Wyong Town Centre and the rail corridor and small patches around the Wyong Bridge on Wyong River.</p> <p>The proposed activity would marginally increase the distance between remaining habitat areas of SOFF.</p>
<b>Conclusion</b>	Disturbance of small, narrow patches of Swamp Oak Floodplain Forest as a result of the proposed action is not likely to cause habitat to become more fragmented and isolated from other areas of habitat.
<b>Criterion</b>	<b>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</b>
<b>Response</b>	<p>Swamp Oak Floodplain Forest is restricted to the NSW North Coast, Sydney Basin and South East Corner Bioregions, however other areas of SOFF occur in the Wyong locality.</p> <p>The remaining area of this ecological community in the locality (10km radius) is about 320 hectares. There is less than 3200 hectares remaining in the Lower Hunter – Central Hunter region. Clearing of up to 1.7 hectares is approximately 0.5% of the remaining area of the EEC in the locality.</p> <p>Habitat to be removed is in an already fragmented, urbanised area.</p>
<b>Conclusion</b>	The habitat to be removed is not likely to be critical to the long term survival of the ecological community in the locality.



<b>Criterion</b>	<b>(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).</b>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<b>(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.</b>
<b>Response</b>	<p>No recovery plan has been gazetted for Swamp Oak Floodplain Forest. However, the OEH community profile sets out a number of priority actions to assist in the conservation of this EEC including:</p> <ul style="list-style-type: none"> <li>• Protect habitat by minimising further clearing of the community. This requires recognition of the values of all remnants in the land use planning process, particularly development consents, rezonings and regional planning.</li> <li>• Weed control.</li> <li>• Undertake restoration including bush regeneration and revegetation.</li> </ul>
<b>Conclusion</b>	The proposal would result in clearing of a small area of habitat of this community. The proposed mitigation measures are consistent with the other priority actions recommended to assist this EEC.
<b>Criterion</b>	<b>(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</b>
<b>Response</b>	<ul style="list-style-type: none"> <li>• Land clearing and associated fragmentation is identified as a threat to the survival of this EEC.</li> </ul>
<b>Conclusion</b>	The proposed action constitutes the key threatening process 'Clearing of native vegetation'.

### Overall Conclusion

The proposed activity would permanently remove approximately up to 1.7 ha of remnant vegetation that has been classified as the endangered ecological community Swamp Oak Floodplain Forest. It is estimated that less than 30% of the original distribution of SOFF remains in NSW.

There is only a small area of Swamp Oak Floodplain Forest (up to 1.7 ha) to be removed in relation to the area of the EEC remaining in the locality and in NSW. The vegetation to be removed is modified and already fragmented from other areas of habitat. The proposal is unlikely to have a significant impact on the EEC.

A Species Impact Statement is not required.

**Ecological Community: River-Flat Eucalypt Forest on Coastal Floodplains**

<b>Criterion</b>	<b>(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<b>(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<b>(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</b>  <b>(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction</b>
<b>Response</b>	<p>The study area contains some River-Flat Eucalypt Forest on Coastal Floodplains (RFEFCF) Endangered Ecological Community.</p> <p>Vegetation would be removed as part of the proposal and is permanent.</p> <p>The local occurrence of this ecological community is about 42 hectares, that is the area of River-Flat Eucalypt Forest on Coastal Floodplains within the study area and outside the study area but contiguous with RFEFCF in the study area. The local occurrence includes an area of RFEFCF east of the railway line. Clearing of up to 0.4 hectares in the construction impact area is approximately 1% of the local occurrence of the EEC.</p>
<b>Conclusion</b>	The proposed activity is not likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

<b>Criterion</b>	<b>(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.</b>
<b>Response</b>	<p>The study area contains some River-Flat Eucalypt Forest on Coastal Floodplains Endangered Ecological Community. About 0.4 hectares of the EEC is likely to be cleared as a result of the proposal.</p> <p>The local occurrence of this ecological community is about 42 hectares, that is the area of River-Flat Eucalypt Forest on Coastal Floodplains within the study area and outside the study area but contiguous with RFEFCF in the study area.</p> <p>Vegetation and habitat removal is permanent and can also result in increased edge effects and indirect impacts to remaining areas of vegetation if mitigation measures are not adequately implemented.</p> <p>A range of mitigation measures would be implemented to prevent indirect impacts on this EEC.</p>
<b>Conclusion</b>	The proposed activity is unlikely likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.
<b>Criterion</b>	<p><b>(d) in relation to the habitat of a threatened species, population or ecological community:</b></p> <p><b>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed</b></p>
<b>Response</b>	<p>The study area contains some River-Flat Eucalypt Forest Endangered Ecological Community.</p> <p>The remaining area of this ecological community is thought to be less than 13,000 hectares in NSW, or less than 30% of its original range. Clearing of up to 0.4 hectares is approximately less than 0.01% of the remaining area of the EEC.</p> <p>Vegetation and habitat removal is permanent and can also result in increased edge effects and indirect impacts to remaining areas of vegetation if mitigation measures are not adequately implemented.</p>
<b>Conclusion</b>	The proposed activity would remove or modify a small area of River-Flat Eucalypt Forest on Coastal Floodplains habitat.
<b>Criterion</b>	<b>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action</b>
<b>Response</b>	<p>Habitat removal is permanent.</p> <p>Habitat to be removed is in an already fragmented, urbanised area. The 0.4 hectares of RFEFCF to be removed by the proposal is in low condition being located on the road verge in narrow strips of vegetation between the existing Pacific Highway running through Wyong Town Centre and the rail corridor and south of the river between the Pacific Highway and South Tacoma Road.</p> <p>The proposed activity would marginally increase the distance between remaining habitat areas of RFEFCF.</p>
<b>Conclusion</b>	Disturbance of small, narrow patches of River-Flat Eucalypt Forest on Coastal Floodplains as a result of the proposed action is likely to only marginally increase the distance between remaining habitat areas of RFEFCF.

<b>Criterion</b>	<b>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</b>
<b>Response</b>	<p>River-Flat Eucalypt Forest on Coastal Floodplains is restricted to the NSW North Coast, Sydney Basin and South East Corner Bioregions, however other areas of RFEFCF occur in the Wyong locality.</p> <p>The remaining area of this ecological community in the locality (10km radius) is about &gt;1300 hectares. There is only about 2000 hectares remaining in the Lower Hunter region. Clearing of up to 0.4 hectares is approximately 0.03% of the remaining area of the EEC in the locality.</p> <p>Habitat to be removed is in low or moderate condition and is in an already fragmented, urbanised area.</p>
<b>Conclusion</b>	The habitat to be removed is not likely to be critical to the long term survival of the ecological community in the locality.
<b>Criterion</b>	<b>(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).</b>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<b>(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.</b>
<b>Response</b>	<p>No recovery plan has been gazetted for River-Flat Eucalypt Forest on Coastal Floodplains. However, the OEH community profile sets out a number of priority actions to assist in the conservation of this EEC including:</p> <ul style="list-style-type: none"> <li>• Protect habitat by minimising further clearing of the community. This requires recognition of the values of all remnants in the land use planning process.</li> <li>• Promote regeneration by avoiding prolonged or heavy grazing.</li> <li>• Undertake restoration including bush regeneration, revegetation and weed control, and promote public involvement in this restoration.</li> </ul>
<b>Conclusion</b>	The project involves clearing of a small area of the community. The proposed mitigation measures are consistent with the other priority actions recommended to assist this EEC.
<b>Criterion</b>	<b>(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</b>
<b>Response</b>	Land clearing and associated fragmentation is identified as a threat to the survival of this EEC.
<b>Conclusion</b>	The proposed action constitutes the key threatening process 'Clearing of native vegetation'.

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### **Overall Conclusion**

The proposed activity would permanently remove approximately up to 0.4 ha of remnant vegetation that has been classified as the endangered ecological community River-Flat Eucalypt Forest on Coastal Floodplains. It is estimated that less than 30% of the original distribution of RFEFCF remains in NSW.

There is only a small area of River-Flat Eucalypt Forest on Coastal Floodplains (up to 0.4 ha) to be removed in relation to the area of the EEC remaining in the locality and in NSW. Vegetation to be removed is in low or moderate condition and already fragmented from other areas of habitat. The proposal is unlikely to have a significant impact on the EEC.

A Species Impact Statement is not required.

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## **Ecological Community: Freshwater Wetlands on Coastal Floodplains**

<b>Criterion</b>	<b>(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<b>(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<b>(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</b>
	<b>(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction</b>
<b>Response</b>	<p>The study area contains some Freshwater Wetlands on Coastal Floodplains Endangered Ecological Community.</p> <p>Vegetation would be removed as part of the proposal and is permanent.</p> <p>The local occurrence of this ecological community is about 73 hectares, that is the area of Freshwater Wetland on Coastal Floodplains within the study area and outside the study area but contiguous with Freshwater Wetlands in the study area. The Freshwater Wetland within the construction impact area flows through a channel under the railway line to a larger area of wetland at Racecourse Swamp. Clearing of up to 0.14 hectares is approximately 0.2% of the local occurrence of the EEC.</p>
<b>Conclusion</b>	The proposed activity is not likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.
<b>Criterion</b>	<b>(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.</b>
<b>Response</b>	<p>The study area contains some Freshwater Wetlands on Coastal Floodplains Endangered Ecological Community. About 0.14 hectares of the EEC is likely to be cleared as a result of the proposal.</p> <p>The local occurrence of this ecological community is about 73 hectares, that is the area of Freshwater Wetland on Coastal Floodplains within the study area and outside the study area but contiguous with Freshwater Wetlands in the study area.</p> <p>Vegetation and habitat removal is permanent and can also result in increased edge effects and indirect impacts to remaining areas of vegetation if mitigation measures are not adequately implemented.</p> <p>A range of mitigation measures would be implemented to prevent indirect impacts on this EEC.</p>

<b>Conclusion</b>	The proposed activity is unlikely likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.
<b>Criterion</b>	<p><b>(d) in relation to the habitat of a threatened species, population or ecological community:</b></p> <p><b>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed</b></p>
<b>Response</b>	<p>The study area contains some Freshwater Wetlands on Coastal Floodplains Endangered Ecological Community.</p> <p>The remaining area of this ecological community is less than 30,000 hectares, in NSW. Clearing of up to 0.14 hectares is &lt;0.01% of the remaining area of the EEC.</p> <p>Vegetation and habitat removal is permanent and can also result in increased edge effects and indirect impacts to remaining areas of vegetation if mitigation measures are not adequately implemented.</p>
<b>Conclusion</b>	The proposed activity would remove or modify a small area of Freshwater Wetlands on Coastal Floodplains habitat.
<b>Criterion</b>	<b>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action</b>
<b>Response</b>	<p>Habitat removal is permanent.</p> <p>Habitat to be removed is in an already fragmented, urbanised area. The 0.14 hectares of Freshwater Wetlands to be removed by the proposal is in low or moderate condition being located on the road verge in a narrow strip of vegetation between the existing Pacific Highway running through Wyong Town Centre and the rail corridor.</p> <p>A network of SEPP 14 wetlands mostly in good condition are present within the broader catchment of Porters Creek, Wyong River and Tuggerah Lake.</p> <p>The proposed activity would marginally increase the distance between remaining habitat areas of Freshwater Wetlands.</p>
<b>Conclusion</b>	Disturbance of a small, narrow strip of Freshwater Wetlands as a result of the proposed action is not likely to cause habitat to become significantly more fragmented and isolated from other areas of habitat.
<b>Criterion</b>	<b>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</b>
<b>Response</b>	<p>Freshwater Wetlands on Coastal Floodplains is restricted to the NSW North Coast, Sydney Basin and South East Corner Bioregions, however other areas of Freshwater Wetlands on Coastal Floodplains occur in the Wyong locality that are protected by SEPP 14.</p> <p>The remaining area of this ecological community in the locality (10km radius) is about 171 hectares. Clearing of up to 0.14 hectares is approximately 0.2% of the remaining area of the EEC in the locality.</p> <p>Habitat to be removed is in low or moderate condition and is in an already fragmented, urbanised area.</p>
<b>Conclusion</b>	The habitat to be removed is not likely to be critical to the long term survival of the ecological community in the locality.



<b>Criterion</b>	<b>(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).</b>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<b>(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.</b>
<b>Response</b>	<p>No recovery plan has been gazetted for Freshwater Wetlands on Coastal Floodplains. However, the OEH community profile sets out a number of priority actions to assist in the conservation of this EEC including:</p> <ul style="list-style-type: none"> <li>• Install stormwater control mechanisms to prevent off-site impacts from adjacent development.</li> <li>• Undertake weed control as required using removal methods that would not damage the community.</li> <li>• Restore natural drainage conditions.</li> </ul>
<b>Conclusion</b>	The proposed mitigation measures are consistent with the priority actions recommended to assist this EEC.
<b>Criterion</b>	<b>(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</b>
<b>Response</b>	<ul style="list-style-type: none"> <li>• Land clearing and associated fragmentation is identified as a threat to the survival of this EEC.</li> </ul>
<b>Conclusion</b>	The proposed action constitutes the key threatening process 'Clearing of native vegetation'.

### Overall Conclusion

The proposed activity would permanently remove approximately up to 0.14 hectares of remnant vegetation that has been classified as the endangered ecological community Freshwater Wetlands on Coastal Floodplains. It was estimated in the 1990s that only about 66% of the original distribution of Freshwater Wetlands on Coastal Floodplains in the Lower Hunter - Central Coast region remains.

There is only a small area of Freshwater Wetlands (up to 0.14 hectares) to be removed and it is in low or moderate condition and already fragmented from other areas of habitat. The proposal is unlikely to have a significant impact on the EEC.

A Species Impact Statement is not required.

**Species Names:** *Callistemon linearifolius* (Netted Bottle Brush), *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea), *Rutidosia heterogama* (Heath Wrinklewort), *Tetraloche juncea* (Black-eyed Susan).

**Reason for grouping:** *Shrub species with similar habitat requirements (dry sclerophyll open forest or woodland).*

<b>Criterion</b>	<b>(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	<p>The study area contains Narrabeen Dooralong Spotted Gum Ironbark Forest. This vegetation may provide potential habitat for these species and its removal is permanent, however the habitat within the study area is in low condition.</p> <p>There are records of these species within a 10km radius occupying similar habitat.</p> <p>None of these species were identified during field surveys and targeted searches.</p>
<b>Conclusion</b>	Given that no individuals of these species would be removed, the proposed activity is unlikely to have an adverse effect on the life cycle of these species.
<b>Criterion</b>	<b>(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<p><b>(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</b></p> <p><b>(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction</b></p> <p><b>(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.</b></p>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.

<b>Criterion</b>	<p><b>(d) in relation to the habitat of a threatened species, population or ecological community:</b></p> <p><b>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed</b></p>
<b>Response</b>	<p>The study area contains Narrabeen Dooralong Spotted Gum Ironbark Forest This vegetation may provide potential habitat for these species and its removal is permanent, however the habitat within the study area is in low condition.</p> <p>Extensive areas of known and potential better quality habitat for these species occur in the region. There are records of these species within a 10km radius occupying similar habitat.</p> <p>The proposed activity would remove 1.2 ha of low quality potential habitat for these species, however no populations or individuals of these species have been recorded within or adjoining the study area.</p>
<b>Conclusion</b>	<p>It is unlikely there would be any impacts to known habitat as a result of the proposed action.</p>
<b>Criterion</b>	<p><b>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action</b></p>
<b>Response</b>	<p>Potential habitat for these species has been identified in the study area, however no individuals were identified during detailed targeted survey.</p> <p>Potential habitat to be removed is in an already fragmented, urbanised area bounded by roads, residential, recreational and rural development. Clearing or disturbance of potential habitat, up to 1.2 ha, may be required.</p> <p>The proposed activity would marginally increase the distance between remaining potential habitat areas.</p>
<b>Conclusion</b>	<p>It is unlikely that any known habitat would become more isolated or fragmented from other areas of known habitat.</p>
<b>Criterion</b>	<p><b>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</b></p>
<b>Response</b>	<p>Extensive areas of known and potential habitat for these species occur in the locality. Potential habitat to be removed within the study area is in low condition and is in an already fragmented, urbanised area bounded by roads, residential, recreational and rural development.</p> <p>Potential habitat for these species has been identified in the study area, however no individuals were identified during detailed targeted survey.</p>
<b>Conclusion</b>	<p>Given that no individuals of these species are present on site and habitat is low quality, it is unlikely the potential habitat to be removed is important to the long-term survival of these species.</p>

<b>Criterion</b>	<b>(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).</b>
<b>Response</b>	No critical habitat has been declared for any of these species.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<b>(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.</b>
<b>Response</b>	<p>No recovery plan has been developed for Netted Bottle Brush, but three priority activities have been identified to aid in its recovery:</p> <ul style="list-style-type: none"> <li>• Search for the species in suitable habitat in areas that are proposed for development or management actions, protect any such site found.</li> <li>• Protect known habitat from clearing or disturbance.</li> <li>• Determine response of species to fire and develop and promote a recommended fire regime.</li> </ul> <p>No recovery plan has been developed for Small-flower Grevillea, but eight priority activities have been identified to aid in its recovery, including:</p> <ul style="list-style-type: none"> <li>• Ensure that personnel planning and undertaking road maintenance are able to identify the species and are aware of its habitat.</li> <li>• Ensure that this species is considered in all planning matters on land that contains or may contain populations.</li> <li>• Conduct searches in potential habitat for new populations.</li> </ul> <p>No recovery plan has been developed for Heath Wrinklewort, but five priority activities have been identified to aid in its recovery, including:</p> <ul style="list-style-type: none"> <li>• Identify roadside populations and protect during roadside maintenance works.</li> <li>• Protect areas of heath and moist open forest from clearing and development.</li> </ul> <p>No recovery plan has been developed for Black-eyed Susan, but seven priority activities have been identified to aid in its recovery, including:</p> <ul style="list-style-type: none"> <li>• Undertake targeted searches for the species in known or potential habitat during its flowering period prior to any clearing or development.</li> </ul>
<b>Conclusion</b>	No individuals or populations have been identified on the site. The proposed mitigation measures are consistent with the priority actions recommended to assist these species.
<b>Criterion</b>	<b>(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</b>
<b>Response</b>	<p>Potential habitat removal is permanent, yet no individuals or populations have been identified.</p> <p>The proposed action constitutes the key threatening process 'Clearing of native vegetation'.</p>
<b>Conclusion</b>	Given that no individuals of these species would be removed as a result of the proposed activity it is unlikely to increase the impact of this KTP on these species.

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### **Overall Conclusion**

While the proposed activity would permanently remove approximately 1.2 ha of Narrabeen Dooralong Spotted Gum Ironbark Forest that has been identified as potential habitat, it is of low quality. No individuals of these species were identified during survey and targeted searches for threatened flora. None of these species are considered to be present nor affected.

No Species Impact Statement is required for Netted Bottle Brush, Small-flower Grevillea, Heath Wrinklewort or Black-eyed Susan.

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**Species Names:** *Caladenia tessellata* (Thick Lip Spider Orchid) *Thelymitra sp adorata* (Wyang Sun Orchid).

**Reason for grouping:** *Terrestrial orchids with similar habitat requirements (grassy dry sclerophyll forest/woodland on clay loam)*

<b>Criterion</b>	<b>(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	<p>The study area contains Narrabeen Dooralong Spotted Gum Ironbark Forest. This vegetation may provide potential habitat for these species and its removal is permanent, however the habitat within the study area is in low condition.</p> <p>There are records of these species within a 10km radius occupying similar habitat.</p> <p>Neither of these species were identified during field surveys and targeted searches.</p>
<b>Conclusion</b>	Given that no individuals of these species would be removed, the proposed activity is unlikely to have an adverse effect on the life cycle of these species.
<b>Criterion</b>	<b>(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<p><b>(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</b></p> <p><b>(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction</b></p>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<b>(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.</b>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.

<b>Criterion</b>	<p><b>(d) in relation to the habitat of a threatened species, population or ecological community:</b></p> <p><b>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed</b></p>
<b>Response</b>	<p>The study area contains Narrabeen Dooralong Spotted Gum Ironbark Forest. This vegetation may provide potential habitat for these species and its removal is permanent, however the habitat within the study area is in low condition.</p> <p>Extensive areas of known and potential better quality habitat for these species occur in the region. There are records of these species within a 10km radius occupying similar habitat.</p> <p>The proposed activity would remove 1.2 ha of low quality potential habitat for these species, however no populations or individuals of these species have been recorded within or adjoining the study area.</p>
<b>Conclusion</b>	<p>The proposal would result in the removal of a very small area of potential habitat for these species.</p>
<b>Criterion</b>	<p><b>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action</b></p>
<b>Response</b>	<p>Potential habitat for these species has been identified in the study area, however no individuals were identified during detailed targeted survey.</p> <p>Potential habitat to be removed is in an already fragmented, urbanised area bounded by roads, residential, recreational and rural development. Clearing or disturbance of potential habitat, up to 1.2 ha, would be required.</p> <p>The proposed activity would marginally increase the distance between remaining potential habitat areas.</p>
<b>Conclusion</b>	<p>It is unlikely that any habitat would become isolated or significantly more fragmented from other areas of habitat.</p>
<b>Criterion</b>	<p><b>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</b></p>
<b>Response</b>	<p>Extensive areas of known and potential habitat for these species occur in the locality. Potential habitat to be removed within the study area is in low condition and is in an already fragmented, urbanised area bounded by roads, residential, recreational and rural development.</p> <p>Potential habitat for these species has been identified in the study area, however no individuals were identified during detailed targeted survey.</p>
<b>Conclusion</b>	<p>Given that no individuals of these species are present on site and habitat is low quality, it is unlikely the potential habitat to be removed is important to the long-term survival of these species.</p>
<b>Criterion</b>	<p><b>(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).</b></p>
<b>Response</b>	<p>No critical habitat has been declared for any of these species.</p>
<b>Conclusion</b>	<p>Not applicable.</p>



<b>Criterion</b>	<b>(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.</b>
<b>Response</b>	<p>A national recovery plan has been developed for <i>Caladenia tessellata</i> (July 2010) and 17 recovery actions have been identified to aid in its recovery, including:</p> <ul style="list-style-type: none"> <li>• Identify and survey potential habitat, using ecological and bioclimatic information that may indicate habitat preference.</li> <li>• Control threats from pest plants.</li> <li>• Control the threat of direct damage from human activities.</li> </ul> <p>No recovery plan has been prepared for the Wyong Sun Orchid however six priority actions have been identified to aid in its recovery, including:</p> <ul style="list-style-type: none"> <li>• Control invasive weeds species which threaten to outcompete the Wyong Sun Orchid.</li> <li>• Conduct targeted surveys for the species in September and October in areas where further development is planned so as to ensure that no further habitat is lost to development.</li> <li>• Protect populations from vehicular traffic.</li> </ul>
<b>Conclusion</b>	The proposed activity does not affect any individuals or populations and is not inconsistent with the priority actions.

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<b>Criterion</b>	<b>(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</b>
<b>Response</b>	<p>Potential habitat removal is permanent, yet no individuals or populations have been identified.</p> <p>The proposed action constitutes the key threatening process 'Clearing of native vegetation'.</p>
<b>Conclusion</b>	The proposed action constitutes the key threatening process 'Clearing of native vegetation'.

### Overall Conclusion

No individual species were identified during survey and targeted searches for threatened flora. While the proposed activity would permanently remove approximately 1.2 ha of remnant native vegetation that has been identified as potential habitat, the species is not considered to be present nor affected.

No Species Impact Statement for *Caladenia tessellata* or *Thelymitra adorata* is required.

**Species Name: *Melaleuca biconvexa* (Biconvex Paperbark).**

<b>Criterion</b>	<b>(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	<p>The study area contains alluvial forest vegetation that may provide potential habitat for this species and its removal is permanent, however the habitat within the study area is in low to moderate condition.</p> <p>There are numerous records of this species within a 10km radius, many within 1km of the study area occupying similar habitat.</p> <p>No individuals of this species were identified during field surveys and targeted searches.</p>
<b>Conclusion</b>	Given that no individuals of the species would be removed, the proposed activity is unlikely to have an adverse effect on the life cycle of this species.
<b>Criterion</b>	<b>(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<p><b>(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</b></p> <p><b>(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction</b></p> <p><b>(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.</b></p>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.

<b>Criterion</b>	<p><b>(d) in relation to the habitat of a threatened species, population or ecological community:</b></p> <p><b>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed</b></p>
<b>Response</b>	<p>The study area contains alluvial forest vegetation that may provide potential habitat for this species and its removal is permanent, however the habitat within the study area is in low to moderate condition.</p> <p>Extensive areas of known and potential better quality habitat for this species occurs in the region. There are numerous records of this species within a 10km radius, many within 1km of the study area occupying similar habitat.</p> <p>The proposed activity would remove 2.1 ha of low to moderate quality potential habitat for this species, however no populations or individuals of the species have been recorded within or directly adjoining the study area.</p>
<b>Conclusion</b>	The proposed action would result in the removal of a small area of potential habitat.
<b>Criterion</b>	<b>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action</b>
<b>Response</b>	<p>Potential habitat for this species has been identified in the study area, however no individuals were identified during detailed targeted survey.</p> <p>Potential habitat to be removed is in an already fragmented, urbanised area bounded by roads, residential, recreational and rural development. Clearing or disturbance of potential habitat, up to 0.4 ha, may be required.</p> <p>The proposed activity would marginally increase the distance between remaining potential habitat areas.</p>
<b>Conclusion</b>	It is unlikely that any known habitat would become isolated or significantly more fragmented from other areas of habitat.
<b>Criterion</b>	<b>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</b>
<b>Response</b>	<p>Extensive areas of known and potential habitat for this species occurs in the locality. Potential habitat to be removed within the study area is in low to moderate condition and is in an already fragmented, urbanised area bounded by roads, residential, recreational and rural development.</p> <p>Potential habitat for the species has been identified in the study area, however no individuals were identified during detailed targeted survey.</p>
<b>Conclusion</b>	Given that no individuals of the species are present on site and habitat is low to moderate quality, it is unlikely the potential habitat to be removed is important to the long-term survival of this species.
<b>Criterion</b>	<b>(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).</b>
<b>Response</b>	No critical habitat has been declared for this species.
<b>Conclusion</b>	Not applicable.

<b>Criterion</b>	<b>(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.</b>
<b>Response</b>	<p>No recovery plan has been developed for Biconvex Paperbark, but seven priority activities have been identified to aid in its recovery including:</p> <ul style="list-style-type: none"> <li>• Survey thoroughly for the presence of Biconvex Paperbark before the approval of development applications.</li> <li>• Ensure run-off into swamps is controlled.</li> <li>• Assess impact of Myrtle Rust through monitoring of populations in proximity to known infestations.</li> </ul>
<b>Conclusion</b>	No individuals or populations have been identified on the site. The proposed mitigation measures are consistent with the priority actions recommended to assist this species.
<b>Criterion</b>	<b>(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</b>
<b>Response</b>	Potential habitat removal is permanent, yet no individuals or populations have been identified. The proposed action constitutes the key threatening process 'Clearing of native vegetation'.
<b>Conclusion</b>	The proposed action constitutes the key threatening process 'Clearing of native vegetation'.

### Overall Conclusion

While the proposed activity would permanently remove approximately 2.1 ha of alluvial forest vegetation that has been identified as potential habitat, it is of low to moderate quality. No individuals of this species were identified during survey and targeted searches. This species is not considered to be present nor affected.

No Species Impact Statement is required for *Melaleuca biconvexa*.

**Species Name: *Maundia triglochinos*.**

<b>Criterion</b>	<b>(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	<p>The study area contains a small area of freshwater wetland that may provide potential habitat for this species and its removal is permanent, however the habitat within the study area is in low condition.</p> <p>There are records of this species within a 10km radius of the study area occupying similar habitat.</p> <p>No individuals of this species were identified during field surveys and targeted searches.</p>
<b>Conclusion</b>	Given that no individuals of the species would be removed, the proposed activity is unlikely to have an adverse effect on the life cycle of this species.
<b>Criterion</b>	<b>(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<b>(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</b> <ul style="list-style-type: none"> <li><b>(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction</b></li> <li><b>(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.</b></li> </ul>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<b>(d) in relation to the habitat of a threatened species, population or ecological community:</b> <ul style="list-style-type: none"> <li><b>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed</b></li> </ul>
<b>Response</b>	<p>The study area contains a small area of freshwater wetland that may provide potential habitat for this species and its removal is permanent, however the habitat within the study area is in low condition.</p> <p>Extensive areas of known and potential better quality habitat for this species occurs in the region. There are records of this species within a 10km radius of the study area occupying similar habitat.</p> <p>The proposed activity would remove 0.14 ha of low quality potential habitat for this species, however no populations or individuals of the species have been recorded within or directly adjoining the study area.</p>

<b>Conclusion</b>	The proposed action would result in the removal of a very small area of potential habitat for the species.
<b>Criterion</b>	<b>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action</b>
<b>Response</b>	<p>Potential habitat for this species has been identified in the study area, however no individuals were identified during detailed targeted survey.</p> <p>Potential habitat to be removed is in an already fragmented, urbanised area bounded by roads, residential, recreational and rural development. Clearing or disturbance of potential habitat, up to 0.14 ha, would be required.</p> <p>The proposed activity would marginally increase the distance between remaining potential habitat areas.</p>
<b>Conclusion</b>	It is unlikely that any known habitat would become isolated or more fragmented from other areas of habitat.
<b>Criterion</b>	<b>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</b>
<b>Response</b>	<p>Extensive areas of known and potential habitat for this species occurs in the locality. Potential habitat to be removed within the study area is in low condition and is in an already fragmented, urbanised area bounded by roads, residential, recreational and rural development.</p> <p>Potential habitat for the species has been identified in the study area, however no individuals were identified during detailed targeted survey.</p>
<b>Conclusion</b>	Given that no individuals of the species are present on site and habitat is low quality, it is unlikely the potential habitat to be removed is important to the long-term survival of this species.
<b>Criterion</b>	<b>(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).</b>
<b>Response</b>	No critical habitat has been declared for this species.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<b>(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.</b>
<b>Response</b>	<p>No recovery plan has been developed for <i>Maundia triglochinos</i>, but two priority activities have been identified to aid in its recovery including:</p> <ul style="list-style-type: none"> <li>• Implement habitat management programs to address threats at sites.</li> <li>• Protect habitat from further clearing.</li> </ul>
<b>Conclusion</b>	No individuals or populations have been identified on the site. The project does involve clearing of a small area of potential habitat. The proposed mitigation measures are consistent with the other priority actions recommended to assist this species.

<b>Criterion</b>	<b>(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</b>
<b>Response</b>	Potential habitat removal is permanent, yet no individuals or populations have been identified. The proposed action constitutes the key threatening process 'Clearing of native vegetation'.
<b>Conclusion</b>	The proposed action constitutes the key threatening process 'Clearing of native vegetation'.

### Overall Conclusion

While the proposed activity would permanently remove approximately 0.14 ha of freshwater wetland vegetation that has been identified as potential habitat, it is of low quality. No individuals of this species were identified during survey and targeted searches. This species is not considered to be present nor affected.

No Species Impact Statement is required for *Maundia triglochinoides*.



**Species Name: *Angophora inopina*.**

<b>Criterion</b>	<b>(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	<p>This species prefers dry sclerophyll woodland on sandy soils, however the OEH threatened species database suggests it can also occur in swamp oak forest. The study area contains some small areas of swamp oak forest that may provide potential habitat for this species and its removal is permanent, however the habitat within the study area is in low condition.</p> <p>There are numerous records of this species within a 10km radius of the study area occupying its preferred habitat.</p> <p>No individuals of this species were identified during field surveys and targeted searches.</p>
<b>Conclusion</b>	Given that no individuals of the species would be removed, the proposed activity is unlikely to have an adverse effect on the life cycle of this species.
<b>Criterion</b>	<b>(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<p><b>(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</b></p> <p><b>(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction</b></p> <p><b>(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.</b></p>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.

<b>Criterion</b>	<p><b>(d) in relation to the habitat of a threatened species, population or ecological community:</b></p> <p><b>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed</b></p>
<b>Response</b>	<p>The study area contains some small areas of swamp oak forest that may provide potential habitat for this species and its removal is permanent, however the habitat within the study area is in low to moderate condition.</p> <p>Extensive areas of known and preferred better quality habitat for this species occurs in the region. There are records of this species within a 10km radius of the study area occupying its preferred habitat.</p> <p>The proposed activity would remove 1.7 ha of low quality marginal habitat for this species, however no populations or individuals of the species have been recorded within or directly adjoining the study area.</p>
<b>Conclusion</b>	<p>The proposed activity would remove a small area of low quality marginal habitat for this species.</p>
<b>Criterion</b>	<p><b>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action</b></p>
<b>Response</b>	<p>Potential habitat for this species has been identified in the study area, however no individuals were identified during detailed targeted survey.</p> <p>Potential habitat to be removed is in an already fragmented, urbanised area bounded by roads, residential, recreational and rural development. Clearing or disturbance of potential habitat, up to 1.7 ha, may be required.</p> <p>The proposed activity would marginally increase the distance between remaining potential habitat areas.</p>
<b>Conclusion</b>	<p>It is unlikely that any known habitat would become more isolated or fragmented from other areas of known habitat.</p>
<b>Criterion</b>	<p><b>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</b></p>
<b>Response</b>	<p>Extensive areas of known and potential habitat for this species occurs in the locality. Potential habitat to be removed within the study area is in low to moderate condition and is in an already fragmented, urbanised area bounded by roads, residential, recreational and rural development.</p> <p>Potential habitat for the species has been identified in the study area, however no individuals were identified during detailed targeted survey.</p>
<b>Conclusion</b>	<p>Given that no individuals of the species are present on site and habitat is not optimal, it is unlikely the potential habitat to be removed is important to the long-term survival of this species.</p>

<b>Criterion</b>	<b>(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).</b>
<b>Response</b>	No critical habitat has been declared for this species.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<b>(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.</b>
<b>Response</b>	<p>No recovery plan has been developed for Charmhaven Apple, but five priority activities have been identified to aid in its recovery including:</p> <ul style="list-style-type: none"> <li>• Preparation of site-specific fire management plans to enhance and maintain floristic and structural diversity.</li> <li>• Habitat rehabilitation through weed removal.</li> <li>• Protect and buffer known habitat from clearing, fragmentation and disturbance.</li> </ul>
<b>Conclusion</b>	No individuals or populations have been identified on the site. The proposed mitigation measures are consistent with the priority actions recommended to assist this species.
<b>Criterion</b>	<b>(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</b>
<b>Response</b>	Potential habitat removal is permanent, yet no individuals or populations have been identified. The proposed action constitutes the key threatening process 'Clearing of native vegetation'.
<b>Conclusion</b>	Given that no individuals of the species would be removed, the proposed activity is unlikely to result in an increase in the impact of this KTP on this species.

### Overall Conclusion

While the proposed activity would permanently remove approximately 1.7 ha of swamp oak forest vegetation that has been identified as potential habitat, it is not optimal habitat for the species. No individuals of this species were identified during survey and targeted searches. This species is not considered to be present nor affected.

No Species Impact Statement is required for *Angophora inopina*.

**Species Name: *Eucalyptus parramattensis* subsp. *parramattensis* (population).**

<b>Criterion</b>	<b>(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<b>(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	<p>The study area contains alluvial forest vegetation that may provide potential habitat for this endangered population and its removal is permanent, however the habitat within the study area is in low to moderate condition.</p> <p>The endangered population occurs within the Wyong and lake Macquarie local government areas occupying similar habitat. The study area is within the Wyong LGA.</p> <p>No individuals of this species were identified during field surveys and targeted searches.</p>
<b>Conclusion</b>	Given that no individuals of the species would be removed, the proposed activity is unlikely to have an adverse effect on the life cycle of this species that constitutes the endangered population.
<b>Criterion</b>	<b>(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</b> <ul style="list-style-type: none"> <li><b>(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction</b></li> <li><b>(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.</b></li> </ul>
<b>Response</b>	Not applicable.
<b>Conclusion</b>	Not applicable.

<b>Criterion</b>	<p><b>(d) in relation to the habitat of a threatened species, population or ecological community:</b></p> <p><b>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed</b></p>
<b>Response</b>	<p>The study area contains some small areas of alluvial forest vegetation that may provide potential habitat for this species and its removal is permanent, however the habitat within the study area is in low to moderate condition.</p> <p>Extensive areas of known and potential better quality habitat for this species occurs in the region. There are many records of this species within the Wyong and Lake Macquarie LGAs occupying similar habitat that constitute the endangered population.</p> <p>The proposed activity would remove 2.1 ha of low to moderate quality potential habitat for this species, however no populations or individuals of the species have been recorded within or directly adjoining the study area.</p>
<b>Conclusion</b>	<p>It is unlikely there would be any impacts to known habitat as a result of the proposed action.</p>
<b>Criterion</b>	<p><b>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action</b></p>
<b>Response</b>	<p>Potential habitat for this endangered population has been identified in the study area, however no individuals were identified during detailed targeted survey.</p> <p>Potential habitat to be removed is in an already fragmented, urbanised area bounded by roads, residential, recreational and rural development. Clearing or disturbance of potential habitat, up to 2.1 ha, would be required.</p> <p>The proposed activity would marginally increase the distance between remaining potential habitat areas.</p>
<b>Conclusion</b>	<p>It is unlikely that any known habitat would become more isolated or fragmented from other areas of known habitat.</p>
<b>Criterion</b>	<p><b>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</b></p>
<b>Response</b>	<p>Extensive areas of known and potential habitat for this endangered population occurs in the locality. Potential habitat to be removed within the study area is in low to moderate condition and is in an already fragmented, urbanised area bounded by roads, residential, recreational and rural development.</p> <p>Potential habitat for the endangered population has been identified in the study area, however no individuals were identified during detailed targeted survey.</p>
<b>Conclusion</b>	<p>Given that no individuals of the species are present on site and habitat is not optimal, it is unlikely the potential habitat to be removed is important to the long-term survival of this endangered population.</p>

<b>Criterion</b>	<b>(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).</b>
<b>Response</b>	No critical habitat has been declared for this species.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<b>(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.</b>
<b>Response</b>	<p>No recovery plan has been developed for <i>Eucalyptus parramattensis subsp. parramattensis</i> endangered population, but six priority activities have been identified to aid in its recovery including:</p> <ul style="list-style-type: none"> <li>• Improve vegetative connectivity within and between sub-populations through revegetation/regeneration programs.</li> <li>• Install stormwater control mechanisms to prevent off-site impacts from adjacent development.</li> </ul>
<b>Conclusion</b>	No individuals or populations have been identified on the site. The proposed mitigation measures are consistent with the priority actions recommended to assist this endangered population.
<b>Criterion</b>	<b>(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</b>
<b>Response</b>	Potential habitat removal is permanent, yet no individuals or populations have been identified in the study area. The proposed action constitutes the key threatening process 'Clearing of native vegetation'.
<b>Conclusion</b>	Given that no individuals of the species would be removed, the proposed activity is unlikely to result in an increase in the impact of this KTP on this endangered population.

### Overall Conclusion

While the proposed activity would permanently remove approximately 2.1 ha of alluvial and swamp oak forest vegetation that has been identified as potential habitat, it is of low to moderate quality. No individuals of this species were identified during survey and targeted searches. This endangered population is not considered to be present nor affected.

No Species Impact Statement is required for *Eucalyptus parramattensis subsp. parramattensis*.

**Species: *Crinia tinnula* (Wallum Froglet) and *Litoria aurea* (Green and Golden Bell Frog)**

The Wallum Froglet and Green and Golden Bell Frog are listed as vulnerable and endangered under the TSC Act, respectively. Neither species has been identified in field surveys.

Wallum Froglets are usually associated with acidic swamps on coastal sand plains although they are found in a range of other habitats. They breed in permanent swamps, shallow ephemeral pools and drainage ditches (OEH, 2014).

The Green and Golden Bell Frog inhabits a variety of habitats particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). They breed in a large variety of water bodies and shelter in dense vegetation within 0.5 kilometres of these sites (OEH, 2014).

Suitable foraging and sheltering habitat is available for both species within the study area.

<b>Criterion</b>	<b>(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	<p>There is a small area of wetland habitat in the north of the study area between the Pacific Highway and the railway line (ESU 5). A concrete drain under the railway line connects this small area of wetland to the larger wetlands of the Wyong Racecourse Swamp.</p> <p>This habitat would form suitable sheltering habitat for the Wallum Froglet and Green and Golden Bell Frog. No suitable breeding habitat is present.</p> <p>The proposal would remove 0.14 ha of wetland containing potential habitat for the Wallum Froglet and Green and Golden Bell Frog. Previous surveys have not identified either species within the study area. The closest record of occurrence for the Green and Golden Bell Frog is from 1992, approximately 1.8 kilometres from the study area.</p>
<b>Conclusion</b>	The proposal is unlikely to place a viable local population of the Wallum Froglet or Green and Golden Bell Frog at risk of extinction as these species are only likely to utilise the study area for sheltering on occasion and there are no records of the species occurring within or nearby the study area.
<b>Criterion</b>	<b>(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	Not applicable to a threatened species.
<b>Conclusion</b>	Not applicable.

<b>Criterion</b>	<p><b>(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</b></p> <p><b>(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction</b></p> <p><b>(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</b></p>
<b>Response</b>	Not applicable to a threatened species.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<p><b>(d) in relation to the habitat of a threatened species, population or ecological community:</b></p> <p><b>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed</b></p>
<b>Response</b>	Approximately 0.14 ha of wetland would be removed by the proposal. This habitat may provide shelter and foraging sites for the Wallum Froglet and Green and Golden Bell Frog. Additional suitable habitat occurs in the Wyong Racecourse Swamp. This habitat is connected to the study area by a drain under the railway line.
<b>Conclusion</b>	The habitat to be removed is a small area of potential and foraging habitat connected to a larger area of suitable habitat by a drain under the railway line.
<b>Criterion</b>	<b>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action</b>
<b>Response</b>	Suitable habitat for the Wallum Froglet and Green and Golden Bell Frog is already partially isolated from other suitable habitat by the Pacific Highway and railway line. Only a concrete drain connects the wetland within the study area to the larger Wyong Racecourse Swamp. The proposal occurs in an area already highly impacted by urban development.
<b>Conclusion</b>	As the wetlands within the study area are already isolated from other suitable habitat, it is unlikely that any known habitat would become more isolated or fragmented from other areas of known habitat.
<b>Criterion</b>	<b>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</b>
<b>Response</b>	Wallum Froglet and Green and Golden Bell Frog habitat within the study area provides only foraging and sheltering opportunities for these species. No suitable breeding habitat occurs.
<b>Conclusion</b>	Given the presence of more suitable habitat outside of the study area and the lack of records of either species, the proposal is unlikely to be important to the long-term survival of the species.



<b>Criterion</b>	<b>(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).</b>
<b>Response</b>	No critical habitat has been declared for these species.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<b>(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.</b>
<b>Response</b>	<p>No recovery plan or threat abatement plan has been prepared for the Wallum Froglet. Management actions for the species relevant to the proposal include:</p> <ul style="list-style-type: none"> <li>• Control stormwater runoff, drainage, ground water extraction and associated changes in water chemistry, pH, quality and quantity that may adversely impact on habitats and/or species' populations.</li> <li>• Control the invasion of weeds that may adversely impact on Wallum habitats.</li> <li>• Develop and implement measures to minimise the spread of the disease chytridiomycosis to and between habitats.</li> </ul> <p>A draft recovery plan has been developed for Green and Golden Bell Frog (DECC 2005). The main objectives of the recovery plan are:</p> <ul style="list-style-type: none"> <li>• Increase the security of key Green and Golden Bell Frog populations by way of preventing the further loss of Green and Golden Bell Frog habitat at key populations and secure opportunities for increasing protection of habitat areas.</li> <li>• Ensure extant Green and Golden Bell Frog populations are managed to eliminate or attenuate the operation of factors that are known or discovered to be detrimentally affecting the species.</li> <li>• Implement habitat management initiatives.</li> <li>• Establish self-sustaining and representative captive populations.</li> <li>• Increase the level of regional and local awareness of the conservation status of the Green and Golden Bell Frog.</li> </ul>
<b>Conclusion</b>	The proposal does not interfere with the objectives of the draft recovery plan for the Green and Golden Bell Frog. Mitigation measures recommended in this report would assist in reducing the impact of the proposal of these species.
<b>Criterion</b>	<b>(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</b>
<b>Response</b>	<p>The following key threatening processes are considered relevant to the proposal and these species:</p> <ul style="list-style-type: none"> <li>• Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands</li> <li>• Clearing of native vegetation</li> <li>• Infection of frogs by amphibian chytrid causing the disease chytridiomycosis.</li> </ul>
<b>Conclusion</b>	The proposal is unlikely to result in an increase in the impact of any of these KTPs on the Wallum Froglet or Green and Golden Bell Frog species.

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### **Overall Conclusion**

It is unlikely that the proposed actions would have a significant negative impact on any local populations of Wallum Froglet or Green and Golden Bell Frog. Only suitable foraging and sheltering habitat is available and no individuals of either species have been identified within the study area.

A Species Impact Statement is not required.

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**Species: *Glossopsitta pusilla* (Little Lorikeet), *Callocephalon fimbriatum* (Gang-gang Cockatoo) and *Lathamus discolor* (Swift Parrot)**

**Grouping: Woodland birds**

The Little Lorikeet is listed as vulnerable under the TSC Act. This species occupies open forest and woodland, feeding on flowering trees. They require trees with small hollows for breeding and roost in the canopy in the treetops, often some distance from feeding areas.

The Gang-gang Cockatoo is listed as vulnerable under the TSC Act. In summer, they are generally found in tall mountain forests and woodlands. In winter, they may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas. Gang-gang cockatoos favour old growth attributes for nesting and roosting.

The Swift Parrot is listed as endangered under the TSC Act. The species breeds in Tasmania and migrates to mainland Australia during the winter months to forage. Feed trees favoured by Swift Parrots in the Hunter-Central Rivers CMA are mature trees of Swamp Mahogany, Spotted Gum, Forest Red Gum, White Box, Mugga Ironbark, Grey Box, Black Butt and Red Bloodwood. Some suitable foraging trees occur within the study area.

<b>Criteria</b>	<b>(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	<p>Each of these species require mature trees for foraging. Foraging habitat is available within the study area in remnant patches of vegetation.</p> <p>The study area is unlikely to provide suitable nesting habitat for the Little Lorikeet as they prefer to nest close to foraging habitat. Hollow-bearing trees in the study area occur in isolated patches of vegetation.</p> <p>No suitable breeding habitat for the Gang-gang Cockatoo occurs in the study area.</p> <p>Swift Parrots breed in Tasmania and migrate to the east coast of the mainland during winter months.</p>
<b>Conclusion</b>	The proposal would require the removal of approximately 1.64 ha of vegetation that may provide suitable foraging habitat for the Little Lorikeet, Gang-gang Cockatoo and Swift Parrot. It is unlikely the removal of this habitat would place a viable local population of these species at risk of extinction as they are likely to use larger areas of foraging habitat and utilise the study area as supplementary foraging sites on occasion.
<b>Criteria</b>	<b>(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	Not applicable to a threatened species.
<b>Conclusion</b>	Not applicable.

<b>Criteria</b>	<p><b>(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</b></p> <p><b>(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction</b></p> <p><b>(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</b></p>
<b>Response</b>	Not applicable to a threatened species.
<b>Conclusion</b>	Not applicable.
<b>Criteria</b>	<p><b>(d) in relation to the habitat of a threatened species, population or ecological community:</b></p> <p><b>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed</b></p>
<b>Response</b>	Approximately 1.64 ha of vegetation containing potential foraging habitat for the Little Lorikeet, Gang-gang Cockatoo and Swift Parrot would be removed by the proposal. The vegetation to be removed occurs in isolated patches disturbed by urban development. Additional suitable foraging habitat occurs within the locality.
<b>Conclusion</b>	The potential habitat to be removed by the proposal is a small proportion of the suitable foraging habitat available to the Little Lorikeet, Gang-gang Cockatoo and Swift Parrot in the locality.
<b>Criteria</b>	<b>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action</b>
<b>Response</b>	Suitable foraging habitat for the Little Lorikeet, Gang-gang Cockatoo or Swift Parrot within the study area occurs in remnant vegetation through the Wyong Town Centre.
<b>Conclusion</b>	Removal of 1.64 ha of vegetation would not increase the isolation or fragmentation of any areas of potential Little Lorikeet, Gang-gang Cockatoo or Swift Parrot habitat.
<b>Criteria</b>	<b>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</b>
<b>Response</b>	The proposal would require the removal of 1.64 ha of foraging habitat in an urban environment. Little Lorikeets and Gang-gang Cockatoos are known to utilise resources within urban environments. Additional resources are available in the locality. There are insufficient resources within the study area to support a population of Little Lorikeets, Gang-gang Cockatoos or Swift Parrots.
<b>Conclusion</b>	The potential habitat within the study area is unlikely to be important to the long-term survival of the Little Lorikeet, Gang-gang Cockatoo or Swift Parrot within the locality. As there are insufficient resources to support a local population, the species are likely to rely on additional resources outside the study area to persist in the locality.

<b>Criteria</b>	<b>(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).</b>
<b>Response</b>	To date, no critical habitat has been declared for the Little Lorikeet, Gang-gang Cockatoo or Swift Parrot.
<b>Conclusion</b>	Not applicable.
<b>Criteria</b>	<b>(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.</b>
<b>Response</b>	<p>No recovery plan or threat abatement plan has been prepared for the Little Lorikeet or Gang-gang Cockatoo. A proposed Priority Action Statement has been prepared for the Little Lorikeet (OEH, 2014), including the following strategies:</p> <ul style="list-style-type: none"> <li>• Encourage retention of the hollow bearing trees through PVPs (Property Vegetation Plans) and EIA (Environmental Impact Assessment).</li> <li>• Encourage retention of old-growth Eucalyptus trees through PVPs and EIA.</li> </ul> <p>No priority actions for the Gang-gang Cockatoo are relevant to the proposal.</p> <p>A National Recovery Plan has been prepared for the Swift Parrot (Saunders and Tzaros, 2011). No recovery actions for the Swift Parrot are relevant to the proposal.</p>
<b>Conclusion</b>	The proposal would require the removal of four hollow-bearing trees, none of which are old-growth eucalypts. The proposal would not interfere with any actions identified to recovery the Gang-gang Cockatoo or Swift Parrot.
<b>Criteria</b>	<b>(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</b>
<b>Response</b>	<p>The following key threatening process are relevant to the proposal and the Little Lorikeet:</p> <ul style="list-style-type: none"> <li>• Clearing of native vegetation</li> <li>• Infection of native plants by <i>Phytophthora cinnamomi</i></li> <li>• Loss of hollow-bearing trees</li> </ul>
<b>Conclusion</b>	The proposal would result in the clearing of 1.64 ha of native vegetation and loss of four hollow-bearing trees.

### Overall Conclusion

Due to the limited availability of habitat resources available to these species, their absence during seasonal bird surveys and mobile nature of these woodland birds, it is unlikely that the proposed actions would negatively impact any individuals or populations of Little Lorikeet, Gang-gang Cockatoo or Swift Parrot that may utilise the study area.

No Species Impact Statement for the Little Lorikeet, Gang-gang Cockatoo or Swift Parrot is required.

**Species: *Calyptorhynchus lathami* (Glossy Black-cockatoo)**

The Glossy Black-cockatoo is listed as vulnerable under the TSC Act. They inhabit 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 (OEH, 2014) and occur within the study area in isolated patches of remnant vegetation. Hollow-bearing trees in the study area are unlikely to provide suitable nesting sites.

<b>Criteria</b>	<b>(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	The Glossy Black-cockatoo feeds on <i>Allocasuarina</i> and <i>Casuarina</i> species and breeds in large hollow-bearing eucalypts. Suitable foraging habitat is available within the study area in Swamp Oak Forest habitat as well as scattered casuarinas that have been incorporated into landscaping.
<b>Conclusion</b>	The proposal would require the removal of approximately 1.67 ha of Swamp Oak Forest that provides foraging habitat for the Glossy Black-cockatoo. It is unlikely the removal of this habitat would place a viable local population of these species at risk of extinction.
<b>Criteria</b>	<b>(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	Not applicable to a threatened species.
<b>Conclusion</b>	Not applicable.
<b>Criteria</b>	<b>(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</b> <b>(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction</b> <b>(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</b>
<b>Response</b>	Not applicable to a threatened species.
<b>Conclusion</b>	Not applicable.
<b>Criteria</b>	<b>(d) in relation to the habitat of a threatened species, population or ecological community:</b> <b>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed</b>
<b>Response</b>	Approximately 1.67 ha of Swamp Oak Forest providing foraging habitat for the Glossy Black-cockatoo would be removed by the proposal. No suitable nesting sites would be removed. Additional areas of Swamp Oak Forest occur along the Wyong River and around wetlands within two kilometres of the study area. These areas are larger and less disturbed than vegetation within the Wyong Town Centre.

<b>Conclusion</b>	The proposal would require the removal of a small proportion of the suitable foraging habitat available to the Glossy Black-cockatoo within the locality.
<b>Criteria</b>	<b>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action</b>
<b>Response</b>	Due to high levels of disturbance in the Wyong Town Centre, areas of suitable foraging habitat are already fragmented and isolated. Glossy Black-cockatoos are capable of travelling some distance to feed.
<b>Conclusion</b>	Removal of 1.67 ha of Swamp Oak Forest would not isolate or fragment any areas of potential Glossy Black-cockatoo habitat.
<b>Criteria</b>	<b>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</b>
<b>Response</b>	The site provides some foraging habitat in a disturbed urban environment. The proposed actions would remove a small amount of potential habitat. Additional resources are available in the locality. There are no suitable breeding sites present.
<b>Conclusion</b>	Potential habitat within the study area is unlikely to be important to the long-term survival of the Glossy Black-cockatoo as food resources are limited and there are no suitable breeding sites.
<b>Criteria</b>	<b>(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).</b>
<b>Response</b>	To date, no critical habitat has been declared for the Glossy Black-cockatoo.
<b>Conclusion</b>	Not applicable.
<b>Criteria</b>	<b>(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.</b>
<b>Response</b>	No recovery plan or threat abatement plan has been prepared for the Glossy Black-cockatoo. A Priority Action Statement has been prepared for the Glossy Black-cockatoo (OEH, 2014). None of the strategies listed are relevant to the proposal.
<b>Conclusion</b>	No recovery plans or threat abatement plans have been prepared, however, mitigation measures in this report would assist in reducing the effect of the proposal on Glossy Black-cockatoo foraging habitat that occurs within the study area.

<b>Criteria</b>	<b>(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</b>
<b>Response</b>	<p>The following key threatening process are relevant to the proposal and the Glossy Black-cockatoo:</p> <ul style="list-style-type: none"> <li>• Clearing of native vegetation</li> <li>• Infection of native plants by <i>Phytophthora cinnamomi</i></li> <li>• Loss of hollow-bearing trees</li> </ul>
<b>Conclusion</b>	The proposal would result in the clearing of 1.67 ha of foraging habitat for the Glossy Black-cockatoo. It is unlikely <i>Phytophthora cinnamomi</i> would be introduced to the study area by the proposal. Although hollow-bearing trees would be removed, it is unlikely that these trees would provide suitable breeding sites for the Glossy Black-cockatoo.

### Overall Conclusion

Due to the limited availability of habitat resources available to these species, their absence during seasonal bird surveys and mobile nature of this species, it is unlikely that the proposed actions would have a significant negative impact on a individuals or populations of Glossy Black-cockatoo that may utilise the study area.

No Species Impact Statement for the Glossy Black-cockatoo is required.



**Species: *Ixobrychus flavicollis* (Black Bittern)**

The Black Bittern is listed as vulnerable under the TSC Act. They generally inhabit areas of permanent water and dense vegetation in both terrestrial and estuarine wetlands. Black Bitterns roost in trees or on the ground amongst dense reeds during the day. They feed on frogs, reptiles, fish and invertebrates. Nests are built on a branch overhanging water (OEH, 2014).

There are records of the Black Bittern occurring less than one kilometre from the study area. No suitable breeding habitat occurs within the study area. Wetland habitat may provide suitable foraging and roosting habitat.

<b>Criteria</b>	<b>(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	The study area contains no suitable nesting habitat for the Black Bittern. Potential foraging and roosting habitat is restricted to a small wetland in the north of the study area between the Pacific Highway and railway line.
<b>Conclusion</b>	The proposal would require the removal of 0.14 ha of vegetation that may provide suitable foraging and/or roosting sites for the Black Bittern. It is unlikely the removal of this habitat would place a viable local population of this species at risk of extinction as the species is unlikely to rely on the resources of the study area.
<b>Criteria</b>	<b>(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	Not applicable to a threatened species.
<b>Conclusion</b>	Not applicable.
<b>Criteria</b>	<b>(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</b> <b>(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction</b> <b>(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</b>
<b>Response</b>	Not applicable to a threatened species.
<b>Conclusion</b>	Not applicable.

<b>Criteria</b>	<p><b>(d) in relation to the habitat of a threatened species, population or ecological community:</b></p> <p><b>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed</b></p>
<b>Response</b>	Approximately 0.14 ha of vegetation containing potential foraging and roosting habitat for the Black Bittern would be removed by the proposal. Extensive areas of more suitable habitat occur in the locality.
<b>Conclusion</b>	The potential habitat to be removed by the proposal is a small proportion of the suitable habitat available to Black Bitterns in the region.
<b>Criteria</b>	<b>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action</b>
<b>Response</b>	<p>The study area contains vegetation remnants as a result of urbanisation and infrastructure in the Wyong town centre.</p> <p>The proposal would require the removal of 0.14 ha of vegetation containing potential foraging and roosting sites for the Black Bittern that has already been isolated from other areas of suitable habitat.</p> <p>The Black Bittern is potentially nomadic all year in the Hunter-Central Rivers CMA so is capable of travelling to forage, nest and roost.</p>
<b>Conclusion</b>	Removal of 0.14 ha of vegetation would not increase the isolation or fragmentation of any areas of potential Black Bittern habitat.
<b>Criteria</b>	<b>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</b>
<b>Response</b>	The site provides some foraging and roosting habitat in a disturbed urban environment. The proposal would remove a small amount of this potential habitat. Additional, more suitable, resources are available in the locality.
<b>Conclusion</b>	The potential habitat within the study area is unlikely to be important to the long-term survival of the Black Bittern within the locality.
<b>Criteria</b>	<b>(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).</b>
<b>Response</b>	To date, no critical habitat has been declared for the Black Bittern.
<b>Conclusion</b>	Not applicable.

<b>Criteria</b>	<b>(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.</b>
<b>Response</b>	<p>No recovery plan or threat abatement plan has been prepared for the Black Bittern. Priority actions identified for the include:</p> <ul style="list-style-type: none"> <li>• Enhance knowledge of the breeding locations of this species. Survey suitable habitat eg vegetated wetlands during the breeding season. Investigate habitat usage particularly in Swamp Oak Forest.</li> <li>• In areas of suitable breeding habitat, seek to retain and manage riparian vegetation.</li> </ul>
<b>Conclusion</b>	None of the priority actions identified to assist in the recovery of the Black Bittern are relevant to the proposal.
<b>Criteria</b>	<b>(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</b>
<b>Response</b>	<p>The following key threatening process are relevant to the proposal and the Black Bittern:</p> <ul style="list-style-type: none"> <li>• Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands.</li> <li>• Clearing of native vegetation.</li> </ul>
<b>Conclusion</b>	The proposal would not result in the increase of any key threatening processes that would affect the Black Bittern.

### Overall Conclusion

Due to the limited availability of habitat resources available to this species, its absence during seasonal bird surveys and nomadic nature, it is unlikely that the proposed actions would have a significant negative impact on the Black Bittern to the extent that it would be placed at risk of localised extinction.

No Species Impact Statement for the Black Bittern is required.

**Species:** *Miniopterus schreibersii oceanensis* (Eastern Bentwing Bat), *Mormopterus norfolkensis* (Eastern Freetail Bat), *Myotis macropus* (Southern Myotis) and *Scoteanax rueppellii* (Greater Broad-nosed Bat)

#### Grouping: Microbats

The Eastern Bentwing Bat, Eastern Freetail Bat, Southern Myotis and Greater Broad-nosed Bat are listed as vulnerable under the TSC Act.

<b>Criteria</b>	<b>(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	<p>No roosting structures or maternity caves have been identified on site and it is highly unlikely that breeding occurs within the study area. The Wyong River bridge provides potential roosting habitat although these species are more likely to utilise other habitat features for roosting.</p> <p>The Eastern Freetail Bat and Greater Broad-nosed Bat may utilise hollow-bearing trees on site as roosting habitat and forage around the vegetated parts of the study area. The Southern Myotis roosts in hollows or structures near water and forages on the surface of streams and pools. Eastern Bentwing Bats primarily roost in caves and man-made structures so are likely to only utilise the study area for foraging on occasion.</p> <p>Foraging habitat for each of these species occurs within the study area. Suitable foraging habitat would be retained by the proposal.</p>
<b>Conclusion</b>	The proposed actions are unlikely to have an adverse effect on the life cycle of these species such that a viable local population is placed at risk of extinction. Suitable foraging habitat would be retained on site and no breeding sites would be affected.
<b>Criteria</b>	<b>(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	Not applicable to a threatened species.
<b>Conclusion</b>	Not applicable.
<b>Criteria</b>	<p><b>(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</b></p> <p><b>(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction</b></p> <p><b>(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.</b></p>
<b>Response</b>	Not applicable to a threatened species.
<b>Conclusion</b>	Not applicable.

<b>Criteria</b>	<p><b>(d) in relation to the habitat of a threatened species, population or ecological community:</b></p> <p><b>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed</b></p>
<b>Response</b>	<p>There would be some loss of potential foraging habitat for the Eastern Bentwing Bat, Eastern Freetail Bat and Greater Broad-nosed Bat. This habitat occurs as remnant vegetation in a disturbed urban environment.</p> <p>The proposal would require the removal of the Wyong River bridge that provides potential roosting habitat for these species.</p> <p>Vegetation adjacent to Southern Myotis foraging habitat would be removed.</p>
<b>Conclusion</b>	<p>The actions proposed would result in a limited amount of microbat habitat to be removed.</p>
<b>Criteria</b>	<p><b>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action</b></p>
<b>Response</b>	<p>These species are highly mobile, with the Eastern Bentwing-bat capable of dispersing up to 300 km from maternity caves outside breeding season.</p> <p>The area of habitat to be removed is a very small proportion of the home range of the Eastern Bentwing Bat, Eastern Freetail Bat and Greater Broad-nosed Bat.</p> <p>No Southern Myotis habitat would be removed by the proposal.</p>
<b>Conclusion</b>	<p>It is unlikely any microbat habitat would become fragmented or isolated as a result of the proposed actions due to the high mobility of these species.</p>
<b>Criteria</b>	<p><b>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</b></p>
<b>Response</b>	<p>These species require suitable roosting, breeding and foraging habitat. Foraging habitat is available within the study area. The only potential roosting site identified in the study area is the Wyong River bridge</p>
<b>Conclusion</b>	<p>Given the habitat on site is not adequate to sustain populations of these microbat species it is unlikely the habitat to be modified or removed is important to the long-term survival of any of these microbat species.</p>
<b>Criteria</b>	<p><b>(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).</b></p>
<b>Response</b>	<p>To date, no critical habitat has been declared for any of these four microbat species.</p>
<b>Conclusion</b>	<p>Not applicable.</p>

<b>Criteria</b>	<b>(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.</b>
<b>Response</b>	<p>No recovery plans or threat abatement plans have been prepared for these species. Priority Action Statements have been prepared for threatened microbats. Relevant actions include:</p> <ul style="list-style-type: none"> <li>• Promote roosting habitat in new artificial structures within the species range (Southern Myotis)</li> <li>• Prepare EIA guidelines which address the retention of hollow bearing trees maintaining diversity of age groups, species diversity, structural diversity. Give priority to largest hollow bearing trees (Eastern Freetail Bat and Greater Broad-nosed Bat).</li> </ul>
<b>Conclusion</b>	<p>The proposal would not interfere with any actions identified to recovery the Eastern Bentwing Bat, Eastern Freetail Bat, Southern Myotis or Greater Broad-nosed Bat. Recommendations in this report are consistent with the priority actions and may enhance existing roosting habitat within the study area.</p>
<b>Criteria</b>	<b>(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</b>
<b>Response</b>	<p>The following key threatening process are relevant to the proposal and the four threatened microbats:</p> <ul style="list-style-type: none"> <li>• Clearing of native vegetation</li> <li>• Loss of hollow-bearing trees</li> </ul>
<b>Conclusion</b>	<p>The actions proposed constitute these key threatening process. Mitigation measures have been recommended to minimise the impact of key threatening processes on microbat habitat.</p>

### Overall Conclusion

There is some suitable foraging habitat available for the four threatened microbat species within the study area. While the proposed works may impact on some potential foraging habitat, the small area of disturbance and the high mobility of the species would ensure there is unlikely to be a significant impact on these species.

A Species Impact Statement for the Eastern Bentwing Bat, Eastern Freetail Bat, Southern Myotis or Greater Broad-nosed Bat is not required.

**Species Name: *Pteropus poliocephalus* (Grey-headed Flying-fox)**

The Grey-headed Flying-fox is listed as a vulnerable species under the TSC Act. Individuals travel up to 50 kilometres to feed opportunistically on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines. They are also observed in cultivated gardens and fruit crops. Grey-headed Flying-foxes roost in large numbers in camps close to reliable foraging sources and usually located in gullies with dense vegetation and close to water (OEH, 2014). The closest Grey-headed Flying-fox camp to the study area is the rarely occupied Jilliby camp located 6.5 kilometres to the north west.

The proposal would require the removal of trees from roadsides and landscaping that may provide foraging opportunities for the Grey-headed Flying-fox when in flower.

<b>Criterion</b>	<b>(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	<p>The proposal would remove trees that may provide foraging opportunities for the Grey-headed Flying-fox when in flower or fruiting. Individuals are capable of travelling up to 50 kilometres in a night to forage on available resources. Additional food resources for the Grey-headed Flying-fox are available throughout Wyong Shire.</p> <p>The proposal would not affect a Grey-headed Flying-fox roost site or interfere with breeding activity.</p>
<b>Conclusion</b>	Considering the availability of resources within Wyong Shire, high mobility of the species and absence of breeding or roosting sites within the study area, it is unlikely that the proposal would place a viable local population of the Grey-headed Flying-fox at risk of extinction.
<b>Criterion</b>	<b>(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</b>
<b>Response</b>	Not applicable to a threatened species.
<b>Conclusion</b>	Not applicable.
<b>Criterion</b>	<b>(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</b>  <b>(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction</b>  <b>(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</b>
<b>Response</b>	Not applicable to a threatened species.
<b>Conclusion</b>	Not applicable.

<b>Criterion</b>	<p><b>(d) in relation to the habitat of a threatened species, population or ecological community:</b></p> <p><b>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed</b></p>
<b>Response</b>	<p>The proposal would require the clearing of vegetation adjacent to the Pacific Highway through Wyong Town Centre. This would include the removal of 1.64 ha of native vegetation that may contain foraging habitat for the Grey-headed Flying-fox when in flower. These trees are located in roadside vegetation or parks.</p> <p>Within Wyong Shire is extensive areas of bushland, riparian vegetation, parks and residential gardens that provides foraging habitat for the Grey-headed Flying-fox.</p>
<b>Conclusion</b>	<p>The proposal would require the removal of 1.64 ha of vegetation that may contain foraging habitat for the Grey-headed Flying-fox.</p>
<b>Criterion</b>	<p><b>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action</b></p>
<b>Response</b>	<p>The proposal would require the removal of 1.64 ha of vegetation from roadside parks and landscaping.</p> <p>The Grey-headed Flying-fox is known to travel up to 50 kilometres in a night to forage as food resources are available.</p>
<b>Conclusion</b>	<p>Given the high mobility of this species and their foraging behaviour, it is unlikely that suitable foraging habitat would become more isolated or fragmented from other areas of known habitat.</p>
<b>Criterion</b>	<p><b>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</b></p>
<b>Response</b>	<p>Approximately 1.64 ha of potential foraging habitat for the Grey-headed Flying-fox would be removed by the proposal. This species is capable of travelling long distances to forage as food resources become available. The locality contains additional habitat suitable for foraging.</p> <p>No roosting or breeding site would be affected by the proposal.</p> <p>Due to the disturbed nature of the study area, the affected habitat consists of individual trees rather than an area(s) of continuous habitat.</p>
<b>Conclusion</b>	<p>Given the high mobility of the species and availability of additional food resources within the region, the habitat to be removed is not considered to be important to the long-term survival of the Grey-headed Flying-fox.</p>
<b>Criterion</b>	<p><b>(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).</b></p>
<b>Response</b>	<p>No critical habitat has been declared for this species.</p>
<b>Conclusion</b>	<p>Not applicable.</p>



<b>Criterion</b>	<b>(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.</b>
<b>Response</b>	<p>A draft recovery plan has been prepared for the Grey-headed Flying-fox (DECCW, 2009). The main objectives of the recovery plan are:</p> <ul style="list-style-type: none"> <li>• Reduce the impact of threatening processes</li> <li>• Conserve their functional role as seed dispersers and pollinators</li> <li>• Improve information available to guide recovery plan</li> </ul>
<b>Conclusion</b>	Given the small extent of potential foraging habitat to be potentially removed/modified, the proposal is unlikely to negatively impact on the objectives of the recovery plan.
<b>Criterion</b>	<b>(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</b>
<b>Response</b>	<p>The following key threatening process is considered relevant to the proposal and the Grey-headed Flying-fox:</p> <ul style="list-style-type: none"> <li>• Clearing of native vegetation</li> </ul>
<b>Conclusion</b>	The small extent of habitat loss would not increase the operation of the threat of land clearing on the Grey-headed Flying-fox in this locality.

### Overall Conclusion

The proposal would remove approximately 1.64 ha of vegetation containing trees that may provide suitable foraging habitat for the Grey-headed Flying-fox when in flower. Flying-foxes are highly mobile species capable up travelling up to 50 kilometres to forage as food resources become available. It is unlikely that the proposed actions would have a significant negative impact on any local population of the Grey-headed Flying-fox.

A Species Impact Statement is not required for the Grey-headed Flying-fox.



## Appendix 6: EPBC Act assessments of significance

### NOTE:

In assessing Matters of National Environmental Significance (MNES) associated with impact or potential impact on:

- Wetlands of international importance<sup>3</sup>
- Listed threatened species and communities<sup>4</sup>
- Listed migratory species<sup>5</sup>

These/this assessment(s) may have been undertaken with prescribed designated mitigation measures that form part of the 'Action'<sup>6</sup>. The effect of which is that these mitigation measures become a mandatory obligation based on Consent Authority approval to proceed.

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<sup>3</sup> As detailed in Subdivision B, Division 1, Part 3 of the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

<sup>4</sup> As detailed in Subdivision C, Division 1, Part 3 of the EPBC Act

<sup>5</sup> As detailed in Subdivision D, Division 1, Part 3 of the EPBC Act

<sup>6</sup> Action is as detailed in Section 523 of the EPBC Act

**Species: *Angophora inopina* (Charmhaven Apple) - V, *Caladenia tessellata* (Thick Lip Spider Orchid) - V, *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea) – V, *Melaleuca biconvexa* (Biconvex Paperbark) – V, *Rutidosia heterogama* (Heath Wrinklewort) – V, *Tetratheca juncea* (Black-eyed Susan) – V.**

<b>Criterion</b>	<p><b>An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:</b></p> <p><b>i. lead to a long-term decrease in the size of an important population of a species</b></p>
<b>Response</b>	<p>These species are known to occur in the open forest and alluvial forest vegetation communities that occur in the study area. The habitat within the study area is mostly in low condition.</p> <p>No important populations of these species have been identified within or adjoining the study area.</p> <p>Several records of <i>Melaleuca biconvexa</i> occur within a 1 km of the study area, but none of these records are in the study area and no specimens were found after targeted surveys for these species in the study area.</p>
<b>Conclusion</b>	<p>The proposal would not lead to a long-term decrease in the size of an important population of any of these species.</p>
<b>Criterion</b>	<p><b>ii. reduce the area of occupancy of an important population</b></p>
<b>Response</b>	<p>These species are known to occur in the open forest and alluvial forest vegetation communities that occur in the study area. The proposal is likely to result in the clearing of approximately 3.3 ha of potential habitat for these species within the study area. The habitat within the study area is mostly in low condition.</p> <p>No important populations of these species have been identified within or adjoining the study area and no specimens were found after targeted surveys for these species in the study area.</p>
<b>Conclusion</b>	<p>The proposal would not reduce the extent of area of occupancy of an important population of any of these species.</p>
<b>Criterion</b>	<p><b>iii. fragment an existing important population into two or more populations</b></p>
<b>Response</b>	<p>The proposal is likely to result in the clearing of approximately 3.3 ha of potential habitat for these species within the study area. The habitat within the study area is mostly in low condition. Potential habitat to be removed is in an already degraded, fragmented, mostly urbanised area bounded by roads, residential, recreational, commercial and rural development.</p> <p>No important populations of these species have been identified within or adjoining the study area and no specimens were found after targeted surveys for these species in the study area.</p>
<b>Conclusion</b>	<p>The proposal would not fragment an existing population into two or more populations.</p>

<b>Criterion</b>	<b>iv. adversely affect habitat critical to the survival of a species</b>
<b>Response</b>	No critical habitat has been declared for these species.
<b>Conclusion</b>	The proposal would not adversely affect habitat critical to the survival of these species.
<b>Criterion</b>	<b>v. disrupt the breeding cycle of an important populations</b>
<b>Response</b>	No important populations of these species have been identified within or adjoining the study area and no specimens were found after targeted surveys for these species in the study area.
<b>Conclusion</b>	The proposal would not adversely affect the breeding cycle of an important population of these species.
<b>Criterion</b>	<b>vi. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</b>
<b>Response</b>	<p>These species are known to occur in the open forest and alluvial forest vegetation communities that occur in the study area. The proposal is likely to result in the clearing of approximately 3.3 ha of potential habitat for these species within the study area. The habitat within the study area is mostly in low condition.</p> <p>Potential habitat to be removed is in an already degraded, fragmented, mostly urbanised area bounded by roads, residential, recreational, commercial and rural development.</p> <p>Extensive areas of known and potential better quality habitat for this species occurs in the region.</p> <p>No individuals of these species were found after targeted surveys in the study area.</p>
<b>Conclusion</b>	Although there would be some removal of potential habitat, is unlikely to be to the extent that these species are likely to decline as habitat is low quality and no individuals or populations were found in the study area.
<b>Criterion</b>	<b>vii. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat</b>
<b>Response</b>	<p>The proposal has the potential to aid the spread of weeds due to the movement and/or introduction of soil, vehicles and equipment.</p> <p>A Site Erosion and Sediment Control Plan or Soil Water Management Plan, in accordance with the Blue Book, is to be implemented for the proposal.</p> <p>Weed, stormwater and pest management activities should be implemented as part of the environmental management framework for the site.</p>
<b>Conclusion</b>	The proposed actions are unlikely to result in the spread of invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.

<b>Criterion</b>	<b>viii. introduce disease that may cause the species to decline</b>
<b>Response</b>	<p>The study area is potential infected with <i>Phytophthora cinnamomi</i> and /or Myrtle Rust. Habitat disturbance may aid the spread of these pathogens.</p> <p>Protocols to prevent introduction or spread of <i>Phytophthora cinnamomi</i> and/or Myrtle Rust would be implemented for the proposal. Mitigation measures would include controls on the movement of vehicles, and human traffic into vegetation habitat. The proposed management controls for <i>Phytophthora</i> and Myrtle Rust would reduce the risk of spread these pathogens.</p>
<b>Conclusion</b>	The proposed activity is unlikely to spread a pathogen with potential to cause these species to decline.
<b>Criterion</b>	<b>ix. interfere substantially with the recovery of the species</b>
<b>Response</b>	<p>No recovery plans have been prepared for these species.</p> <p>Threats that have been identified that interfere with the recovery of these species, which are relevant to the proposed activity include vegetation removal. The proposed activity would result in the removal of 3.3 ha of remnant native vegetation that is potential habitat for these species. Habitat to be lost is mostly low condition with some small areas of moderate condition vegetation.</p> <p>No important populations of these species have been identified within or adjoining the study area and no specimens were found after targeted surveys for these species in the study area.</p>
<b>Conclusion</b>	As none of these species have been recorded in the study area, the proposed activity is unlikely to interfere with the recovery of these species.

### Overall Conclusion

The proposed activity would permanently remove approximately 3.3 ha of native vegetation, which provides potential habitat for these species. However, despite targeted surveys, these species were not located within the study area. While it is unlikely these species are present, mitigation measures have been proposed to protect potential habitat wherever possible and reduce threats and off-site impacts. The proposed activity is unlikely to have a significant impact on these vulnerable species. Referral to Department of Environment is not required.

**Species: *Thelymitra adorata* (Wyong Sun Orchid) - CE**

<b>Criterion</b>	<b>An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:</b>
<b>Response</b>	<p><b>i. lead to a long-term decrease in the size of a population</b></p> <p><i>Thelymitra adorata</i> is known to occur in grassy woodland or occasionally derived grassland in well-drained clay loam or shale derived soils. The vegetation type in which the majority of populations occur (including the largest colony) is a Spotted Gum - Ironbark Forest with a diverse grassy understorey and occasional scattered shrubs. Some disturbed Narrabeen Dooralong Spotted Gum Ironbark Forest occurs on the study area.</p> <p>The species was not recorded in the study area following extensive targeted searches.</p>
<b>Conclusion</b>	Given that no individuals of these species occur on the site, the proposed action is not likely to have a significant impact on these species leading to a long-term decrease in the size of a population.
<b>Criterion</b>	<b>ii. reduce the area of occupancy of the species</b>
<b>Response</b>	1.4 ha of low quality potential habitat for these species is proposed to be removed from the subject site. These species would not be able to occupy the study area after the proposed activity.
<b>Conclusion</b>	Given that no individuals of these species occur on the site and potential habitat is low quality, the proposed action is not likely to have a significant impact on these species leading to a reduction in the area of occupancy of the species.
<b>Criterion</b>	<b>iii. fragment an existing population into two or more populations</b>
<b>Response</b>	The species was not recorded in the study area following extensive targeted searches. Known populations within the locality are highly restricted, occurring in small isolated colonies of a few to about 25m <sup>2</sup> extent. The proposal would not fragment an existing population into two or more populations.
<b>Conclusion</b>	The proposed activity is unlikely to fragment an existing population into two or more populations.
<b>Criterion</b>	<b>iv. adversely affect habitat critical to the survival of a species</b>
<b>Response</b>	Other areas of known and potential habitat for these species occur in the locality. Potential habitat for these species has been identified in the study area, however no individuals were identified during detailed targeted survey. The 1.4 hectares of potential habitat to be cleared in the proposal area is in low condition.
<b>Conclusion</b>	The proposed activity is unlikely to adversely affect habitat critical to the survival of these species.

<b>Criterion</b>	<b>v. disrupt the breeding cycle of a population</b>
<b>Response</b>	<i>Thelymitra adorata</i> was not recorded in the study area following extensive targeted searches.
<b>Conclusion</b>	Given that no individuals of these species would be removed, is unlikely to disrupt the breeding cycle of a population of these species.
<b>Criterion</b>	<b>vi. modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</b>
<b>Response</b>	<p>1.4 ha of potential habitat within study area would be removed.</p> <p>These species are known to occur in Narrabeen Dooralong Spotted Gum ironbark Forest and the ecotone with Alluvial Redgum Footslopes Forest which occurs in the study area.</p> <p>Extensive areas of known and potential habitat for these species occur in the locality (&gt;2800ha).</p> <p>The species was not recorded at the site after extensive targeted searches.</p>
<b>Conclusion</b>	Although there would be removal of 1.4 ha of potential habitat, is unlikely to be to the extent that the species is likely to decline as no individuals or populations were found in the study area.
<b>Criterion</b>	<b>vii. result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat</b>
<b>Response</b>	<p>The proposal has the potential to aid the spread of weeds due to the movement and/or introduction of soil, vehicles and equipment.</p> <p>A Site Erosion and Sediment Control Plan or Soil Water Management Plan, in accordance with the Blue Book, is to be implemented for the project.</p> <p>Weed, stormwater and pest management activities should be implemented as part of the environmental management framework for the site.</p>
<b>Conclusion</b>	It is unlikely that the proposed action would result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat.



<b>Criterion</b>	<b>viii. introduce disease that may cause the species to decline</b>
<b>Response</b>	The species is not known to be susceptible to specific disease. The project is unlikely to introduce a disease that may cause the species to decline.
<b>Conclusion</b>	It is unlikely that the proposed action would introduce disease that may cause the species to decline.
<b>Criterion</b>	<b>ix. interfere with the recovery of the species</b>
<b>Response</b>	<p>The proposed activity would result in the removal of 1.4 ha of remnant native vegetation on the subject site.</p> <p>Proposed habitat loss is not consistent with the recovery plans or activities for the species.</p> <p>The species was not observed in the study area.</p>
<b>Conclusion</b>	The proposed activity is unlikely to interfere with the recovery of these species.

#### **Overall Conclusion**

The proposed activity would permanently remove approximately 1.4 ha of remnant native vegetation, which provides potential habitat for the species. However, despite targeted surveys, the species was not located within the study area. While it is unlikely the species is present, mitigation measures have been proposed to protect potential habitat and reduce threats. The proposed activity is unlikely to have a significant impact on *Thelymitra adorata*.

Referral to DoE is not required.

**Species: *Litoria aurea* (Green and Golden Bell Frog)**

The Green and Golden Bell Frog is listed as vulnerable under the EPBC Act.

EPBC Act Policy Statement 3.19 (2009) states that:

*“Owing to the continued decline of the green and golden bell frog, the restricted nature of all known populations in NSW and the uncertainty regarding the current status of the Victorian populations, all current populations of green and golden bell frog are regarded as an ‘important population’. A current population is defined as a site where one or more green and golden bell frogs have been detected on at least one occasion since 1995, even if they have not recently been discovered at the site (due to the species tendency towards local extinction and recolonisation cycles).”*

In the years since 1995, there are no records of the Green and Golden Bell Frog occurring within a 10 kilometre radius of the study area.

<b>Criterion</b>	<b>An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:</b>
	<b>i. lead to a long-term decrease in the size of an important population of a species</b>
<b>Response</b>	<p>A small wetland in the north of the study area contains suitable foraging and sheltering habitat for the Green and Golden Bell Frog.</p> <p>There are no records of the Green and Golden Bell Frog occurring within 10 kilometres of the study area since 1995.</p>
<b>Conclusion</b>	<p>As there are no records of the Green and Golden Bell Frog occurring within near the study area it is assumed there is no population present. Therefore, the removal of 0.14 ha of potential habitat would not lead to a long-term decrease in the size of a population of this species.</p>
<b>Criterion</b>	<b>ii. reduce the area of occupancy of an important population</b>
<b>Response</b>	<p>Approximately 0.14 ha of wetland between the Pacific Highway and railway line that may provide suitable foraging and sheltering habitat for the Green and Golden Bell Frog would be removed.</p> <p>There are no records of the Green and Golden Bell Frog occurring within the study area or less than 10 kilometres of the study area since 1995.</p>
<b>Conclusion</b>	<p>The proposal would not reduce the extent of area of occupancy of an important population of this species.</p>
<b>Criterion</b>	<b>iii. fragment an existing important population into two or more populations</b>
<b>Response</b>	<p>The proposal would require the removal of 0.14 ha of wetland that may provide suitable foraging and sheltering habitat for the Green and Golden Bell Frog.</p> <p>The study area is in the urbanised town centre of Wyong where vegetation exists as remnants due to previous disturbance.</p> <p>There are no records of the Green and Golden Bell Frog occurring within the study area or less than 10 kilometres of the study area since 1995.</p>
<b>Conclusion</b>	<p>As there is no extant population of the Green and Golden Bell Frog in the study area, the proposal would not fragment an existing population into two or more populations.</p>

<b>Criterion</b>	<b>iv. adversely affect habitat critical to the survival of a species</b>
<b>Response</b>	No critical habitat has been declared for these species.
<b>Conclusion</b>	The proposal would not adversely affect habitat critical to the survival of this species.
<b>Criterion</b>	<b>v. disrupt the breeding cycle of an important populations</b>
<b>Response</b>	<p>No suitable breeding habitat for the Green and Golden Bell Frog has been identified in the study area.</p> <p>There are no records of the Green and Golden Bell Frog occurring within the study area or less than 10 kilometres of the study area since 1995.</p>
<b>Conclusion</b>	The proposal would not adversely affect the breeding cycle of an important population of Green and Golden Bell Frog.
<b>Criterion</b>	<b>vi. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</b>
<b>Response</b>	<p>The proposal would require the removal of 0.14 ha of wetland that may provide suitable foraging and sheltering habitat for the Green and Golden Bell Frog</p> <p>There are no records of the Green and Golden Bell Frog occurring within the study area or less than 10 kilometres of the study area since 1995.</p>
<b>Conclusion</b>	The removal of 0.14 ha of potential Green and Golden Bell Frog habitat is unlikely to result in the decline of the extent of the Green and Golden Bell Frog as there are no records of the species occurring within the study.
<b>Criterion</b>	<b>vii. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat</b>
<b>Response</b>	<p>The proposal would not cause the introduction or increase the presence of Mosquito Fish (<i>Gambusia holbrooki</i>).</p> <p>Potential Green and Golden Bell Frog habitat within the study is ephemeral, therefore unsuitable for the Mosquito Fish.</p> <p>Other species such as the cat (<i>Felis catus</i>) that prey on Green and Golden Bell Frogs are likely to be already present within the study area.</p>
<b>Conclusion</b>	The proposal is unlikely to result in the spread of invasive species that are harmful to the Green and Golden Bell Frog becoming established in the wetland.
<b>Criterion</b>	<b>viii. introduce disease that may cause the species to decline</b>
<b>Response</b>	<p>The proposal is not likely result in the introduction of Amphibian chytridiomycosis as a hygiene protocol would be adopted to prevent potential spread of disease.</p> <p>The study area occurs in an urbanised environment so is unlikely to be free of disease.</p>
<b>Conclusion</b>	The proposed activity is unlikely to introduce disease with potential to cause this species to decline.

<b>Criterion</b>	<b>ix. interfere substantially with the recovery of the species</b>
<b>Response</b>	<p>A draft recovery plan has been developed for Green and Golden Bell Frog (DECC 2005). The main objectives of the recovery plan are:</p> <ul style="list-style-type: none"> <li>• Increase the security of key Green and Golden Bell Frog populations by way of preventing the further loss of Green and Golden Bell Frog habitat at key populations and secure opportunities for increasing protection of habitat areas.</li> <li>• Ensure extant Green and Golden Bell Frog populations are managed to eliminate or attenuate the operation of factors that are known or discovered to be detrimentally affecting the species.</li> <li>• Implement habitat management initiatives.</li> <li>• Establish self-sustaining and representative captive populations.</li> <li>• Increase the level of regional and local awareness of the conservation status of the Green and Golden Bell Frog.</li> </ul> <p>The study area is not considered to support a key population of the Green and Golden Bell Frog.</p>
<b>Conclusion</b>	The proposal is unlikely to interfere with the recovery of the Green and Golden Bell Frog.
<b>Significant impact threshold for the green and golden bell frog (DEWHA 2009)</b>	
<b>Criterion</b>	<p><b>There is a possibility of a significant impact on the green and golden bell frog, and a referral under the EPBC Act should be considered, if the action results in:</b></p> <p><b>i. the removal or degradation of aquatic or ephemeral habitat either where the green and golden bell frog has been recorded since 1995 or habitat that has been assessed as being suitable according to these guidelines. This can include impacts from chytrid, Gambusia originating off-site</b></p>
<b>Response</b>	<p>In the years since 1995 there are no records of the Green and Golden Bell Frog occurring within 10 kilometres of the study area. It is therefore considered likely that there is no population of Green and Golden Bell Frogs present.</p> <p>The habitat within the study area is not capable of supporting a population of the Green and Golden Bell Frog as there is no suitable breeding habitat.</p> <p>Removal of 0.14 ha of wetland that may provide potential foraging and/or sheltering habitat would not have a significant impact on the Green and Golden Bell Frog.</p>
<b>Criterion</b>	<b>ii. the removal or degradation of terrestrial habitat within 200 metres of habitat identified in threshold (i).</b>
<b>Response</b>	<p>The study area contains 0.14 ha of wetland that may provide potential habitat for the Green and Golden Bell Frog</p> <p>As determined in (i), removal of 0.14 ha of wetland that may provide potential foraging and/or sheltering habitat would not have a significant impact on the Green and Golden Bell Frog.</p>

<b>Criterion</b>	<b>iii. breaking the continuity of vegetation fringing ephemeral or permanent waterways or other vegetated corridors linking habitats meeting the criteria in (i).</b>
<b>Response</b>	<p>The study area is located in the urban centre of Wyong.</p> <p>Removal of 0.14 ha of wetland habitat would not severe the connectivity of any suitable Green and Bell Frog habitat.</p>

### **Overall Conclusion**

The proposal is not considered to have a significant impact on the Green and Golden Bell Frog. Referral to Department of Environment is not required.

**Species: *Lathamus discolor* (Swift Parrot)**

The Swift Parrot is listed as endangered under the EPBC Act.

<b>Criterion</b>	<b>An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:</b> <b>i. lead to a long-term decrease in the size of a population</b>
<b>Response</b>	The Swift Parrot occurs as one population in Australia.  They breed in Tasmania and migrate to the mainland to forage during the winter months.  Some suitable foraging habitat would be removed from the study area.
<b>Conclusion</b>	The foraging habitat to be removed by the proposal is unlikely to lead to a long-term decrease in the Swift Parrot population.
<b>Criterion</b>	<b>ii. reduce the area of occupancy of the species</b>
<b>Response</b>	The study area is an urbanised environment containing limited foraging resources for the Swift Parrot in parks and roadside landscaping.  Swift Parrots are only likely to forage in the study area during winter months if eucalypts are in flower.  Occurrence of the Swift Parrot may vary from year to year depending on flowering eucalypts and lerp infestations.
<b>Conclusion</b>	The proposal would not reduce the extent of area of occupancy of the Swift Parrot.
<b>Criterion</b>	<b>iii. fragment an existing population into two or more populations</b>
<b>Response</b>	The Swift Parrot occurs as one population in Australia.  Breeding occurs in Tasmania and individuals migrate to the east coast on the mainland to forage during the winter months.
<b>Conclusion</b>	The proposal would not fragment an existing population into two or more populations.
<b>Criterion</b>	<b>iv. adversely affect habitat critical to the survival of a species</b>
<b>Response</b>	No critical habitat has been declared for this species.
<b>Conclusion</b>	The proposal would not adversely affect habitat critical to the survival of this species.
<b>Criterion</b>	<b>v. disrupt the breeding cycle of a population</b>
<b>Response</b>	Swift Parrots breed in Tasmania and migrate to the Australian mainland during the winter months.
<b>Conclusion</b>	The proposal would not adversely affect the breeding cycle of the Swift Parrot.

<b>Criterion</b>	<b>vi. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</b>
<b>Response</b>	<p>The study area is an urbanised environment containing limited foraging resources for the Swift Parrot in parks and roadside landscaping.</p> <p>Swift Parrots are only likely to forage in the study area during winter months if eucalypts are in flower.</p> <p>Occurrence of the Swift Parrot may vary from year to year depending on flowering eucalypts and lerp infestations.</p>
<b>Conclusion</b>	Swift Parrots forage throughout the east coast of the Australian mainland depending on the availability of food resources. The study area is unlikely to be an important feeding area such that the removal of some suitable habitat would cause the species to decline.
<b>Criterion</b>	<b>vii. result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat</b>
<b>Response</b>	<p>The proposal would not cause the establishment of an invasive species.</p> <p>Invasive species, such as the Common Myna (<i>Acridotheres tristis</i>) may already be present in the study area, but are not likely to affect the Swift Parrot.</p>
<b>Conclusion</b>	The proposal is unlikely to result in an invasive species becoming established in habitat that may be utilised by the Swift Parrot.
<b>Criterion</b>	<b>viii. introduce disease that may cause the species to decline</b>
<b>Response</b>	The proposed works do not involve procedures that are likely to increase the potential for introduction of diseases that may affect the Swift Parrot.
<b>Conclusion</b>	The proposed activity is unlikely to introduce disease with potential to cause this species to decline.
<b>Criterion</b>	<b>ix. interfere with the recovery of the species</b>
<b>Response</b>	<p>A National Recovery Plan has been prepared for the Swift Parrot (Saunders and Tzaros, 2011).</p> <p>No recovery actions for the Swift Parrot are relevant to the proposal.</p>
<b>Conclusion</b>	The proposed activity is unlikely to interfere with the recovery of the Swift Parrot.

### Overall Conclusion

The proposal is not considered to have a significant impact on individuals or populations of the Swift Parrot that may utilise the study area. The Swift Parrot is only likely to utilise the study area for foraging during the winter months when suitable food resources are available.

Referral to Department of Environment is not required.

**Species: *Pteropus poliocephalus* (Grey-headed Flying-fox)**

The Grey-headed Flying-fox is listed as vulnerable under the EPBC Act.

<b>Criterion</b>	<b>An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:</b>
	<b>i. lead to a long-term decrease in the size of an important population of a species</b>
<b>Response</b>	<p>The proposal would remove trees that may provide foraging opportunities for the Grey-headed Flying-fox when in flower or fruiting. Additional food resources are available throughout Wyong Shire.</p> <p>The proposal would not affect a Grey-headed Flying-fox roost site or interfere with breeding activity.</p>
<b>Conclusion</b>	<p>Although the proposal would require the removal of foraging habitat for the Grey-headed Flying-fox, this species is highly mobile and capable of travelling long distance to forage as resources are available. No roosting or breeding activity would be affected. Therefore, the proposal would not lead to a long-term decrease in the size of an important population of this species.</p>
<b>Criterion</b>	<b>ii. reduce the area of occupancy of an important population</b>
<b>Response</b>	<p>Grey-headed Flying-foxes are a highly mobile species capable of travelling long distances to opportunistically forage on food resources as they are available.</p> <p>The proposal would require the removal of 1.64 ha of vegetation from parks and roadside landscaping within an urbanised area.</p>
<b>Conclusion</b>	<p>The proposal would not reduce the extent of area of occupancy of an important population of this species.</p>
<b>Criterion</b>	<b>iii. fragment an existing important population into two or more populations</b>
<b>Response</b>	<p>The Grey-headed Flying-fox is a highly mobile species that can fly long distances to reach seasonal foraging resources.</p>
<b>Conclusion</b>	<p>The proposal would not fragment an existing population into two or more populations or erect any barriers to the movement of the Grey-headed Flying-fox.</p>
<b>Criterion</b>	<b>iv. adversely affect habitat critical to the survival of a species</b>
<b>Response</b>	<p>No critical habitat has been declared for this species.</p>
<b>Conclusion</b>	<p>The proposal would not adversely affect habitat critical to the survival of this species.</p>
<b>Criterion</b>	<b>v. disrupt the breeding cycle of an important populations</b>
<b>Response</b>	<p>There are no roost or breeding sites in the study area.</p> <p>Foraging resources occur in an urbanised environment.</p>
<b>Conclusion</b>	<p>The proposal would not adversely affect the breeding cycle of an important population of this species.</p>



<b>Criterion</b>	<b>vi. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</b>
<b>Response</b>	Vegetation within the study area occurs as remnants in an urban environment. The Grey-headed Flying-fox is a highly mobile species that can fly long distances to reach seasonal foraging resources.
<b>Conclusion</b>	Although there would be some removal of potential foraging habitat, is unlikely to be to the extent that this species is likely to decline.
<b>Criterion</b>	<b>vii. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat</b>
<b>Response</b>	The proposal would not cause the establishment of an invasive species. Invasive species, such as the European Rabbit are already present in the study area, but not likely to affect the Grey-headed Flying-fox.
<b>Conclusion</b>	The proposed actions are unlikely to result in an invasive species that is harmful to the Grey-headed Flying-fox becoming established in its habitat.
<b>Criterion</b>	<b>viii. introduce disease that may cause the species to decline</b>
<b>Response</b>	The proposed works do not involve procedures that are likely to increase the potential for introduction of diseases that may affect the Grey-headed Flying-fox.
<b>Conclusion</b>	The proposed activity is unlikely to introduce disease with potential to cause this species to decline.
<b>Criterion</b>	<b>ix. interfere substantially with the recovery of the species</b>
<b>Response</b>	A draft recovery plan has been prepared for the Grey-headed Flying-fox (DECCW, 2009). The main objectives of the recovery plan are: <ul style="list-style-type: none"> <li>• Reduce the impact of threatening processes</li> <li>• Conserve their functional role as seed dispersers and pollinators</li> <li>• Improve information available to guide recovery plan</li> </ul>
<b>Conclusion</b>	The proposed activity is unlikely to interfere with the recovery of this species.

### Overall Conclusion

The study area contains foraging habitat that may be utilised the Grey-headed Flying-fox when eucalypt species are in flower. No roosting sites occur within or nearby the study area. The proposal is not considered to have a significant impact on individuals or populations of the Grey-headed Flying-fox that may utilise the study area.

Referral to Department of Environment is not required.

**Species Name: *Apus pacificus* (Fork-tailed Swift) and *Hirundapus caudacutus* (White-throated Needletail)**

<b>Criterion</b>	<p><b>An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:</b></p> <p><b>i. substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species</b></p>
<b>Response</b>	<p>The Study Area is highly modified and occurs in a heavily urbanised context.</p> <p>The majority of vegetation is highly disturbed and weed dominated.</p> <p>Use of the study area by the Fork-tailed Swift and White-throated Needletail would be rare. Part of the study area would be impacted by the proposal, but the remainder would be retained and rehabilitated.</p>
<b>Conclusion</b>	<p>Given the degraded state of the study area and its infrequency of use, the proposal would not substantially modify, destroy or isolate an important area of habitat for the Fork-tailed Swift or the White-throated Needletail.</p>
<b>Criterion</b>	<p><b>ii. result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species</b></p>
<b>Response</b>	<p>The proposal would not cause the establishment of an invasive species.</p> <p>Invasive species, such as the European Rabbit are already present in the study area, but not likely to affect these species.</p>
<b>Conclusion</b>	<p>The proposed actions are unlikely to result in an invasive species that is harmful to one of the migratory species becoming established in an area of important habitat for the migratory species.</p>
<b>Criterion</b>	<p><b>iii. seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species</b></p>
<b>Response</b>	<p>Use of the study area by the Fork-tailed Swift and White-throated Needletail would be rare and would not involve an ecologically significant proportion of their populations.</p> <p>Both species breed in the northern hemisphere.</p>
<b>Conclusion</b>	<p>It is highly unlikely that the proposed actions would disrupt the lifecycle of an ecologically significant proportion of the population of these migratory species.</p>

**Overall Conclusion**

As the study site provides only intermittent suitable habitat it is considered that the proposal would not have a significant impact on these migratory species.

Referral to Department of Environment is not required.

**Species Name: *Haliaeetus leucogaster* (White-bellied Sea-Eagle)**

The White-bellied Sea-Eagle is listed as migratory under the EPBC Act. It was recorded during surveys undertaken by Parsons Brinckhoff in 2013 and there are numerous other records of the species occurring within 10 kilometres of the study area.

<b>Criterion</b>	<b>An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:</b>  <b>i. substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species</b>
<b>Response</b>	Due to the high mobility of the White-bellied Sea-eagle, the study area is unlikely to be an important hunting area. The Study Area is highly modified and occurs in a heavily urbanised context.  The majority of vegetation is highly disturbed and weed dominated.
<b>Conclusion</b>	Given the degraded state of the study area and its infrequency of use, the proposal would not substantially modify, destroy or isolate an important area of habitat for the White-bellied Sea-eagle.
<b>Criterion</b>	<b>ii. result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species</b>
<b>Response</b>	The proposal would not result in the establishment of an invasive species.  No important habitat has been identified within the study area.  Invasive species already present in the study area are not likely to affect the White-bellied Sea-eagle.
<b>Conclusion</b>	The proposed actions are unlikely to result in an invasive species that is harmful to the White-bellied Sea-eagle becoming established in an area of important habitat for the migratory species.
<b>Criterion</b>	<b>iii. seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species</b>
<b>Response</b>	The White-bellied Sea-eagle may utilise the study area for hunting on occasion.  No breeding sites were identified.
<b>Conclusion</b>	It is highly unlikely that the proposed actions would disrupt the lifecycle of an ecologically significant proportion of the population of White-bellied Sea-eagle.

**Overall Conclusion**

As the study site provides only hunting habitat that may be utilised on occasion by the White-bellied Sea-eagle, it is considered that the proposal would not have a significant impact on this migratory species.

Referral to Department of Environment is not required.



# Appendix 7: Aquatic assessment report





Final report

# **Aquatic Flora and Fauna Report for the Pacific Highway Upgrade through Wyong Town Centre**

For SMEC Australia

May 2014









# Aquatic Survey and Assessment at the Pacific Highway, Wyong

For: SMEC Australia Pty Ltd

Watershed Ecology

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The information within this document is and shall remain the property of Watershed Ecology

The cover and back pages depict the Wyong River near the Pacific Highway, Wyong



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# 1 INTRODUCTION

---

## 1.1 Purpose

The Roads and Maritime Services (Roads and Maritime) commissioned SMEC Australian Pty Ltd (SMEC) to develop a concept design for a 2.4 kilometre section of the Pacific Highway at Wyong, extending from the intersection of Johnson Road in the south to south of Cutler Drive in the north. The current single lane in each direction road is proposed to be upgraded to dual carriageway, with two lanes in each direction separated by a central median strip.

This report is part of a larger environmental assessment that SMEC is managing to enable Roads and Maritime to satisfy provisions within the *Environmental Planning and Assessment Act 1979*. This report is a technical supporting document to a Review of Environmental Factors (REF) authored by SMEC. This report describes the environmental constraints associated with aquatic ecosystems within the study area and provides options for abating adverse environmental risks.

## 1.2 Study Area

The study area that this report refers to is a 2.4 kilometre section of the Pacific Highway at Wyong, extending from the intersection of Johnson Road in the south to south of Cutler Drive in the north. The study area is linear shaped and crosses the Wyong River (Figure 1).

The study area is within the Wyong LGA on the Central Coast of New South Wales (NSW) approximately 80 kilometres northeast of Sydney.

## 1.3 Aims

The aim of this ecological impact assessment is to:

- Identify potential environmental and statutory planning constraints associated with aquatic ecosystems to the Proposal; and,
- To describe the associated adverse environmental risks and propose requirements for mitigation.

The results of this investigation will inform the REF.

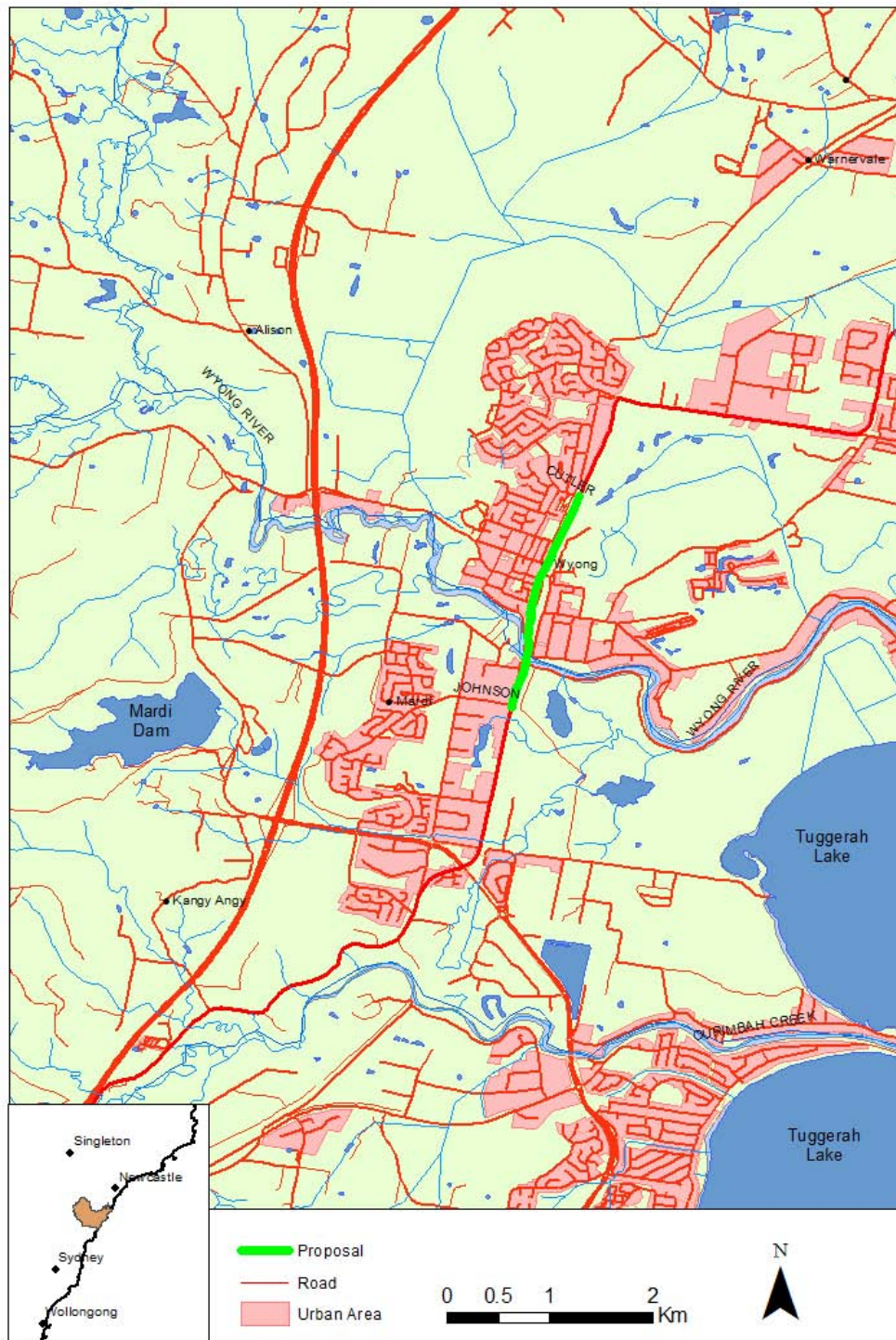


Figure 1. The location of the proposal is highlighted in green.



## 1.4 Structure of this Document

Investigations for this report comprise of the following:

- Literature review and database searches for threatened aquatic flora and fauna species, populations, and ecological communities under the EPBC Act, FM Act, and TSC Act.
- Assessment of relevant Commonwealth and NSW statutory requirements and the Proposal's potential trigger of these.
- An aquatic and riparian survey to determine the adverse ecological risks for aquatic ecosystems in the study site.
- Results of the aquatic ecological assessment. The field assessment refines the desktop study and determines the likelihood for occurrence onsite of threatened species and endangered ecological communities that were recorded in the wider area.
- Assessment of the potential for adverse impacts to flora and fauna associated with aquatic ecosystems from the proposal.
- Recommendations for avoidance of impacts and/or appropriate mitigation and management measures.

## 1.5 Exclusions and Limitations

This report investigates the potential impacts that are associated with the Proposal as described in the proposal brief by SMEC. This report should not be construed as providing advice on any work or developments other than the Proposal. No assessment was made for any future projects or activities that may arise because of this Proposal.

The scope of this flora and fauna report does not include the following items:

- Consultation with the local community, Wyong Shire Council or Local Aboriginal Land Councils;
- Detailed aquatic fauna survey that would confirm absence of species;
- Detailed freshwater fauna or water quality sampling;
- Species Impact Statements (SIS) for approval of the Proposal; and,
- Consultation with state agencies such as NSW DPI.

Certain provisions in this report assume reliance on conceptual design and technical information (provided by: N Philps (SMEC) email 20 March 2014, M Corrigan (SMEC) email 15 April 2014). If the design of the Proposal changes from that assessed due to design development, inclusion of new information, changing motivations or any other reason, the results of any impact assessment or control measures provided in this report may no longer apply.

This aquatic flora and fauna assessment was undertaken in accordance with SMEC's scope of works and as such is reliant on third party information and third party technical reports. The third party information and third party technical reports used to inform this report may vary in quality and scope. Watershed Ecology does not warrant that the data contained in third party reports is correct or complete and no attempts were made to verify third party data or conclusions.



## 2 PLANNING FRAMEWORK

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### 2.1 Introduction

This chapter outlines the state and regional planning policies that would apply to the Proposal.

### 2.2 NSW State Legislation

This section provides an assessment of relevant State (NSW) environmental legislation that is likely to have a significant bearing on the Proposal, including:

- *Fisheries Management Act 1994*
- *Water Management Act 2000*
- *Threatened Species Conservation Act 1995*
- *Water Management Act 2000*

#### 2.2.1 Fisheries Management Act 1994

The *NSW Fisheries Management Act 1994* (FM Act) establishes provisions for the identification, conservation, and recovery of threatened fish, aquatic invertebrates, and marine vegetation. The Act also covers the identification and management of key threatening processes that affect threatened species or could cause other species to become threatened.

If a planned development or activity is likely to have any impact on a threatened species, a preliminary assessment of the potential impacts must be made (the 'Assessment of Significance' or 'seven part test'). If the impacts are likely to be significant, or if critical habitat is affected, a species impact statement must be prepared. In these cases, the Director-General of Department of Primary Industries (DPI) must agree to the development approval and the Minister for Primary Industries may need to be consulted.

If the Proposal requires works on or near riverbanks then approval from the relevant agencies would be required. Under the 'integrated development' provisions of the *NSW Environmental Planning and Assessment Act 1979*, DPI is an 'approval body' for local development that requires one or more of the following permits under the FM Act.

The definition of 'dredging work' under section 198A of the FM Act includes:

- Any work that involves excavating water land, or
- Any work that involves the removal of material from water land that is prescribed by the regulations as being dredging work to which this Division applies

The definition of 'reclamation work' under Section 198A includes any work that involves:

- Using any material (such as sand, soil, silt, gravel, concrete, oyster shells, tyres, timber or rocks) to fill in or reclaim water land, or
- Depositing any such material on water land for the purpose of constructing anything over water land (such as a bridge), or

- Draining water from water land for the purpose of its reclamation.

## COMMENT

The proposed activity includes two new bridges across the Wyong River and construction near two wetlands. The proposed activity has the potential to adversely impact upon aquatic and riparian environments. Under section 199 of the FM Act, Roads and Maritime is required to give written notification to the Minister for Fisheries for any reclamation or dredging work.

The construction of the new bridges has the potential to harm marine vegetation including seagrass. Works would require a Fisheries Permit pursuant to sections 219 and 220 of the FM Act.

### 2.2.2 *Threatened Species Conservation Act 1995*

The *Threatened Species Conservation Act 1995* (TSC Act) lists threatened species, populations, and ecological communities in NSW. If a threatened species, population or ecological community or its habitat is likely to occur in any area which may be affected by a development Proposal, then a 'seven-part test' in accordance with Section 5A of the EP&A Act (as amended by the TSC Act) must be conducted to determine whether the Proposal would have a significant impact.

If it is concluded that there would be a significant impact, then a Species Impact Statement (SIS) must be prepared, and the Proposal would then be subject to approval from the Director-General of the Office of Environment and Heritage.

## COMMENT

The study area does not have the potential to provide habitat for any threatened aquatic insect species listed under the TSC Act. Therefore, an SIS would not be required.

### 2.2.3 *Water Management Act 2000*

The objectives of the *Water Management Act 2000* (WM Act) are to provide for the sustainable and integrated management of NSW water sources for the benefit of both present and future generations.

The objectives include:

- To apply the principles of ecologically sustainable development;
- To protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and their water quality;
- To recognise the role of the community, as a partner with government, in resolving issues relating to the management of water sources;
- To integrate the management of water sources with the management of other aspects of the environment, including the land, its soil, its native vegetation and its native fauna; and
- To encourage best practice in the management and use of water.

Under the Act, approvals are required for controlled activities. A controlled activity means:

- 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.

## **COMMENT**

A public authority (which includes Roads and Maritime) is exempt from the requirements to obtain a controlled activity approval under Clause 38 of the Water Management (General) Regulation 2004.

### **2.2.4 Catchment values – Including Drinking Water and Sub Catchments of High Conservation Value**

The proposed activity site is not located within a catchment area or special area as specified under the *Sydney Water Catchment Management Act 1998*.

### **2.2.5 Wild and Scenic Rivers**

The proposed activity will not affect any wild and/or scenic rivers.

### **2.2.6 State Environmental Planning Policy No 14 - Coastal Wetlands**

A State Environmental Planning Policy No 14 - Coastal Wetlands (SEPP 14) is a wetland that is included on a map contained in SEPP – Coastal Wetlands. SEPP 14 aims to ensure that the coastal wetlands are preserved and protected in the environmental and economic interests of the State.

The policy applies to local government areas outside the Sydney metropolitan area that front the Pacific Ocean. Over 1300 wetlands are identified as being of high natural value from Tweed Heads to Broken Bay and from Wollongong to Cape Howe. Land clearing, levee construction, drainage work or filling may only be carried out within these wetlands with the consent of the local council and the agreement of the Director General of Planning and Environment. Such development also requires an environmental impact statement to be lodged with a development application.

## **COMMENT**

Thirteen wetlands within 10 kilometres of the proposal site are designated SEPP 14 wetlands under clause 7.1 (Figure 2). Two large wetlands that are north of the Proposal would not be impacted by the development as they are outside the catchment area of the proposed activity. With the exception of Racecourse Swamp and Tuggerah Lake, surface flows from the Proposal would not impact the remaining wetlands east of the Proposal as they are surrounded by urban areas and/or are not directly connected to the area.

Downstream of the Proposal is Tuggerah Lake. The western part of the Lake, near the Wyong River mouth, is designated SEPP 14 wetland. Tuggerah Lake is 2.6

kilometres east of the Proposal or 6.5 kilometres downstream of Wyong River. For this wetland, any adverse impacts would be diffuse with a significant time – lag. Much of Tuggerah Lake is surrounded by an urban environment this means that existing development activities have adversely impacted the condition of the Lake and the SEPP 14 wetland and continue to do so.

On the other hand, Racecourse Swamp is 70 metres east of the northern part of the Proposal. A culvert connects flows under the railway line adjacent to the proposal site. While the Proposal site is not directly within Racecourse Swamp, the potential for adverse impacts as a result of construction of the proposal and its operation cannot be discounted. To abate the potential for adverse impacts to these wetlands, water quality measures would need to be implemented during all stages of construction.



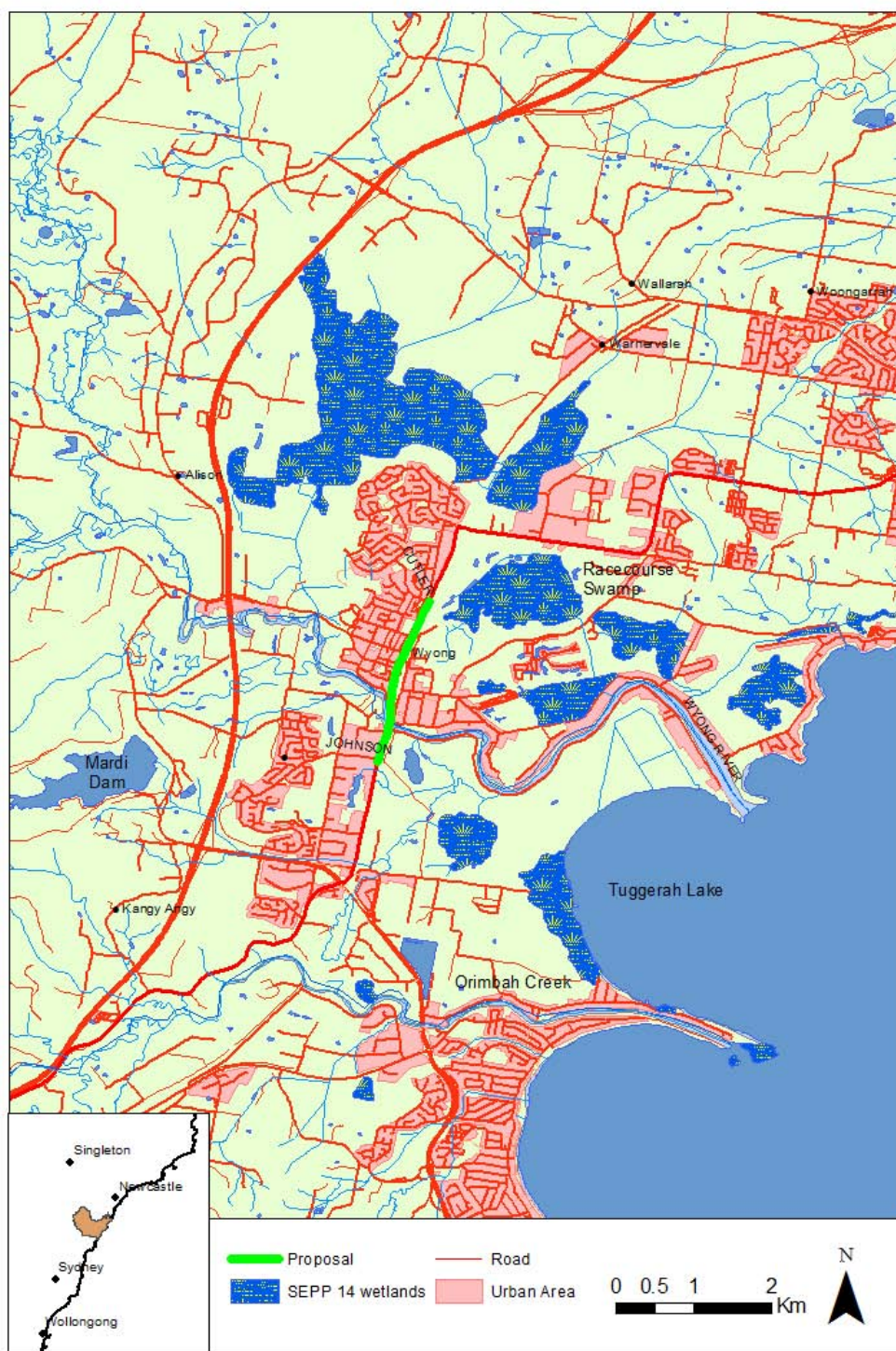


Figure 2. Thirteen SEPP 14 wetlands are within 10 kilometres of the Proposal.

## 2.3 Commonwealth Legislation

### 2.3.1 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Department of Environment. It includes management of impacts on Matters of National Environmental Significance (MNES) including:

- World heritage properties.
- Ramsar wetlands.
- National threatened species and ecological communities.
- Migratory species.
- Commonwealth marine areas.
- Nuclear actions.

Under the EPBC Act, Commonwealth approval is required for any 'controlled action', being a project or development that would have, or that would be likely to have, a significant impact on any MNES. In such cases, the action must be referred to the Commonwealth Minister for Environment, and approvals sought.

#### COMMENT

The study area does not have the potential to provide habitat for any threatened Commonwealth – listed aquatic species. Therefore, a referral to the Minister is not required.



### 3 DATABASE SEARCHES AND FIELD SURVEY

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Database searches were undertaken to determine potential aquatic environmental constraints for the study site. This section describes the outcomes of these searches. Where appropriate, the database outputs are in sequential order in Appendix A. The search date is shown for each database as these databases are being continually updated.

#### 3.1 Commonwealth Department of Environment – Protected Matters Database

The Department of Environment Protected Matters Database was searched on 30 April 2014 for MNES associated with freshwater or estuarine environments and Other Matters Protected by the EPBC Act. The protected matters recorded within 10 kilometres of the Proposal include a threatened ecological community and three threatened fish species. They are: Subtropical and Temperate Coastal Saltmarsh, the Macquarie Perch (*Macquaria australasica*) and the Black Rockcod (*Epinephelus daemeli*). Assessments of significance are in Appendix B.

#### 3.2 NSW Office of Environment and Heritage Atlas of NSW Wildlife – Threatened Aquatic Flora and Fauna Records

The OEH Atlas of NSW Wildlife was searched on 30 April 2014 for threatened aquatic flora and fauna records from 1980 onwards. Within the Lake Macquarie / Tuggerah Lakes catchment - one threatened insect (Giant Dragonfly (*Petalura gigantea*)) is recorded. This species listed as threatened under the TSC Act.

One record is 9 kilometres south of the study area and another is about 11 kilometres north of the Proposal. An assessment of significance is in Appendix B.

#### 3.3 NSW Department of Primary Industries Threatened Fish Records

The DPI 'Records Viewer' was developed to provide public access to information regarding records and distribution of threatened and protected species of fish and marine vegetation held by DPI NSW (DPI 2011b, c).

The records displayed through this application are derived from a range of sources including:

- Field survey records by DPI NSW.
- Data from specific DPI NSW research projects.
- Community sightings from the Protected, Threatened, and Pest Species Sighting Program.
- Scientific literature and published reports.
- Scientific, brood stock and aquarium collection permit returns.

This 'Records Viewer' was searched on 30 April 2014 for fish listed under the FM Act as threatened or protected. The Hunter/Central Rivers Catchment Management Authority (CMA) and the Wyong LGA were both searched for post 1980 records. No threatened fish species were listed as occurring in the Hunter/Central Rivers CMA or the Wyong LGA.

### **3.4 NSW Department of Primary Industries Threatened Species, Populations and Ecological Communities**

Detailed profiles of threatened fish, populations and ecological communities as listed under the FM Act were reviewed on 30 April 2014. These taxa were searched according to their geographic (CMA) region. Listings found in the Hawkesbury – Nepean CMA that are associated with freshwater or estuarine environments include; Oxleyan pygmy perch (*Nannoperca oxleyana*), Purple Spotted Gudgeon (*Mogurnda adspersa*) and endangered populations of *Posidonia australis* (seagrass species). Assessments of significance for these species are in Appendix B.

### **3.5 NSW Office of Environment and Heritage Atlas of NSW Wildlife – Fish Species Records**

The OEH Atlas of NSW Wildlife was searched for fish records across the Hawkesbury – Nepean CMA on 30 April 2014. Five fish species are recorded in this database (Appendix A). None of the recorded fish species are listed as threatened. One species, the Mosquito Fish (*Gambusia holbrooki*) (10 records) is considered to be part of a key threatening process, 'Predation by *Gambusia holbrooki* Girard, 1859 (plague minnow or mosquito fish)', under the TSC Act. *Gambusia* are associated with urban waterways. The nearest record is about 4 kilometers north of the study area.

### **3.6 NSW Department of Primary Industries Key Fish Habitat**

One of the objectives of the FM Act is to 'conserve key fish habitats'. For habitat management, the intention of this objective is that by promoting the fish habitat then fish populations can be conserved and protect fish habitats are protected.

The DPI 'Key Fish Habitat' (KFH) for Wyong LGA was searched 30 April 2014. Key fish habitat is identified across New South Wales in order to help achieve the objectives of the FM Act. That is, 'conserve key fish habitats'. KFH includes all marine and estuarine habitats up to highest astronomical tide level (that reached by 'king' tides) and most permanent and semi-permanent freshwater habitats including rivers, creeks, lakes, lagoons, billabongs, weir pools and impoundments up to the top of the bank (DPI 2011a). Small headwater creeks and gullies (first and second order streams) that only flow for a short period after rain, as well as farm dams constructed on such systems, are not included (DPI 2011a).

For the Wyong LGA, nearly all of the permanent third order rivers and streams over the LGA are considered to represent KFH. In the study area, KFH is designated for the Wyong River (Appendix A)..

### **3.7 Directory of Important Wetlands Australia**

The Directory of Important Wetlands Australia (DIWA) identifies important wetlands, and provides a substantial knowledge base of what defines wetlands, their variety, and the dependence on them of many flora and fauna species. The wetland classification system used in the Directory identifies 40 different wetland types in three categories including; Marine and Coastal Zone wetlands, Inland wetlands, and Human-made wetlands.

The NSW Directory of Important Wetlands was searched for wetlands within the Lake Macquarie / Tuggerah Lakes catchment on 30 April 2014. No Ramsar wetlands are recorded within the catchment. However, six wetlands listed under the NSW Directory of Important Wetlands were found to occur in the Lake Macquarie /

Tuggerah Lakes catchment. Of these, four wetlands occur with the Wyong LGA and two are directly downstream of the Proposal (Details are in Appendix A).

The nearest wetland is Wyong Racecourse Swamp (Reference code: NSW 143) which is 70 metres from the Proposal. Downstream of the Proposal is Tuggerah Lake (code NSW 141), which is 2.6 kilometres east of the Proposal or 6.5 kilometres downstream of Wyong River.



## 4 ECOLOGICAL ASSESSMENT

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To determine the potential for adverse impacts associated with the environmental constraints as described in the previous chapter, the existing environment within the study site was investigated using a desktop and field assessment. The components of the environment discussed in this chapter are water – dependent flora and fauna, water quality and hydrology.

### 4.1 Aquatic Biodiversity

The aquatic biodiversity of the Proposal is described in this section. This includes a description of the aquatic ecosystems and fauna habitat. Environmental constraints including threatened aquatic species and significant species were also identified.

#### 4.1.1 Survey Methods

To identify the ecological constraints and inform the detailed design of the proposed development, a desktop review was undertaken followed by a site inspection and preliminary ecological survey. The preliminary field investigation was undertaken on 30 April 2014. The objectives of this field investigation were to identify and assess the aquatic ecosystems in the study site and evaluate the potential occurrence of threatened aquatic species.

Three aquatic ecosystems were considered in the survey. They were Wyong River and two unnamed wetland systems south of the Proposal (Figure 3). Three sites were accessed to assess the condition of the Wyong River and determine the potential for adverse risks associated with the proposal. Two sites were just upstream of the Pacific Highway Bridge in the study area. One site was on the adjacent to the proposal, 150 metres upstream of the bridge, and another was 800 metres upstream of the bridge. At these sites, 10 metre sweep macroinvertebrate samples were taken (Figure 3).

A third site on the Wyong River, 150 metres downstream of the bridge, was also accessed (Figure 3). No macroinvertebrate samples were taken at this site as the invertebrate fauna would not be considered representative of the Wyong River at a larger scale (EPA VIC 2003).

Two unnamed wetlands systems were also considered in the survey. While these wetlands are not directly in the study area they are vulnerable to off site impacts associated with the Proposal. One wetland system was just south of Johnson Road and adjacent to the Pacific Highway, another was directly east of Cutler Drive. For these sites, only habitat assessments were conducted.

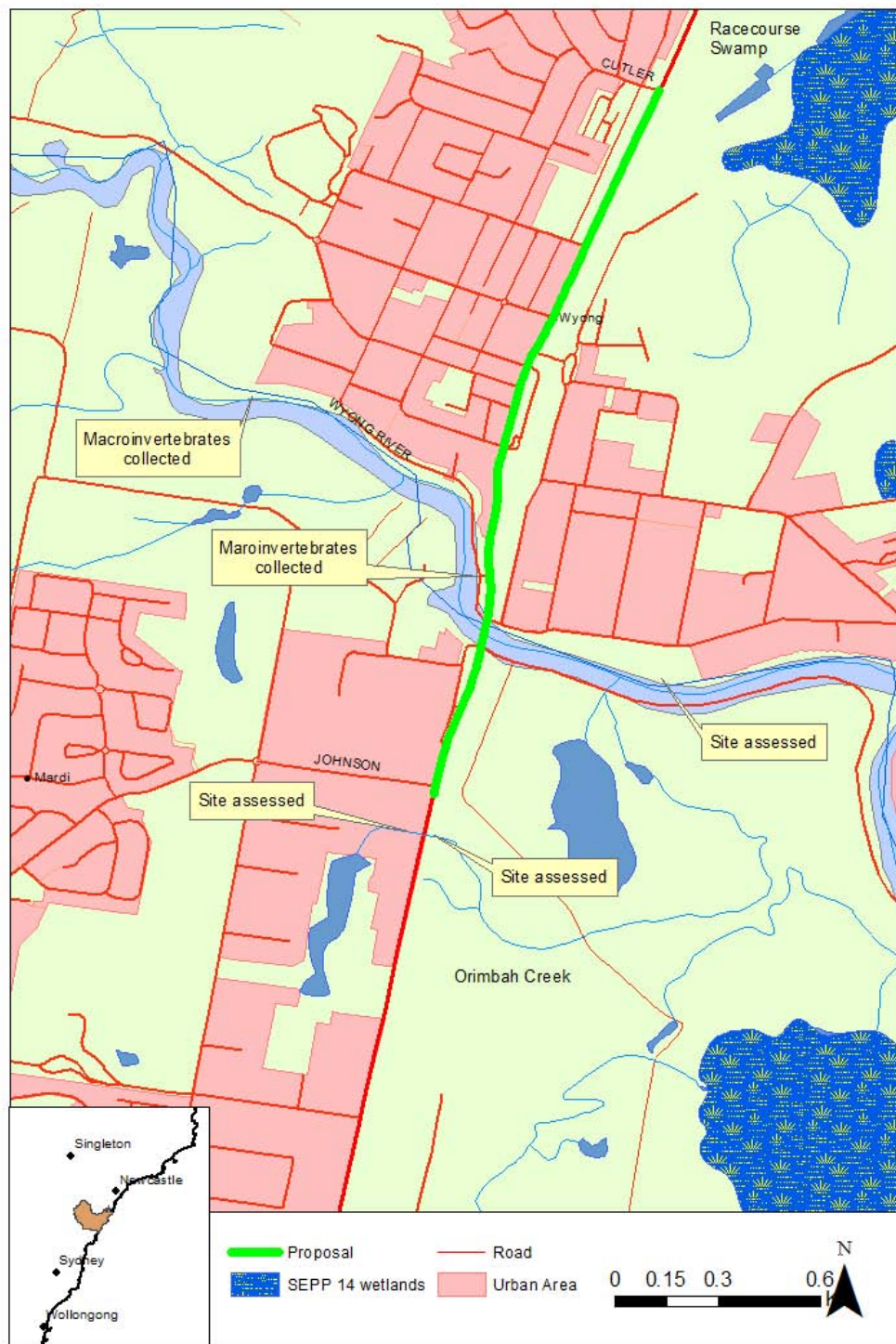


Figure 3. The sample sites for the aquatic survey.



## **Aquatic assessment**

The conditions of the aquatic ecosystems in the study area were assessed using a modified version of the AUstralian RIVers Assessment System (AUSRIVAS) habitat assessment (Parsons et al. 2002, EPA VIC 2003, Turak et al. 2004). Here a combination of Australian Rivers Assessment System (AUSRIVAS) habitat assessments as developed by Victorian and New South Wales' state agencies was used. The AUSRIVAS habitat assessments were originally developed to gauge river health. Parameters included; riparian complexity and width, instream condition, stream substrate complexity, local land use, sources of local and catchment level pollution, shading and water quality were considered as potentially influencing local aquatic community structure and composition as well as overall river function.

To assist in understanding the main drivers of site condition, HABSCORE was also used. HABSCORE was originally developed by the United States Environmental Protection Agency and has been adapted for Australian conditions by the Environmental Monitoring Unit at the Environment Protection Authority of Victoria (Barbour and Stribling 1991, Barbour et al. 1999). It classifies stream habitat condition based on the variety and quality of substrate, channel morphology, bank structure and riparian vegetation (Barbour et al. 1999).

## **Survey limitations**

Benchmarked AUSRIVAS was not conducted for the aquatic habitat surveys. Such assessments require macroinvertebrate and water quality sampling, as well as macroinvertebrates identifications and subsequent AUSRIVAS calculations. This approach was not considered appropriate, as it is highly time consuming and not cost - effective within the constraints of this stage of the investigation. Instead two ten (10) metre sweep samples were taken to provide an indication of the aquatic macroinvertebrate community in the Wyong River.

## **Site access**

Surveys were limited to areas of public land. For the Wyong River the site surveys were on public parks and for an unnamed tributary, access was sought from the Pacific Highway near Johnson Street in the study area. One aquatic ecosystem that was north of Howarth Street in the study area was not accessed as it was on private land. Due to the steep banks leading to the Wyong River, its uncertain depth and velocity, the river was not entered. Macroinvertebrate sampling was restricted to safe parts of the bank and jetties.

### **4.1.2 Threatened Aquatic Fauna**

No threatened aquatic fauna were observed utilising the habitat within the project area site and none are considered likely to utilise the Proposal area. Details are in Appendix B.

### **4.1.3 Pest aquatic fauna**

The Mosquito Fish (*Gambusia holbrooki*) is recorded as occurring in the Hunter Central CMA – Wyong catchment and is an exotic pest in NSW. This species thrives in shallow slow flowing water bodies. They can tolerate a wide range of temperatures and water quality. Mosquito fish can reproduce several times a year throughout the warmer months and local populations can grow rapidly (DPI 2013).

The proposed works would not affect the presence of this species. However, 'predation by *Gambusia holbrooki*', is a key threatening process under Schedule 3 of the TSC Act (refer to section 5.1.3).

## 4.2 Threatened and Endangered Ecological Communities and Populations

There are no endangered ecological communities or populations listed under the FM Act in the Proposal area that are at risk of extinction in the near future.

## 4.3 Wyong River Catchment

The Wyong River is part of the Hunter catchment, which is the largest coastal catchment in NSW. The catchment area of the Wyong River is about 439 square kilometres. The Wyong River originates in the Watagan Mountains and discharges into Tuggerah Lake on the Central Coast of NSW. Tuggerah Lake is the largest of three interconnected coastal lakes, which enters the Pacific Ocean via a single entrance at The Entrance. Associated with increasing human – induced disturbance, Tuggerah Lake has undergone and will continue to undergo significant disturbance. Indeed, increasing urbanisation has changed the quality and quantity of flows into the estuary (Dickinson et al. 2006).

### 4.3.1 Wyong River at Wyong

The Wyong River is a major perennial river, flowing through Wyong township. The Wyong River is a lowland river characterised by connecting wetlands. In the Proposal area, the Wyong River had little or no major sedimentary deposits; although the riverbanks had a high proportion of silt, sand and clay. The water column appeared brown and opaque, indicating a high proportion of sediment is transported from the headwaters to the lower parts of the river. The riverbanks appeared naturally stable, although there was a small rockwall adjacent to a jetty at one site. Otherwise there was little evidence of erosion in the study area. Lateral movements of the river appeared to be restricted to the main channel. The main aquatic habitats were 'run' (areas of moderately flowing water in the middle of the river) and 'pool' (still areas of water along the riverbanks). Shading was restricted to the margins of the Wyong river and the major components of carbon supply are likely to be phytoplankton (Whittington et al. 2001). The riparian zone comprised of *Lomandra longifolia* Matt rush), *Casuarina* species (She – oak), *Corymbia maculata* (Spotted gum), and *Glyceria maxima* (Reed sweetgrass) (Figure 4). Minor inputs were from coarse and fine particulate organic matter and logs (*sensu* (Whittington et al. 2001).

In the Proposal area, the Wyong River was about 55 metres wide. Further upstream, near Hope Street and River Road, the River was about 60 metres wide. Fourteen macroinvertebrate taxa were found in the Wyong River which is considered to be relatively low (Miller and Barbee 2003). The average SIGNAL value, which indicates water pollution and environmental quality through the presence and absence of invertebrates, was 3 (Chessman 2003) (Appendix C). The high degree of sedimentation as evidenced by the opaque watercolour, may be smothering interstitial spaces and lowering the oxygen concentrations in the water column. Therefore, restricting opportunities for a diverse and productive habitat. Another reason for the poor SIGNAL value is that the macroinvertebrate sampling protocols were originally designed for wadeable streams; although many large studies, such as the Sustainable Rivers Audit, typically survey large rivers (Norris et al. 2001, Thoms et al. 2001, Whittington et al. 2001). Large rivers, such as the Wyong River, are unlikely to support a diverse array of macroinvertebrates and therefore, the results are not surprising.



While the aquatic condition of the Wyong River is comparatively low, as evidenced by the macroinvertebrate samples, steps will need to be considered to abate an adverse environmental risks to the river banks, riparian zone and water quality. Options for consideration are outlined in chapter 5.



Figure 4. The survey site, Wyong River at River Road (150 metres upstream of the bridge) showing the riparian zone.



Figure 5. The survey site on the Wyong River 800 metres upstream of the bridge. The riparian zone is shown.



Figure 6. The survey site on the Wyong River, just downstream of the bridge.

#### 4.3.2 Unnamed Creek at Pacific Highway

An unnamed Creek flows under the Pacific Highway 150 metres south of Johnson Road. This creek is just outside the Proposal area, however, it is considered here as it may be vulnerable to secondary impacts from construction activities associated with the Proposal. The creek appears to originate from a local wetland, west of Gavenlock Road.

This unnamed creek and its associated wetland appear are subject to seasonal flows. Stream slope is low and flows are mostly rainfall dependent. Two arms flow through an industrial area before connecting and flowing under the Pacific Highway past a pioneer dairy homestead. The creek was flowing slowly during the survey and appeared fairly shallow. Much of the streambed was heavily vegetated with macrophytes. Detritus, or fine particulate organic matter, heavily covered the instream macrophytes and the stream substrate. Run – off and associated contaminants from impermeable surfaces in the industrial area appear to be contributing to stream condition. The riparian zone appeared to be in good condition. The riparia was comprised of mature trees, shrubs and bushes and the stream banks showed no obvious signs of recent slippage.





Figure 7. Looking upstream of the Unnamed Creek at Pacific Highway, just south of Johnston Road.



Figure 8. Looking downstream of the Unnamed Creek at Pacific Highway.

### **4.3.3 Racecourse Swamp**

Racecourse Swamp was considered in the survey as it could be vulnerable to off - site impacts associated with the Proposal. This wetland is directly east of Cutler Drive, adjacent to the horseracing course on Howarth Street. site access was not possible as the area is on private land. Therefore, the findings of the desktop assessment are considered here.

At its closest point, this wetland is 70 metres east of the project site and a culvert connects flows under the railway line adjacent to the proposal site. While the Proposal site is not directly within Racecourse Swamp, surface flows from the culvert would originate from the Pacific Highway (the Proposal site). Since wetlands typically retain sediment, any increases in sediment – laden waters from the proposal site would require management to abate the adverse environmental risks to wetland condition. Options for consideration are outlined in chapters 5 and 6.

## 5 IMPACTS

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### 5.1 Potential Impacts

Potential impacts are the range of likely ecological effects predicted to occur as a result of unmitigated project activities. Potential impacts consider the range of aquatic values identified within and adjacent to the Proposal at the broadest level. Potential impacts for the proposed activity include:

- Degradation of aquatic habitat;
- Changed hydrology; and,
- Enhancement of Key Threatening Processes.

In addition to the aquatic habitats identified onsite, assessments to determine the likelihood of downstream impacts from the Proposal are considered.

#### 5.1.1 Degradation of Aquatic Habitat

Details of the proposal are yet to be finalised, therefore the short term and temporary impacts are not wholly known. Nonetheless the adverse risks for Wyong River, Tuggerah Lake, Racecourse Swamp and the unnamed wetlands are considered. Any changes to the riparian zone and/or the instream habitat of these aquatic ecosystems associated with the Proposal are likely to have the following impacts. Potential risks associated with the proposal are listed below.

- Instream condition:
  - Including degradation of water quality through increased sedimentation from the Proposal;
  - Loss of macrophytes and streamside vegetation; and,
  - Elimination of instream and riparian habitat.

These factors would reduce opportunities for suitable macroinvertebrate habitat and aquatic fauna passage.

- Water quality - due to sediment inputs downstream of the Proposal and therefore reducing aquatic habitat condition;
- Macroinvertebrates habitat – due to sediment inputs downstream of the Proposal; and,
- Passage of aquatic fauna - if works are undertaken in the Wyong River.

The instream habitats in the Proposal area are not expected to undergo a significant change in condition due to the proposal. Nonetheless, environmental controls will be applied to mitigate against any residual risk to aquatic environments.

### 5.1.2 Changed Hydrology

The surface and ground water levels and flows within the project area and their potential for change were not investigated. Large flood events can increase sedimentation to aquatic ecosystems; particularly wetlands. However, it is recommended that a hydrological and hydraulic investigation is undertaken to ascertain the potential flood risk to the proposal and determine what aquatic ecosystems (if any) might be vulnerable to adverse impacts.

The Proposal has the potential to reduce surface water quality to Racecourse Swamp. Measures to address this and the management of the wetland will be included in the construction environment management plan (CEMP) to mitigate against any residual risk to the wetland.

### 5.1.3 Key Threatening Processes

Under the FM Act, key threatening processes (KTP) are considered to be those that either adversely affect threatened species, populations or ecological communities, or could cause species, populations or ecological communities that are not threatened to become threatened. KTP's that are relevant to the Proposal are:

- Instream structures and other mechanisms that alter natural flow,
- The introduction of fish to fresh waters within a river catchment outside their natural range,
- Removal of large woody debris from New South Wales rivers and streams
- Degradation of native riparian vegetation along New South Wales watercourses
- Predation by the plague minnow (*Gambusia holbrooki*) (TSC Act)
- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands (TSC Act)

The potential of impact of these KTPs within the scope of the Proposal are discussed below.

#### **Instream structures and other mechanisms that alter natural flow**

Instream structures that modify natural flow include dams, weirs, canals, navigation locks, floodgates, culverts, flow regulators, levee banks, erosion control structures, and causeways. Mechanisms that alter natural flow regimes include the operation of the above structures as well as water extraction, pumping and diversion, and sand and gravel extraction.

Alteration to natural flow regimes can occur by reducing or increasing flows; altering the seasonality of flows; changing the frequency, duration, magnitude, timing, predictability and variability of flow events; altering surface and subsurface water levels; changing the rate of rise or fall of water levels; and by altering water temperatures.

Any roads and bridges must be constructed to minimise any adverse. Recommendations are described in the next chapter.

## **The introduction of fish to fresh waters within a river catchment outside their natural range**

At least 11 non-native species currently have self-sustaining populations in NSW waterways. Fish introduced to waters outside their natural range can impact on native flora and fauna in a number of ways including predation, competition for resources, habitat degradation and by the spread of diseases. Several threatened species are affected by this threatening process.

One of these species, the plague minnow, occurs in the Tuggerah Lakes catchment.

## **Removal of large woody debris from New South Wales rivers and streams**

Large woody debris provides important habitat and shelter for native fish and other aquatic organisms in the rivers of NSW. Snags are often used for breeding and resting locations and they provide shelter from predators. The removal of large woody debris adversely affects several threatened species.

Since the Wyong River is a large, lowland river, and it flows into Tuggerah Lake, large woody debris would occur in the River and the Lake. On the other hand, Racecourse Swamp and the unnamed Creek would not support large woody debris. The Proposal does not require the removal of instream habitat.

## **Degradation of native riparian vegetation along NSW watercourses**

Riparian vegetation is vegetation on land that adjoins, directly influences or is influenced by, a body of water. Riparian vegetation is found alongside creeks and rivers, areas around lakes, wetlands and on river floodplains. It is part of a healthy functioning ecosystem and has numerous ecological benefits. Riparian vegetation is degraded by the complete removal or modification of native plants by processes such as clearing, gravel extraction, cropping, livestock grazing, trampling and introduction of, or invasion by, non-native species. Riparian vegetation degradation along NSW watercourses has been listed as a KTP because of its negative impacts on threatened species, populations and ecological communities listed under the *FM Act 1994*.

Degradation of riparian vegetation adversely affects several species that are listed as vulnerable and or endangered under the FM Act. However, the occurrence of any threatened species is unlikely as the urban area would not support the environmental requirements of these biota. Safeguards are described in the next chapter.

### *Predation by the plague minnow (Gambusia holbrooki) (TSC Act)*

*Gambusia holbrooki* Girard, 1859 (previously known as *Gambusia affinis*) (Plague Minnow, also known as Mosquito Fish) is a small freshwater fish that is an aggressive and voracious predator. It is known to prey upon eggs and tadpoles of Green and Golden Bell Frog, *Litoria aurea* and is linked to the decline of *Litoria aurea*, the New England Bell Frog *Litoria castanea*, Southern Bell Frog *Litoria raniformis*, and the Southern Tablelands Bell Frog (*Litoria sp.*). Predation by the plague minor (*Gambusia holbrooki*) is listed as a key threatening process because it adversely affects two or more threatened species and it could cause species that are not threatened to become threatened.

*Gambusia* prefer warm still or slow flowing water. However they are extremely tolerant of any water conditions, and can stand temperature ranges from -4°C (water



under ice) to 44°C. They prefer freshwater but can live in saltier water and are commonly found in estuaries.

The works are not expected to introduce the Mosquito Fish to any aquatic ecosystem as their flows and morphology will remain unchanged.

### **Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands (TSC Act)**

Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands is listed as a key threatening process under the TSC Act. This key threatening process is defined as reducing or increasing flows, altering seasonality of flows, changing the frequency, duration, magnitude, timing, predictability and variability of flow events, altering surface and subsurface water levels and changing the rate of rise or fall of water levels (DEC 2005). The three human – induced processes that alter flows in streams, rivers and their floodplains, and wetlands in NSW, are: building of dams, diversion of flows by structures or extraction, and alteration of flows on floodplains with levees and structures (DEC 2005).

This key threatening process is recognised as a major factor that contributes to the loss of biological diversity and ecological function in aquatic ecosystems, including floodplains (DEC 2005). This process has the potential to lead to the species decline and/or populations or ecological communities that rely on river flows for their short and long term survival (DEC 2005).

Impacts associated with altering natural flow regimes, include:

- Extraction of water which reduces flows, leading to a lower distribution of organic matter on which invertebrates and vertebrates depend on:
  - The proposed activity does not include water extraction;
- The permanent flooding of wetlands that kills vegetation depending on intermittent flooding, decreasing habitat for invertebrates and waterbirds as a result:
  - The proposed activity does not include permanent flooding of wetlands.
- Deeper and more permanent standing water which permits the establishment and spread of exotic species:
  - The proposal does not require permanent change to the instream habitat of the aquatic ecosystems. Flow patterns are not intended to alter during the proposal or as a consequence of it.
- Changes to the physical, chemical and biological conditions of rivers and streams which alters biota:
  - The proposal is unlikely to alter the physical, chemical and biological condition of the Wyong River, Racecourse Swamp or the unnamed creek assuming that safeguards, as outlined in the next chapter, are implemented.
  - The proposed works may clear some of the riparian vegetation at Wyong River and the unnamed creek. Clearing riparian vegetation can potentially increase sunlight to short sections of these streams and increase sediment inputs. However, the risk of



impact is very low and these impacts, if they occur, are likely to be highly localised and temporary.

- The works are not expected to alter the channel shape of Wyong River, unnamed creek or Racecourse Swamp. Therefore, the local geomorphology of the creek is not expected to change.
- Where the proposed works include the establishment of in-stream sediment control structures for construction and revegetation of riparian zone with native vegetation when the works are completed. These actions are considered to aid with improving localised water quality and with maintenance of the Wyong River during the post construction phase.

Although no significant impacts are predicted safeguards are recommended to mitigate any residual risks to the water quality of the Wyong River and local wetland systems. These are described in the next chapter.

## 5.2 Assessments of Significance

Assessments of significance were completed for the Giant Dragonfly (*Petaleura gigantea*), Macquarie perch (*Macquaria australasica*), Black Rock Cod (*Epinephelus daemeli*), Oxleyan pygmy perch (*Nannoperca oxleyana*), Purple spotted gudgeon (*Mogurnda adspersa*) and populations of *Posidonia australis* (seagrass species) (Appendix B).

The assessments concluded that the species' occurrence was highly unlikely. This is because the urban area would not support the environmental requirements of these biota. Safeguards are described in the next chapter.

## 5.3 Coastal Wetlands

Of the six wetlands that were found to occur within 10 kilometres of the Proposal (section 3.7), two wetlands would be adversely affected by the Proposal. These wetlands, are within the catchment area of the Proposal and downstream flows would impact their condition.

- Wyong Racecourse Swamp is (Reference code: NSW 143) which is 70 metres from the Proposal. As a culvert runs under the Railway line to the Proposal site, surface waters flows from the Proposal would adversely impact the condition of the wetland.
- Tuggerah Lake (code NSW 141) is 2.6 kilometres east of the Proposal or 6.5 kilometres downstream of Wyong River. Therefore, any adverse impacts on the Wyong River at the Proposal site would directly influence the condition of the Lake.

To abate the potential for adverse impacts to these wetlands, water quality measures would need to be implemented during all stages of construction.



## 6 RECOMMENDATIONS

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### 6.1 Aquatic Habitat

As part of the development of the proposal, safeguards will need to be developed to control adverse impacts on aquatic flora and fauna and their associated ecosystems. Adverse impacts to aquatic habitat within the Proposal area can be minimised by the implementation of the following recommended safeguards:

- Establishment of in-stream sediment control structures prior to construction;
- Limit the clearing of vegetation within the riparian zone to the greatest extent practicable;
- Incorporate plantings of locally indigenous mature trees, bushes and grasses in the riparian zone;
- Erosion and sediment control measures are implemented prior to any works commencing;
- Fish passage not being blocked by artificial structures;
- Where possible, ensuring aquatic habitat is retained and enhanced;
- The design of the project shall ensure, to the greatest extent practical, existing surface flow patterns and water quality;
- Improvement in aquatic habitat quality could be achieved by:
  - Rehabilitation of the Wyong River and the wetland areas after construction, including protection, stabilisation and rehabilitation of the eroding banks and revegetation;
  - Removal of waste material and rubbish accumulated in and around aquatic habitat after construction;
  - Incorporation of the principles of water urban design as part of the stormwater management for the study site. The aim of these activities is to abate the risk of excessive sediment and nutrient inputs to downstream systems as a consequence of the proposal.

#### Aquatic Habitat Protection

The Proposal should seek to minimise impacts on aquatic habitat. Where the proposal requires works on or near riverbanks then approval from the relevant agencies, such as NSW DPI, would be required. Such approval would be dependent on how the proposal is assessed by the determining authority. To assist in complying with legislation, policies, and guidelines as they relate to fish habitat conservation and management the '*Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update)*' (NSW DPI ISBN 978 1 74256 283 4) should be consulted as part of the development of the Proposal.

In addition, specific legislation and policy requirements must be observed during the planning, design, and construction of waterway crossings in NSW. This includes bridges, roads, culverts, and similar structures that have an impact on fish and aquatic habitats. The aforementioned reference (Fairfull 2013) should also be consulted in the development of the Proposal.

#### Soil and Water Management and Hydrology

The extent to which surface and subsurface water flows might be adversely affected by the Proposal needs further investigation. Key issues for consideration are:

- Flood risk to the proposal and the construction activity. A hydrological and hydraulic investigation should be undertaken to ascertain the potential flood risk to the proposal and to determine what aquatic ecosystems (if any) might be vulnerable to adverse impacts.
- The potential for change in the quantity and quality of surface and subsurface water flows in light of the risks to stream and wetland health and key fish habitat.
- Excessive sedimentation: to manage this a concept erosion and sediment control plan will need to be developed.

### **Erosion and sedimentation**

Concept erosion and sediment control plans (ESCPs) will need to be developed as part of the detailed design of the Proposal. These plans will need to be developed in accordance with Managing Urban Stormwater: Soils and Construction ('the Blue Book') (Landcom 2004).

The principle of 'minimum disturbance' should be prioritised in the development of the ESCP's to minimise environmental risk associated with the Proposal. This can be achieved through:

- Staging of works to address areas of erosion hazard in order of risk priority;
- The use of temporary local controls e.g. 'off site' water diversions;
- The use of secondary controls e.g. bunding and temporary excavation / traps; and,
- The use of tertiary controls e.g. sediment booms.

All controls identified on the plans are to be constructed, installed, and maintained in accordance with the Blue Book guidelines. It is intended that the ESCP be revised for any changes that may be required in regards to site specific constraints e.g. change in construction methodology or recent flood events, before commencing works. Post commencement, the ESCP would remain a progressive document and would be updated continually to reflect current staging in works.

### **Pacific Highway bridges over the Wyong River**

As part of the Proposal, NSW DPI must be informed under Part 7 (3, 4, 5 and 8) of the FM Act about the construction of any bridges, roads, causeways, culverts, pipelines, cables and similar structures that might impinge upon or adjacent to (within 50 metres of aquatic habitat).

Any roads and bridges must be constructed to minimise habitat loss, changes in sediment transport and stream siltation, and to maintain natural stream flows.

*'Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update)' (Fairfull 2013)* should be consulted in the development of any bridges as part of the Proposal.

To promote the natural values of the Wyong River, it is recommended that wherever possible the design allows for the transmission of natural light underneath them. This might be done through the use of skylights or gaps in the bridge structures. Light penetration will provide opportunities for vegetation growth and will reduce shading impacts on the aquatic habitat and riparian ecosystems.

## Assessments of Significance

While threatened species are not expected to occur or be adversely affected by the proposal, the following safeguards are recommended.

### 6.2 Additional Recommended Safeguards

Recommended safeguards:

1. If any threatened or migratory species (aquatic flora or fauna) are discovered during the works, all work should stop immediately and the environmental project officer notified. Work should only recommence once the impact on the species has been assessed and appropriate control measures provided. An appropriate method to assist with identification is required prior to works commencing, such as an information booklet, contractor induction and/or walk over pre-clearing, during-clearing and post-clearing;
2. The CEMP should clearly identify the boundaries of the work area and disturbance corridor;
3. The CEMP should clearly identify the locations of lay-down and storage areas for materials, equipment, plant and stockpiles;
4. The CEMP should clearly identify the location of work vehicle parking areas;
5. The CEMP should clearly document the location and full extent of any lopping, trimming, clearing or other vegetation disturbance required for the works;
6. The CEMP should clearly identify the locations of any 'no-go' areas within/adjacent to work site boundaries that are not to be in any way disturbed or damaged by the works. Such no – go areas include riparian areas and the wetted areas of the aquatic ecosystems.
7. Riparian vegetation clearance and disturbance should be kept to an absolute minimum, where possible retain the grass layer or stabilise the banks with jute matting;
8. Materials, plant, equipment and stockpiles should not be placed in a manner that results in damage to surrounding riparian areas and aquatic systems;
9. Work vehicle access should be restricted to designated work areas and existing formed access tracks/roadways;
10. A 'no disturbance' buffer should be established by erecting and maintaining exclusion fencing between work areas and any adjoining riparian areas, river, stream, and wetland environments;
11. Areas of riparian vegetation that are not to be disturbed should be fenced-off prior to commencement of works. Workers should be instructed to keep out of such areas;
12. If any damage occurs to vegetation outside of the nominated work area (as shown in the CEMP) the project environmental officers should be notified so that appropriate remediation strategies can be developed and implemented;
13. If it is perceived that significant impacts are occurring to aquatic animals in the vicinity of the work area, works should cease and Roads and Maritime environmental officers contacted for further advice;

14. Retain any removed canopy species as coarse woody debris within Proposal area;

15. Protection and improvement of aquatic habitat, including:

- Erosion and sediment control measures shall be implemented prior to any works commencing;
- Minimisation of impact on habitat for common aquatic fauna, including limiting the clearing of vegetation within the riparian zone to the greatest extent practicable;
- Rehabilitation of riparian zone to provide suitable transformation of habitat for water - dependant fauna, including the plantings of locally indigenous mature trees and grasses in the riparian zone;
- River bank armouring should be minimised to the greatest extent practicable;
- Fish passage not being blocked by artificial structures
- Ensure aquatic habitat is retained and enhanced;
- The design of the Proposal shall ensure, to the greatest extent practical, existing surface flow patterns and water quality to preventing undue change in water flows;
- Improvement in aquatic habitat quality could be achieved by:
  - Rehabilitation of the Wyong River study area after construction, including protection, stabilisation and rehabilitation of the eroding banks and revegetation
  - Incorporation of the principles of water urban design as part of the stormwater management for Wyong River and the wetlands. This activity abates the risk of excessive sediment and nutrient inputs to the River.

## 7 CONCLUSION

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The purpose of this aquatic assessment is to identify potential environmental and statutory planning constraints to the Proposal and to outline the requirements for abating adverse environmental impacts associated with aquatic ecosystems.

Several potential environmental constraints associated with aquatic ecosystems were identified and are summarised below.

They include:

- The presence of key fish habitat within the Wyong River; and,
- Racecourse Swamp and the eastern part of Lake Tuggerah are designated SEPP 14 wetlands.

As the Proposal has the potential to adversely impact aquatic habitat in the Wyong River, Roads and Maritime is required to give written notification to the Minister for Fisheries for any reclamation or dredging work. For the SEPP 14 wetlands, it is recommended that water quality measures and controls occur during all stages of construction.

This aquatic flora and fauna report was prepared to support the biodiversity impact assessment and the REF being prepared by SMEC. Initial desktop surveys identified 6 threatened species that were considered to have the potential to either occur in the Proposal area or be adversely impacted by the Proposal. However, further assessment concluded that the species' occurrence was highly unlikely.

The proposal site is located within the urban area of Wyong. Overall there are relatively few environmental constraints to this proposal. Generally this is because of a lack of habitat quality due to the impacted nature of the environment within the proposal area. However, there is range of low - grade habitats present due to variation in the terrain and the occurrence of the aquatic ecosystems.

Industry standard environmental control measures are included in the proposal to manage against any residual risks to the natural environment in the Proposal. The specifics of these measures should be provided in a construction environmental management plan (CEMP) to be agreed by Roads and Maritime before construction begins.

Overall, the proposal does not represent a significant threat to the ecological environment in the project area.





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## APPENDIX A: DATABASE SEARCHES

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### Table of Contents:

Commonwealth Department of Environment – Protected Matters Database

NPWS Atlas Records

NSW DPI Key Fish Habitat for the Wyong LGA

Directory of Important Wetlands



# EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 30/04/14 10:32:39

[Summary](#)

[Details](#)

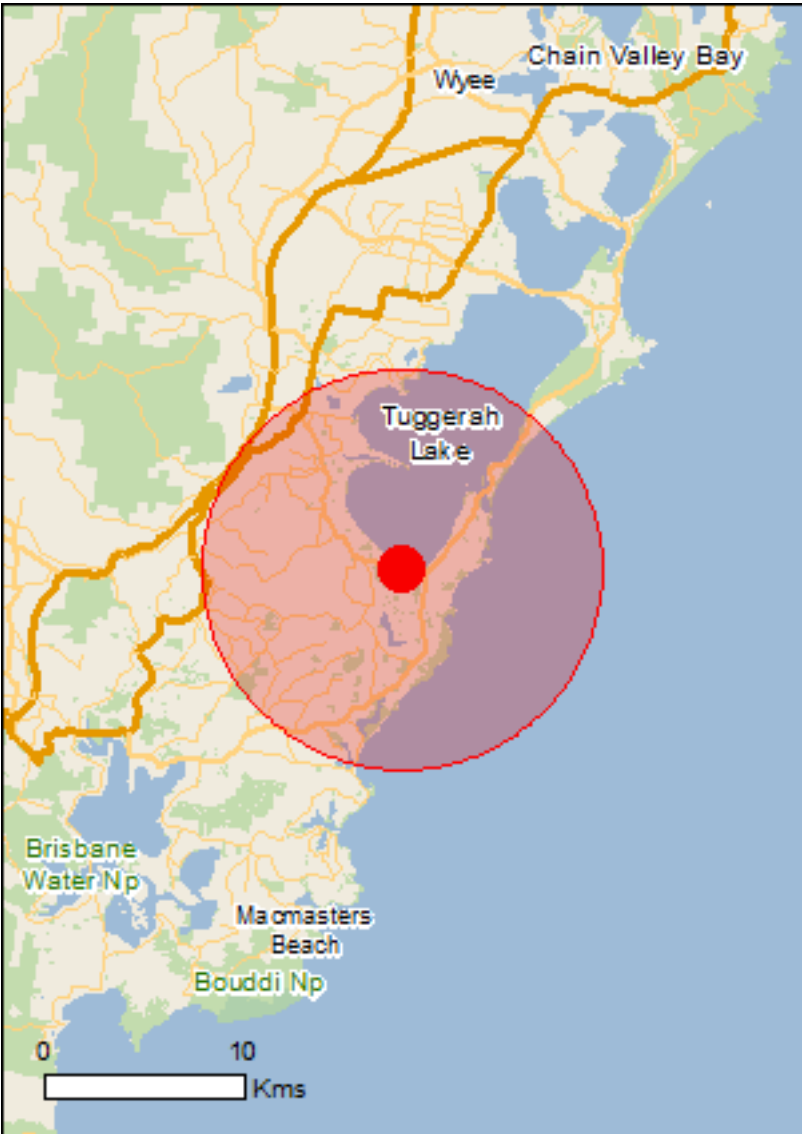
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

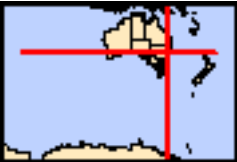
[Acknowledgements](#)



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[Coordinates](#)

Buffer: 10.0Km



# Summary

## Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

<a href="#">World Heritage Properties:</a>	None
<a href="#">National Heritage Places:</a>	None
<a href="#">Wetlands of International Importance:</a>	None
<a href="#">Great Barrier Reef Marine Park:</a>	None
<a href="#">Commonwealth Marine Areas:</a>	1
<a href="#">Listed Threatened Ecological Communities:</a>	2
<a href="#">Listed Threatened Species:</a>	72
<a href="#">Listed Migratory Species:</a>	68

## Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As [heritage values](#) of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

<a href="#">Commonwealth Land:</a>	4
<a href="#">Commonwealth Heritage Places:</a>	None
<a href="#">Listed Marine Species:</a>	88
<a href="#">Whales and Other Cetaceans:</a>	14
<a href="#">Critical Habitats:</a>	None
<a href="#">Commonwealth Reserves Terrestrial:</a>	None
<a href="#">Commonwealth Reserves Marine</a>	None

## Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

<a href="#">Place on the RNE:</a>	5
<a href="#">State and Territory Reserves:</a>	6
<a href="#">Regional Forest Agreements:</a>	1
<a href="#">Invasive Species:</a>	51
<a href="#">Nationally Important Wetlands:</a>	4
<a href="#">Key Ecological Features (Marine)</a>	None

## Details

### Matters of National Environmental Significance

#### Commonwealth Marine Areas [ Resource Information ]

Approval may be required for a proposed activity that is likely to have a significant impact on the environment in a Commonwealth Marine Area, when the action is outside the Commonwealth Marine Area, or the environment anywhere when the action is taken within the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

#### Marine Regions [ Resource Information ]

If you are planning to undertake action in an area in or close to a Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
<a href="#">Temperate East</a>

#### Listed Threatened Ecological Communities [ Resource Information ]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
<a href="#">Littoral Rainforest and Coastal Vine Thickets of Eastern Australia</a>	Critically Endangered	Community likely to occur within area
<a href="#">Subtropical and Temperate Coastal Saltmarsh</a>	Vulnerable	Community likely to occur within area

#### Listed Threatened Species [ Resource Information ]

Name	Status	Type of Presence
Birds		
<a href="#">Anthochaera phrygia</a> Regent Honeyeater [82338]	Endangered	Species or species habitat known to occur within area
<a href="#">Botaurus poiciloptilus</a> Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
<a href="#">Dasyornis brachypterus</a> Eastern Bristlebird [533]	Endangered	Species or species habitat likely to occur within area



Name	Status	Type of Presence
<a href="#">Diomedea epomophora epomophora</a> Southern Royal Albatross [25996]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Diomedea epomophora sanfordi</a> Northern Royal Albatross [82331]	Endangered	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Diomedea exulans antipodensis</a> Antipodean Albatross [82269]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Diomedea exulans exulans</a> Tristan Albatross [82337]	Endangered	Species or species habitat may occur within area
<a href="#">Diomedea exulans gibsoni</a> Gibson's Albatross [82271]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Diomedea exulans (sensu lato)</a> Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Fregetta grallaria grallaria</a> White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Lathamus discolor</a> Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
<a href="#">Macronectes giganteus</a> Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
<a href="#">Macronectes halli</a> Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
<a href="#">Pterodroma leucoptera leucoptera</a> Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
<a href="#">Pterodroma neglecta neglecta</a> Kermadec Petrel (western) [64450]	Vulnerable	Foraging, feeding or related behaviour may occur within area
<a href="#">Rostratula australis</a> Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
<a href="#">Sternula nereis nereis</a> Australian Fairy Tern [82950]	Vulnerable	Species or species habitat may occur within area
<a href="#">Thalassarche bulleri</a> Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
<a href="#">Thalassarche cauta cauta</a> Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Thalassarche cauta salvini</a> Salvin's Albatross [82343]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Thalassarche cauta steadi</a> White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Status	Type of Presence
<a href="#">Thalassarche eremita</a> Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Thalassarche melanophris</a> Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
<a href="#">Thalassarche melanophris impavida</a> Campbell Albatross [82449]	Vulnerable	Species or species habitat may occur within area
Fish		
<a href="#">Epinephelus daemeli</a> Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Macquaria australasica</a> Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
<a href="#">Prototroctes maraena</a> Australian Grayling [26179]	Vulnerable	Species or species habitat likely to occur within area
Frogs		
<a href="#">Heleioporus australiacus</a> Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Litoria aurea</a> Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat may occur within area
<a href="#">Litoria littlejohni</a> Littlejohn's Tree Frog, Heath Frog [64733]	Vulnerable	Species or species habitat may occur within area
<a href="#">Mixophyes balbus</a> Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Mixophyes iteratus</a> Giant Barred Frog, Southern Barred Frog [1944]	Endangered	Species or species habitat may occur within area
Mammals		
<a href="#">Balaenoptera musculus</a> Blue Whale [36]	Endangered	Species or species habitat may occur within area
<a href="#">Chalinolobus dwyeri</a> Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
<a href="#">Dasyurus maculatus maculatus (SE mainland population)</a> Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
<a href="#">Eubalaena australis</a> Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
<a href="#">Megaptera novaeangliae</a> Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
<a href="#">Petrogale penicillata</a> Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
<a href="#">Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)</a> Koala (combined populations of Queensland, New	Vulnerable	Species or species

Name	Status	Type of Presence
South Wales and the Australian Capital Territory) [85104] <a href="#">Potorous tridactylus tridactylus</a>		habitat known to occur within area
Long-nosed Potoroo (SE mainland) [66645]  <a href="#">Pseudomys novaehollandiae</a>	Vulnerable	Species or species habitat may occur within area
New Holland Mouse, Pookila [96]  <a href="#">Pteropus poliocephalus</a>	Vulnerable	Species or species habitat known to occur within area
Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Plants		
<a href="#">Acacia bynoeana</a> Bynoe's Wattle, Tiny Wattle [8575]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Angophora inopina</a> Charmhaven Apple [64832]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Asterolasia elegans</a> [56780]	Endangered	Species or species habitat may occur within area
<a href="#">Astrotricha crassifolia</a> Thick-leaf Star-hair [10352]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Caladenia tessellata</a> Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Cryptostylis hunteriana</a> Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Diuris praecox</a> Newcastle Doubletail [55086]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Eucalyptus camfieldii</a> Camfield's Stringybark [15460]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Genoplesium baueri</a> Yellow Gnat-orchid [7528]	Endangered	Species or species habitat likely to occur within area
<a href="#">Grevillea parviflora subsp. parviflora</a> Small-flower Grevillea [64910]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Melaleuca biconvexa</a> Biconvex Paperbark [5583]	Vulnerable	Species or species habitat known to occur within area
<a href="#">Pelargonium sp. Striatellum (G.W.Carr 10345)</a> Omeo Stork's-bill [84065]	Endangered	Species or species habitat likely to occur within area
<a href="#">Prostanthera askania</a> Tranquillity Mintbush, Tranquility Mintbush [64958]	Endangered	Species or species habitat likely to occur within area
<a href="#">Prostanthera junonis</a> Somersby Mintbush [64960]	Endangered	Species or species habitat likely to occur within area
<a href="#">Pultenaea glabra</a> Smooth Bush-pea, Swamp Bush-pea [11887]	Vulnerable	Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
<a href="#">Rhizanthella slateri</a> Eastern Underground Orchid [11768]	Endangered	Species or species habitat may occur within area
<a href="#">Rutidosis heterogama</a> Heath Wrinklewort [13132]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Streblus pendulinus</a> Siah's Backbone, Sia's Backbone, Isaac Wood [21618]	Endangered	Species or species habitat likely to occur within area
<a href="#">Syzygium paniculatum</a> Magenta Lilly Pilly, Magenta Cherry, Pocket-less Brush Cherry, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Tetratheca juncea</a> Black-eyed Susan [21407]	Vulnerable	Species or species habitat known to occur within area

Reptiles		
<a href="#">Caretta caretta</a> Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
<a href="#">Chelonia mydas</a> Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
<a href="#">Dermochelys coriacea</a> Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
<a href="#">Eretmochelys imbricata</a> Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
<a href="#">Hoplocephalus bungaroides</a> Broad-headed Snake [1182]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Natator depressus</a> Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Sharks		
<a href="#">Carcharias taurus (east coast population)</a> Grey Nurse Shark (east coast population) [68751]	Critically Endangered	Species or species habitat likely to occur within area
<a href="#">Carcharodon carcharias</a> Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
<a href="#">Pristis zijsron</a> Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat may occur within area
<a href="#">Rhincodon typus</a> Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species		[ <a href="#">Resource Information</a> ]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
<a href="#">Apus pacificus</a>		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area



Name	Threatened	Type of Presence
<a href="#">Calonectris leucomelas</a> Streaked Shearwater [1077]		Species or species habitat may occur within area
<a href="#">Diomedea antipodensis</a> Antipodean Albatross [64458]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Diomedea dabbenena</a> Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
<a href="#">Diomedea epomophora (sensu stricto)</a> Southern Royal Albatross [1072]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Diomedea exulans (sensu lato)</a> Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Diomedea gibsoni</a> Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Diomedea sanfordi</a> Northern Royal Albatross [64456]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Macronectes giganteus</a> Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
<a href="#">Macronectes halli</a> Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
<a href="#">Puffinus carneipes</a> Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
<a href="#">Puffinus leucomelas</a> Streaked Shearwater [66541]		Species or species habitat may occur within area
<a href="#">Sterna albifrons</a> Little Tern [813]		Breeding likely to occur within area
<a href="#">Thalassarche bulleri</a> Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
<a href="#">Thalassarche cauta (sensu stricto)</a> Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Thalassarche eremita</a> Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Thalassarche impavida</a> Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
<a href="#">Thalassarche melanophris</a> Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
<a href="#">Thalassarche salvini</a> Salvin's Albatross [64463]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Thalassarche steadi</a> White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or

Name	Threatened	Type of Presence
related behaviour likely to occur within area		
Migratory Marine Species		
<a href="#">Balaenoptera edeni</a> Bryde's Whale [35]		Species or species habitat may occur within area
<a href="#">Balaenoptera musculus</a> Blue Whale [36]	Endangered	Species or species habitat may occur within area
<a href="#">Caperea marginata</a> Pygmy Right Whale [39]		Species or species habitat may occur within area
<a href="#">Carcharodon carcharias</a> Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
<a href="#">Caretta caretta</a> Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
<a href="#">Chelonia mydas</a> Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
<a href="#">Dermochelys coriacea</a> Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
<a href="#">Eretmochelys imbricata</a> Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
<a href="#">Eubalaena australis</a> Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
<a href="#">Lagenorhynchus obscurus</a> Dusky Dolphin [43]		Species or species habitat may occur within area
<a href="#">Lamna nasus</a> Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
<a href="#">Manta birostris</a> Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
<a href="#">Megaptera novaeangliae</a> Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
<a href="#">Natator depressus</a> Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
<a href="#">Orcinus orca</a> Killer Whale, Orca [46]		Species or species habitat may occur within area
<a href="#">Rhincodon typus</a> Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
<a href="#">Sousa chinensis</a> Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		

Name	Threatened	Type of Presence
<a href="#">Haliaeetus leucogaster</a> White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
<a href="#">Hirundapus caudacutus</a> White-throated Needletail [682]		Species or species habitat known to occur within area
<a href="#">Merops ornatus</a> Rainbow Bee-eater [670]		Species or species habitat may occur within area
<a href="#">Monarcha melanopsis</a> Black-faced Monarch [609]		Species or species habitat known to occur within area
<a href="#">Monarcha trivirgatus</a> Spectacled Monarch [610]		Species or species habitat may occur within area
<a href="#">Myiagra cyanoleuca</a> Satin Flycatcher [612]		Species or species habitat known to occur within area
<a href="#">Rhipidura rufifrons</a> Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
<a href="#">Actitis hypoleucos</a> Common Sandpiper [59309]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Ardea alba</a> Great Egret, White Egret [59541]		Species or species habitat known to occur within area
<a href="#">Ardea ibis</a> Cattle Egret [59542]		Species or species habitat likely to occur within area
<a href="#">Arenaria interpres</a> Ruddy Turnstone [872]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Calidris acuminata</a> Sharp-tailed Sandpiper [874]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Calidris alba</a> Sanderling [875]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Calidris canutus</a> Red Knot, Knot [855]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Calidris ruficollis</a> Red-necked Stint [860]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Calidris tenuirostris</a> Great Knot [862]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Charadrius bicinctus</a> Double-banded Plover [895]		Foraging, feeding or related behaviour known to occur within area



Name	Threatened	Type of Presence
<a href="#">Charadrius mongolus</a> Lesser Sand Plover, Mongolian Plover [879]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Gallinago hardwickii</a> Latham's Snipe, Japanese Snipe [863]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Heteroscelus brevipes</a> Grey-tailed Tattler [59311]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Limosa lapponica</a> Bar-tailed Godwit [844]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Limosa limosa</a> Black-tailed Godwit [845]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Numenius madagascariensis</a> Eastern Curlew [847]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Numenius minutus</a> Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour likely to occur within area
<a href="#">Numenius phaeopus</a> Whimbrel [849]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Pluvialis fulva</a> Pacific Golden Plover [25545]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Pluvialis squatarola</a> Grey Plover [865]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Rostratula benghalensis (sensu lato)</a> Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
<a href="#">Tringa stagnatilis</a> Marsh Sandpiper, Little Greenshank [833]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Xenus cinereus</a> Terek Sandpiper [59300]		Foraging, feeding or related behaviour known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land	[ Resource Information ]
The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.	
Name	
Commonwealth Land - Australian Postal Corporation	
Commonwealth Land - Australian Telecommunications Commission	
Commonwealth Land - Director of War Service Homes	
Commonwealth Land - Telstra Corporation Limited	

Listed Marine Species	[ Resource Information ]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.	
Name	Threatened Type of Presence

Name	Threatened	Type of Presence
Birds		
<a href="#">Actitis hypoleucos</a> Common Sandpiper [59309]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Apus pacificus</a> Fork-tailed Swift [678]		Species or species habitat likely to occur within area
<a href="#">Ardea alba</a> Great Egret, White Egret [59541]		Species or species habitat known to occur within area
<a href="#">Ardea ibis</a> Cattle Egret [59542]		Species or species habitat likely to occur within area
<a href="#">Arenaria interpres</a> Ruddy Turnstone [872]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Calidris acuminata</a> Sharp-tailed Sandpiper [874]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Calidris alba</a> Sanderling [875]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Calidris canutus</a> Red Knot, Knot [855]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Calidris melanotos</a> Pectoral Sandpiper [858]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Calidris ruficollis</a> Red-necked Stint [860]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Calidris tenuirostris</a> Great Knot [862]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Calonectris leucomelas</a> Streaked Shearwater [1077]		Species or species habitat may occur within area
<a href="#">Catharacta skua</a> Great Skua [59472]		Species or species habitat may occur within area
<a href="#">Charadrius bicinctus</a> Double-banded Plover [895]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Charadrius mongolus</a> Lesser Sand Plover, Mongolian Plover [879]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Charadrius ruficapillus</a> Red-capped Plover [881]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Diomedea antipodensis</a> Antipodean Albatross [64458]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
<a href="#">Diomedea dabbenena</a> Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
<a href="#">Diomedea epomophora (sensu stricto)</a> Southern Royal Albatross [1072]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Diomedea exulans (sensu lato)</a> Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Diomedea gibsoni</a> Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Diomedea sanfordi</a> Northern Royal Albatross [64456]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Gallinago hardwickii</a> Latham's Snipe, Japanese Snipe [863]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Gallinago megala</a> Swinhoe's Snipe [864]		Foraging, feeding or related behaviour likely to occur within area
<a href="#">Gallinago stenura</a> Pin-tailed Snipe [841]		Foraging, feeding or related behaviour likely to occur within area
<a href="#">Haliaeetus leucogaster</a> White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
<a href="#">Heteroscelus brevipes</a> Grey-tailed Tattler [59311]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Himantopus himantopus</a> Black-winged Stilt [870]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Hirundapus caudacutus</a> White-throated Needletail [682]		Species or species habitat known to occur within area
<a href="#">Lathamus discolor</a> Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
<a href="#">Limosa lapponica</a> Bar-tailed Godwit [844]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Limosa limosa</a> Black-tailed Godwit [845]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Macronectes giganteus</a> Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
<a href="#">Macronectes halli</a> Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
<a href="#">Merops ornatus</a> Rainbow Bee-eater [670]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
<a href="#">Monarcha melanopsis</a> Black-faced Monarch [609]		Species or species habitat known to occur within area
<a href="#">Monarcha trivirgatus</a> Spectacled Monarch [610]		Species or species habitat may occur within area
<a href="#">Myiagra cyanoleuca</a> Satin Flycatcher [612]		Species or species habitat known to occur within area
<a href="#">Numenius madagascariensis</a> Eastern Curlew [847]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Numenius minutus</a> Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour likely to occur within area
<a href="#">Numenius phaeopus</a> Whimbrel [849]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Pandion haliaetus</a> Osprey [952]		Breeding known to occur within area
<a href="#">Pluvialis fulva</a> Pacific Golden Plover [25545]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Pluvialis squatarola</a> Grey Plover [865]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Puffinus carneipes</a> Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
<a href="#">Rhipidura rufifrons</a> Rufous Fantail [592]		Species or species habitat known to occur within area
<a href="#">Rostratula benghalensis (sensu lato)</a> Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
<a href="#">Sterna albifrons</a> Little Tern [813]		Breeding likely to occur within area
<a href="#">Thalassarche bulleri</a> Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
<a href="#">Thalassarche cauta (sensu stricto)</a> Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Thalassarche eremita</a> Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Thalassarche impavida</a> Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
<a href="#">Thalassarche melanophris</a> Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
<a href="#">Thalassarche salvini</a> Salvin's Albatross [64463]	Vulnerable*	Foraging, feeding or related behaviour likely



Name	Threatened	Type of Presence
		to occur within area
<a href="#">Thalassarche steadi</a> White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
<a href="#">Tringa stagnatilis</a> Marsh Sandpiper, Little Greenshank [833]		Foraging, feeding or related behaviour known to occur within area
<a href="#">Xenus cinereus</a> Terek Sandpiper [59300]		Foraging, feeding or related behaviour known to occur within area
Fish		
<a href="#">Acentronura tentaculata</a> Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area
<a href="#">Festucalex cinctus</a> Girdled Pipefish [66214]		Species or species habitat may occur within area
<a href="#">Filicampus tigris</a> Tiger Pipefish [66217]		Species or species habitat may occur within area
<a href="#">Heraldia nocturna</a> Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
<a href="#">Hippichthys penicillus</a> Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
<a href="#">Hippocampus abdominalis</a> Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
<a href="#">Hippocampus whitei</a> White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240]		Species or species habitat may occur within area
<a href="#">Histiogamphelus briggsii</a> Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
<a href="#">Lissocampus runa</a> Javelin Pipefish [66251]		Species or species habitat may occur within area
<a href="#">Maroubra perserrata</a> Sawtooth Pipefish [66252]		Species or species habitat may occur within area
<a href="#">Notiocampus ruber</a> Red Pipefish [66265]		Species or species habitat may occur within area
<a href="#">Phyllopteryx taeniolatus</a> Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
<a href="#">Solegnathus spinosissimus</a> Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
<a href="#">Solenostomus cyanopterus</a> Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
<a href="#">Solenostomus paegnius</a> Rough-snout Ghost Pipefish [68425]		Species or species habitat may occur within

Name	Threatened	Type of Presence
area		
<a href="#">Solenostomus paradoxus</a> Ornate Ghostpipefish, Harlequin Ghost Pipefish, Ornate Ghost Pipefish [66184]		Species or species habitat may occur within area
<a href="#">Stigmatopora argus</a> Spotted Pipefish, Gulf Pipefish [66276]		Species or species habitat may occur within area
<a href="#">Stigmatopora nigra</a> Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
<a href="#">Syngnathoides biaculeatus</a> Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
<a href="#">Trachyrhamphus bicoarctatus</a> Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
<a href="#">Urocampus carinirostris</a> Hairy Pipefish [66282]		Species or species habitat may occur within area
<a href="#">Vanacampus margaritifer</a> Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Mammals		
<a href="#">Arctocephalus forsteri</a> New Zealand Fur-seal [20]		Species or species habitat may occur within area
<a href="#">Arctocephalus pusillus</a> Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Reptiles		
<a href="#">Caretta caretta</a> Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
<a href="#">Chelonia mydas</a> Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
<a href="#">Dermochelys coriacea</a> Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
<a href="#">Eretmochelys imbricata</a> Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
<a href="#">Natator depressus</a> Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
<a href="#">Pelamis platurus</a> Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area
Whales and other Cetaceans		[ <a href="#">Resource Information</a> ]
Name	Status	Type of Presence
Mammals		
<a href="#">Balaenoptera acutorostrata</a> Minke Whale [33]		Species or species habitat may occur within area

Name	Status	Type of Presence
<a href="#">Balaenoptera edeni</a> Bryde's Whale [35]	Endangered	Species or species habitat may occur within area
<a href="#">Balaenoptera musculus</a> Blue Whale [36]		Species or species habitat may occur within area
<a href="#">Caperea marginata</a> Pygmy Right Whale [39]		Species or species habitat may occur within area
<a href="#">Delphinus delphis</a> Common Dophin, Short-beaked Common Dolphin [60]	Endangered	Species or species habitat may occur within area
<a href="#">Eubalaena australis</a> Southern Right Whale [40]		Species or species habitat likely to occur within area
<a href="#">Grampus griseus</a> Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
<a href="#">Lagenorhynchus obscurus</a> Dusky Dolphin [43]	Vulnerable	Species or species habitat may occur within area
<a href="#">Megaptera novaeangliae</a> Humpback Whale [38]		Species or species habitat known to occur within area
<a href="#">Orcinus orca</a> Killer Whale, Orca [46]		Species or species habitat may occur within area
<a href="#">Sousa chinensis</a> Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
<a href="#">Stenella attenuata</a> Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
<a href="#">Tursiops aduncus</a> Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
<a href="#">Tursiops truncatus s. str.</a> Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Places on the RNE		[ <a href="#">Resource Information</a> ]
Note that not all Indigenous sites may be listed.		
Name	State	Status
Natural		
<a href="#">Wamberal Lagoon Nature Reserve</a>	NSW	Registered
Historic		
<a href="#">Gosford Hills Landscape Conservation Area</a>	NSW	Indicative Place
<a href="#">The Entrance Carousel</a>	NSW	Indicative Place
<a href="#">Felton Mathews Tree</a>	NSW	Registered
<a href="#">Old Maitland Road Section</a>	NSW	Registered



State and Territory Reserves		[ Resource Information ]
Name		State
Gosford Coastal Open Space System		NSW
Tuggerah		NSW
Tuggerah		NSW
Wamberal Lagoon		NSW
Wambina		NSW
Wyrrabalong		NSW

Regional Forest Agreements	[ Resource Information ]
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Note that all areas with completed RFAs have been included.

Name	State
<a href="#">North East NSW RFA</a>	New South Wales

Invasive Species	[ Resource Information ]
------------------	--------------------------

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
<a href="#">Acridotheres tristis</a> Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
<a href="#">Alauda arvensis</a> Skylark [656]		Species or species habitat likely to occur within area
<a href="#">Anas platyrhynchos</a> Mallard [974]		Species or species habitat likely to occur within area
<a href="#">Carduelis carduelis</a> European Goldfinch [403]		Species or species habitat likely to occur within area
<a href="#">Columba livia</a> Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
<a href="#">Lonchura punctulata</a> Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
<a href="#">Passer domesticus</a> House Sparrow [405]		Species or species habitat likely to occur within area
<a href="#">Passer montanus</a> Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
<a href="#">Pycnonotus jocosus</a> Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
<a href="#">Streptopelia chinensis</a> Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
<a href="#">Sturnus vulgaris</a> Common Starling [389]		Species or species habitat likely to occur within area
<a href="#">Turdus merula</a> Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		

Name	Status	Type of Presence
<a href="#">Bufo marinus</a> Cane Toad [1772]		Species or species habitat likely to occur within area
<a href="#">Rhinella marina</a> Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
<a href="#">Bos taurus</a> Domestic Cattle [16]		Species or species habitat likely to occur within area
<a href="#">Canis lupus familiaris</a> Domestic Dog [82654]		Species or species habitat likely to occur within area
<a href="#">Felis catus</a> Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
<a href="#">Feral deer</a> Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
<a href="#">Lepus capensis</a> Brown Hare [127]		Species or species habitat likely to occur within area
<a href="#">Mus musculus</a> House Mouse [120]		Species or species habitat likely to occur within area
<a href="#">Oryctolagus cuniculus</a> Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
<a href="#">Rattus norvegicus</a> Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
<a href="#">Rattus rattus</a> Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
<a href="#">Vulpes vulpes</a> Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
<a href="#">Alternanthera philoxeroides</a> Alligator Weed [11620]		Species or species habitat likely to occur within area
<a href="#">Anredera cordifolia</a> Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
<a href="#">Asparagus aethiopicus</a> Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
<a href="#">Asparagus asparagoides</a> Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
<a href="#">Asparagus plumosus</a> Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
<a href="#">Asparagus scandens</a> Asparagus Fern, Climbing Asparagus Fern [23255]		Species or species habitat likely to occur

Name	Status	Type of Presence
<a href="#">Cabomba caroliniana</a>		within area
Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
<a href="#">Chrysanthemoides monilifera</a>		
Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
<a href="#">Chrysanthemoides monilifera subsp. monilifera</a>		
Boneseed [16905]		Species or species habitat likely to occur within area
<a href="#">Chrysanthemoides monilifera subsp. rotundata</a>		
Bitou Bush [16332]		Species or species habitat likely to occur within area
<a href="#">Cytisus scoparius</a>		
Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
<a href="#">Dolichandra unguis-cati</a>		
Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
<a href="#">Eichhornia crassipes</a>		
Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
<a href="#">Genista monspessulana</a>		
Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
<a href="#">Genista sp. X Genista monspessulana</a>		
Broom [67538]		Species or species habitat may occur within area
<a href="#">Lantana camara</a>		
Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
<a href="#">Lycium ferocissimum</a>		
African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
<a href="#">Nassella neesiana</a>		
Chilean Needle grass [67699]		Species or species habitat likely to occur within area
<a href="#">Opuntia spp.</a>		
Prickly Pears [82753]		Species or species habitat likely to occur within area
<a href="#">Pinus radiata</a>		
Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
<a href="#">Protasparagus plumosus</a>		
Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
<a href="#">Rubus fruticosus aggregate</a>		
Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
<a href="#">Sagittaria platyphylla</a>		
Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
<a href="#">Salix spp. except S.babylonica, S.x calodendron &amp; S.x reichardtii</a>		
Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur

Name	Status	Type of Presence
<a href="#">Salvinia molesta</a>		within area
Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
<a href="#">Senecio madagascariensis</a>		
Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
<a href="#">Ulex europaeus</a>		
Gorse, Furze [7693]		Species or species habitat likely to occur within area

Nationally Important Wetlands		[ Resource Information ]
Name		State
<a href="#">Terrigal Lagoon</a>		NSW
<a href="#">Tuggerah Lake</a>		NSW
<a href="#">Wamberal Lagoon</a>		NSW
<a href="#">Wyong Racecourse Swamp</a>		NSW

# Coordinates

-33.366 151.464

## Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

# Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [Department of Environment, Climate Change and Water, New South Wales](#)
- [Department of Sustainability and Environment, Victoria](#)
- [Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [Department of Environment and Natural Resources, South Australia](#)
- [Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts](#)
- [Environmental and Resource Management, Queensland](#)
- [Department of Environment and Conservation, Western Australia](#)
- [Department of the Environment, Climate Change, Energy and Water](#)
- [Birds Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [Museum Victoria](#)
- [Australian Museum](#)
- [SA Museum](#)
- [Queensland Museum](#)
- [Online Zoological Collections of Australian Museums](#)
- [Queensland Herbarium](#)
- [National Herbarium of NSW](#)
- [Royal Botanic Gardens and National Herbarium of Victoria](#)
- [Tasmanian Herbarium](#)
- [State Herbarium of South Australia](#)
- [Northern Territory Herbarium](#)
- [Western Australian Herbarium](#)
- [Australian National Herbarium, Atherton and Canberra](#)
- [University of New England](#)
- [Ocean Biogeographic Information System](#)
- [Australian Government, Department of Defence](#)
- [State Forests of NSW](#)
- [Geoscience Australia](#)
- [CSIRO](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

## NSW Wildlife Atlas

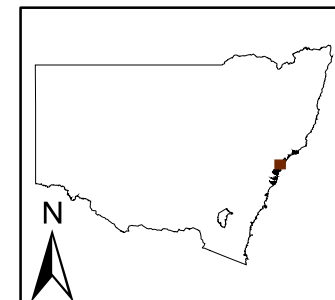
Results of the NSW NPWS search (accessed 30 April 2014)

Class	Family	Scientific Name	Common Name	NSW Status	Count in 10 km radius
Insecta	Petaluridae	Petalura gigantea	Giant Dragonfly	Endangered under shedule	1



# Key Fish Habitat

## WYONG LGA



Source: data from the Australian Geoscience, NSW DPI, NSW DECC and NSW LPI  
 Datum: Geocentric Datum of Australia (GDA)  
 Grid: Mapping Grid of Australia (MGA94)

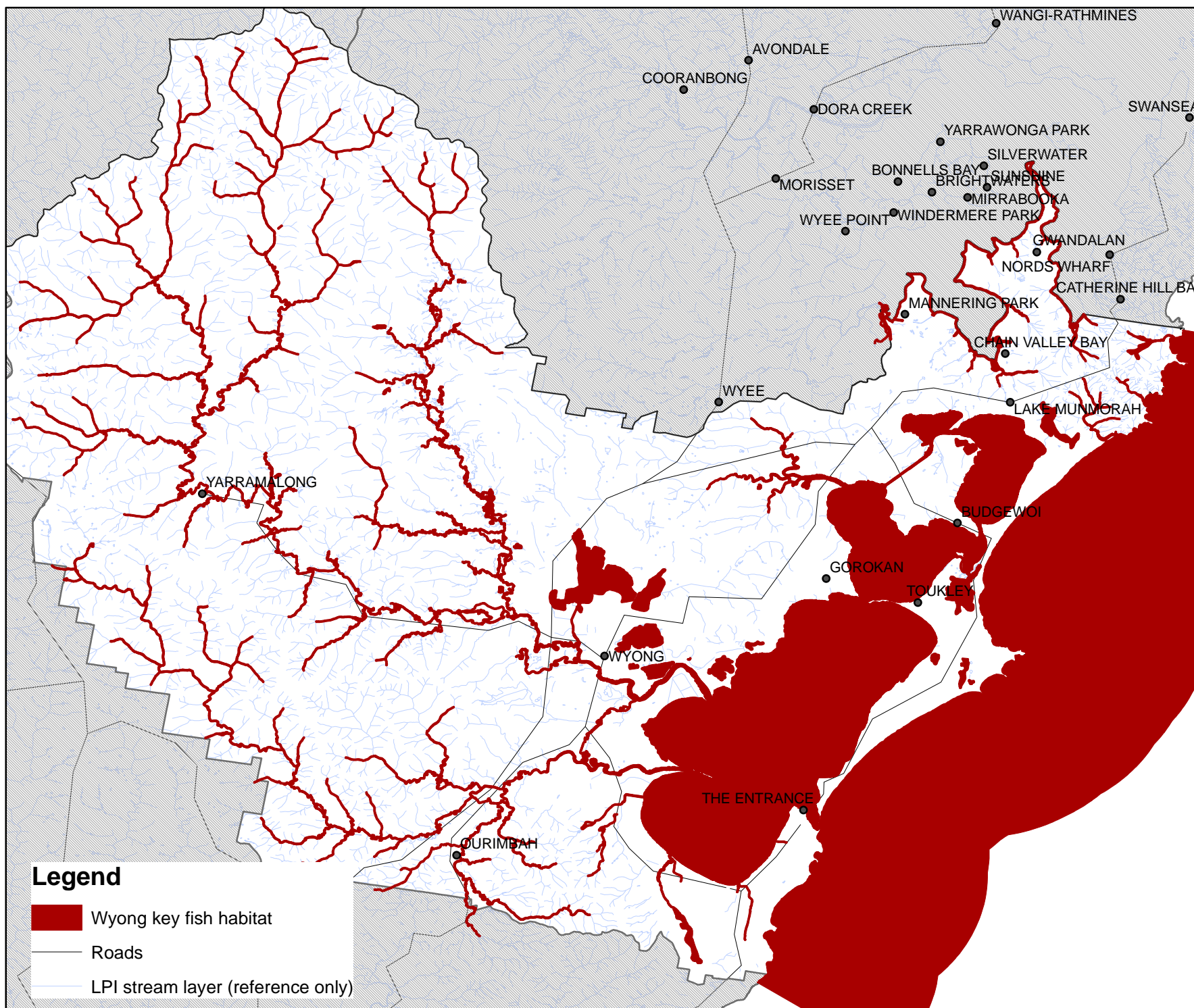
The State of New South Wales, the Department of Primary Industries, its employees, officers, agents or servants are not responsible for the result of any actions taken on the basis of the information contained on the map, or for any errors, omissions or inaccuracies that may occur on this map.

Prepared by GIS section, Fisheries Ecosystems Branch, Division of Agriculture & Fisheries, NSW DPI.

0 1.252.5 5  
 Kilometres



NSW DEPARTMENT OF  
 PRIMARY INDUSTRIES



### Legend

- Wyong key fish habitat
- Roads
- LPI stream layer (reference only)

## Directory of Important Wetlands

Results of the DIWA search (accessed 30 April 2014).

Reference Code	Wetland Name	Catchment	Wyong LGA	Likelihood of downstream impacts
NSW189	Lake Macquarie	Lake Macquarie/Tuggerah Lakes catchment	No	No
NSW141	Tuggerah Lake	Lake Macquarie/Tuggerah Lakes catchment	Yes	Yes
NSW133	Budgewoi Lake Sand Mass	Lake Macquarie/Tuggerah Lakes catchment	Yes	No
NSW134	Colongra Swamp	Lake Macquarie/Tuggerah Lakes catchment	Yes	No
NSW143	Wyong Racecourse Swamp	Lake Macquarie/Tuggerah Lakes catchment	Yes	Yes
NSW183	Jewells Wetland	Lake Macquarie/Tuggerah Lakes catchment	No	No



## **APPENDIX B: ASSESSMENT FOR THE POTENTIAL OCCURRENCE OF THREATENED AQUATIC BIOTA**

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Species	EPBC Act	FM Act	Habitat Requirements	Number of records in project area	Likelihood of Occurrence and Determination of Further Assessment
Giant Dragonfly ( <i>Petaleura gigantea</i> )		Endangered	<p>Distribution: <i>P. gigantea</i> is restricted to east flowing catchments of NSW (Theischinger and Hawking 2006).</p> <p>Habitat: This species lives in permanent swamps and bogs with some free water and open vegetation (Theischinger and Hawking 2006). It uses boggy areas comprising of moist litter and humic soils; often adjacent to the open water wetlands (Theischinger and Hawking 2006).</p>	None	<p>Two records are downstream of the study site (9 to 11 kilometres each). These records are surrounded by urban areas, therefore, the potential of adverse downstream impacts is negligible.</p> <p>Unlikely to occur as <i>P. gigantea</i> as much of the area is urban and disturbed. No permanent high quality swamps were found in the study area.</p> <p>No further assessment required.</p>
Macquarie perch ( <i>Macquaria australasica</i> )  Macquarie Perch, silvereeye, white-eye, mountain perch, Murray perch, grunter, bream and black bream.	Endangered	Endangered	<p>Distribution: <i>Macquaria australasica</i> found in the upper and middle reaches of the Murray and Murrumbidgee rivers, and the upper reaches of the Lachlan River and their tributaries in NSW. These populations are above the major impoundments (i.e. Hume Weir, Burrinjuck Dam and Wyangala Dam respectively) and are all relatively small, restricted and fragmented.</p> <p>Habitat The Macquarie Perch cool, shaded, upland streams with deep rocky pools and substantial cover. As well as aquatic vegetation, additional cover may comprise of large boulders, debris and overhanging banks (Cadwallader and Eden 1979).</p>	None	<p>No records exist for this species in the HC CMA Wyong subcatchment and the study area does not meet the ecological requirements of this species.</p> <p>No further assessment required</p>

Species	EPBC Act	FM Act	Habitat Requirements	Number of records in project area	Likelihood of Occurrence and Determination of Further Assessment
			<p>Insects form a substantial part of the Macquarie Perch diet (Lake 1971). The diet of <i>M. australasica</i> consists predominantly of small benthic aquatic insect larvae and other macroinvertebrates (McKeown 1934, Butcher 1945, Cadwallader and Eden 1979, Battaglione 1988).</p> <p>This species can tolerate temperatures of less than 9°C, they appear to require a temperature of at least 16.5°C for spawning to occur.</p>		
Black Rock Cod <i>Epinephelus daemeli</i>	Vulnerable	Vulnerable	<p>Large reef dwelling cod/groper species. Black cod generally inhabit near-shore rocky and offshore coral reefs at depths down to 50 metres. In coastal waters adult black cod are found in rock caves, rock gutters and on rock reefs.</p> <p>Recently settled juvenile black cod (i.e. individuals that have recently completed the pelagic larval stage) are often found in coastal rock pools while slightly older juvenile black cod are often found in estuary systems (Hutchins and Swainston 1986, Pogonoski et al. 2002, Harasti et al. 2004). The use of estuaries may be an important part of the ecology of juvenile black cod in NSW waters (NSW I&amp;I 2009, Malcolm and Harasti 2010), although it is noteworthy that the Elizabeth and Middleton Reef populations have no access to estuarine habitats.</p> <p>Larger juvenile black cod appear to move into adult habitats, but hide in rock structures and remain highly</p>	None	<p>No records exist for this species in the HC CMA Wyong subcatchment and the study area does not meet the ecological requirements of this species.</p> <p>No further assessment required.</p>

Species	EPBC Act	FM Act	Habitat Requirements	Number of records in project area	Likelihood of Occurrence and Determination of Further Assessment
			cryptic until at least 40 cm in length (Choat et al. 2006, Malcolm and Harasti 2010).		
Oxleyan pygmy perch <i>Nannoperca oxleyana</i>	Endangered	Endangered	Distribution: Restricted to coastal lowlands north – eastern NSW to south – eastern Queensland.  Habitat: Mostly occur in swamps, creeks, and lakes of coastal 'wallum' ( <i>Banksia</i> dominated coastal health). These waters are usually acidic with low salinity and low conductivity and darkly stained. Prefer slow moving or still waters with dense vegetation (e.g. sedges or undercut, root – filled banks fringed with submerged riparian vegetation. Mainly feed on small crustaceans, aquatic insects diatoms and filamentous algae.	None	No suitable habitat is within the study area and no records exist for this species in the lower Hunter region. This species prefers high quality wallum coastal swamps and creeks and such habitat is absent in the study area.  No further assessment required
Purple spotted gudgeon <i>Mogurnda adspersa</i>		Endangered	A benthic species, usually found in slow – moving rivers creeks and wetlands. Often among weeds, rocks or snags. They mainly feed on small fish, insect larvae, worms, tadpoles and plant matter. Courtship and spawning occur over summer.	None	No records exist for this species in the lower reaches and wetlands of the Hunter region. The closest recorded population is in Goorangoola Creek in the Upper Hunter and is unlikely to be in the study area.  No further assessment required
Populations of <i>Posidonia australis</i>		Endangered	<i>Posidonia australis</i> occurs from Wallis Lake to Twofold Bay in Lake Macquarie. The species grows on coarse sandy to fine silty soil between the low tideline to about 10 metres deep.	None	<i>Posidonia</i> are not recorded in the study area and do not occur within the catchment area of the proposal.  No further assessment required.



## APPENDIX C: RECORDED AQUATIC MACROINVERTEBRATES

Taxa	Family	Species	Common Name	SIGNAL
Nematoda	-	-	Round worms	3
Arthropoda				
Acariformes (Acarina)	-	-	Water mites	6
Aranae	-	-	Aquatic spiders	-
Isopoda	-	-	Aquatic slaters	2
Atyidae	-	<i>Paratya sp.</i>	Freshwater shrimps	3
Insecta				
Collembola	Isotomidae	-	Springtails	-
	Hypogastruridae	-	Springtails	-
Hemiptera	Hydrometridae	Hydrometra	Water measurers	3
	Corixidae	<i>Sigara sp.</i>	Water boatmen	2
	Corixidae	<i>Micronecta sp.</i>	Water boatmen	2
	Vellidae	-	Small water striders	3
Coleoptera	Dytiscidae	-	Predaceous diving beetles	2
Diptera	Culicidae	-	Mosquitoes	1
Trichoptera	Leptoceridae	-	Caddis flies	6
Average SIGNAL Value				3



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## Appendix 8: Wyong River bridge pylons biota survey



# Wyong Town Centre Upgrade



## Wyong River bridge pylons biota survey

Prepared for SMEC

14/07/2015



## Wyong River bridge pylons biota survey - Final Report

prepared for

SMEC Australia Pty Ltd

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### Document control

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14/07/2015

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### Revision Schedule

Rev No	Date	Description	Issued to
1	11.06.2015	Draft for client review	J.McMahon, SMEC
2	14.07.2015	Final report	J.McMahon, SMEC

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# 1. Background

The NSW Roads and Maritime Services (RMS) is planning to upgrade the Pacific Highway through the Wyong town centre to provide two lanes in each direction between Johnson Road at Tuggerah and Cutler Drive at Wyong.

RMS commissioned SMEC Australian Pty Ltd (SMEC) to develop a concept design for a 2.4 kilometre section of the Pacific Highway upgrade and prepare a Review of Environmental Factors (REF) under the provisions of Part 5 of the *Environment Planning and Assessment Act 1979* (EP&A Act).

The section of the Pacific Highway to be upgraded crosses the Wyong River (Figure 1). A full description of the study area; environmental and statutory planning constraints; and the potential for the proposed highway upgrade to adversely impact on the river's aquatic ecology of the river, was assessed by Watershed Ecology (May 2014).

This assessment was undertaken to determine the presence or absence of aquatic habitat on the pylons of the existing Wyong River road bridge and remnant wooden piles from a previous bridge crossing.

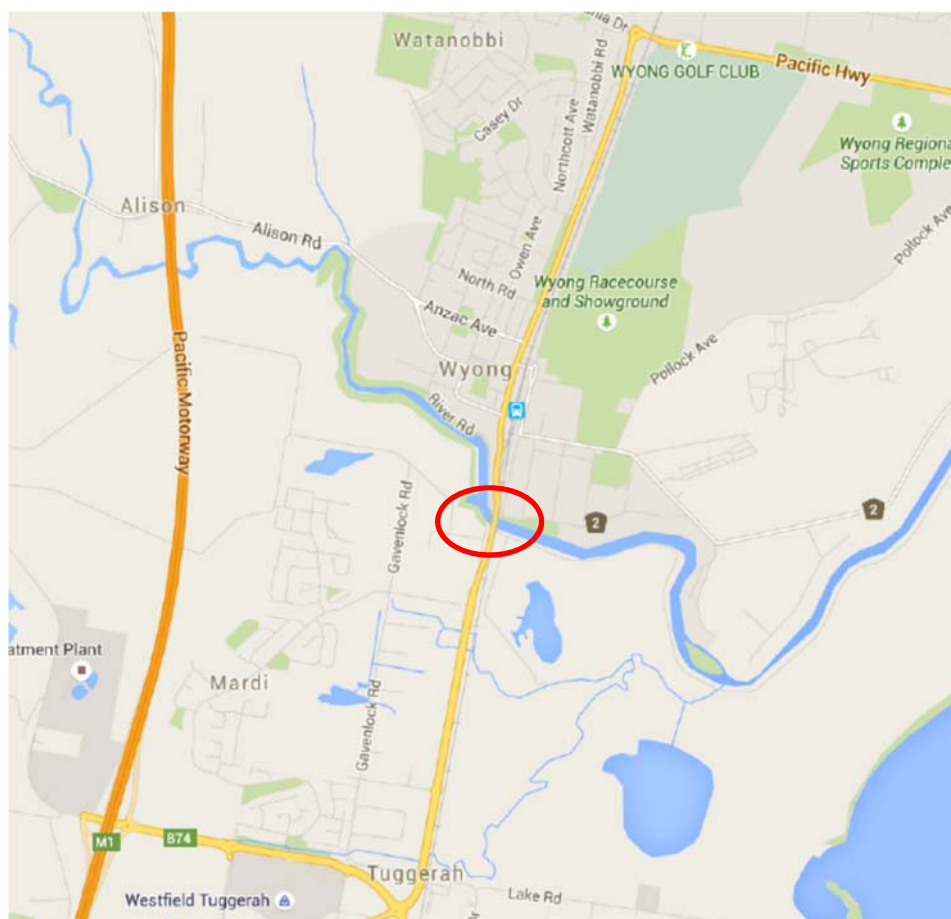


Figure 1. Location of Wyong River crossing

## 2. Assessment Results

### 2.1 Methods

Boat based field assessment was undertaken on the 26<sup>th</sup> May 2015 during light (<10knots) west south westerly winds and approximately four weeks following cyclonic conditions experienced on the Central Coast in late April 2015.

Turbidity levels, and hence visibility, were sufficient to enable the use of an underwater camera fitted with LED lamps to visually inspect the pylons from a 6m aluminium centre console work vessel.

Video footage was captured from two of the eight bridge pylons (pylon no. 3 and no. 6) and one remnant timber pylon for later desktop analysis. Figure 2 illustrates the location and numbering of pylons and photographs are provided in Figure 3.

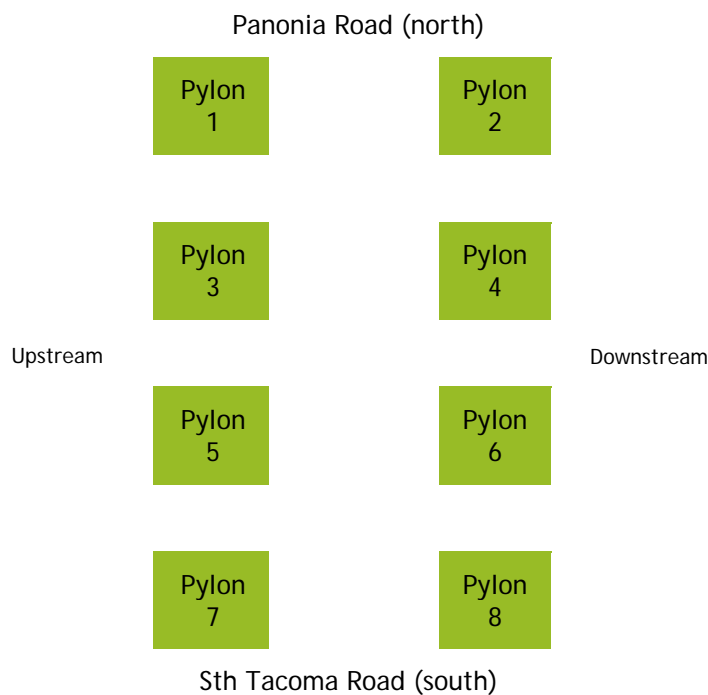
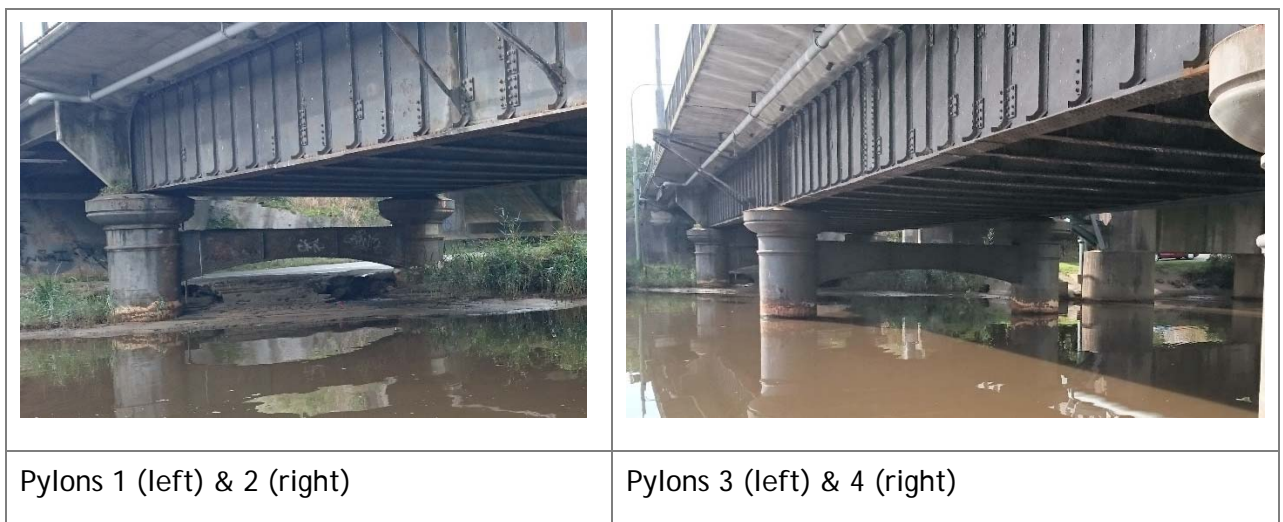


Figure 2. Pylon numbering



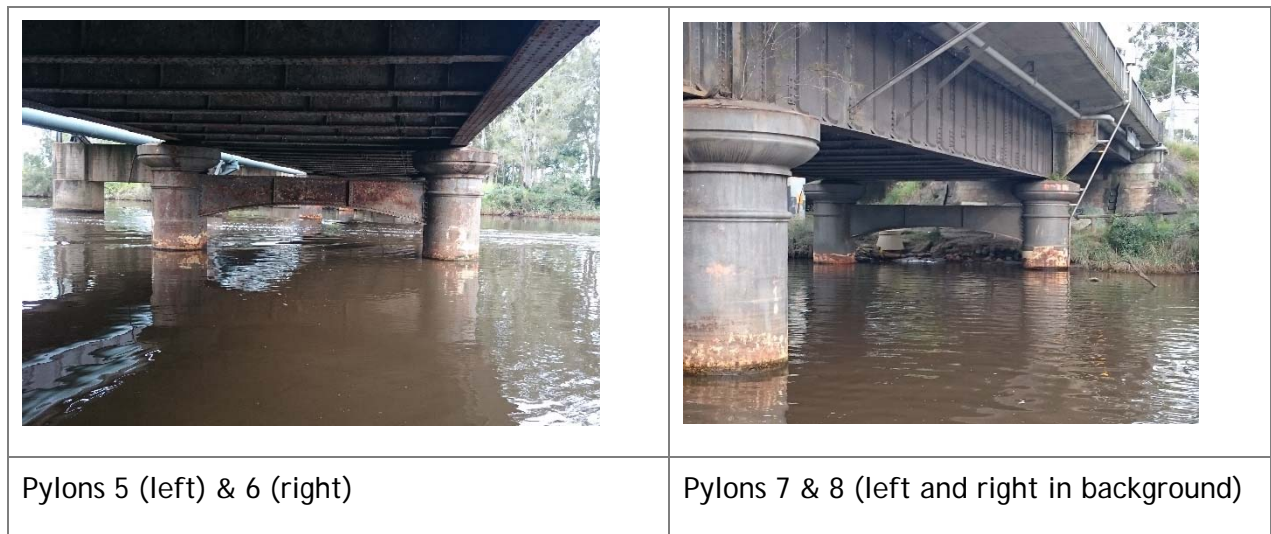


Figure 3. Pylon photographs

## 2.3 Results

The Wyong River bridge is located approximately 6.5 kilometres upstream of Tuggerah Lake (Figure 1). Water chemistry is tidally influenced although water level is only marginally influenced by tidal heights.

The width of the river at this location is approximately 55 metres (Watershed Ecology, 2014).

The bridge is supported by 8 pylons, four (pylons 3 to 6) located in water over 6 m (deepest level measured being 6.7m at tide of approximately 1.0m). Pylons 1 and 2 are only marginally inundated whereas pylons 7 and 8 appear to be permanently inundated but relatively shallowly.

A distinct freshwater lens was evident overlying saline water at a depth of approximately 0.6 m from the surface.

All pylons were colonised by barnacles, possibly *Balanus amphitrite* (striped barnacle), which occurs abundantly as a fouling animal (on pylons, rock and mangroves) higher up in estuaries, from 0 to 2 m depth.

Barnacle abundance increased substantially in saline water underneath the freshwater lens, decreases in density at around 1.5 m and disappearing completely at 2.0 to 2.1 m (refer Figures 4 & 5).



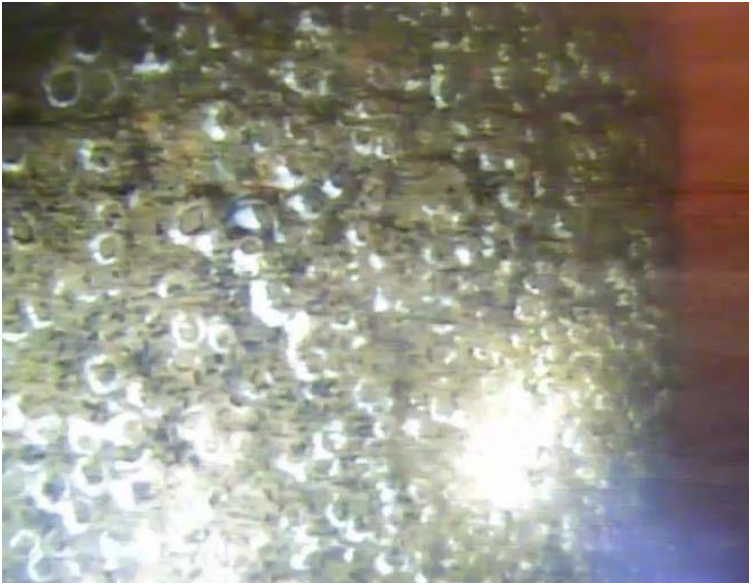
	Pylon 6 - surface
	Pylon 6 - freshwater lens <1.0 m (poor visibility)
	Pylon 6 - 1.0-2.0 m (under freshwater lens, improved visibility)

Figure 4. Pylon no. 6 photographic plates






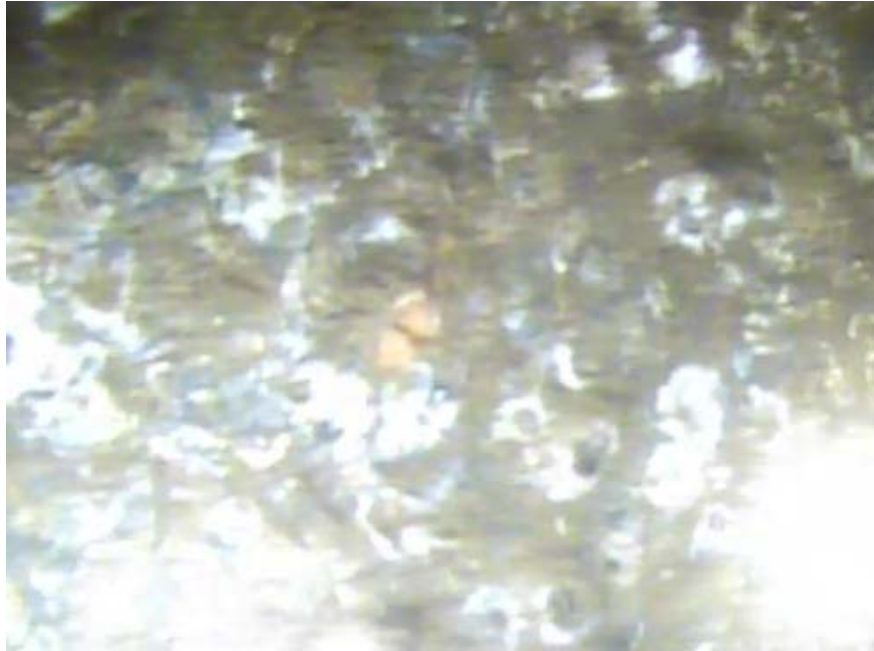
	<p>Pylon 3 - surface</p>
	<p>Pylon 3 - 1.0-1.5 m</p>
	<p>Pylon 3 - 1.5-2.0 m</p>

Figure 5. Pylon no. 3 photographic plates

What appeared to be a small ascidian possibly *Stolonica australis* (little orange ascidian) was observed on Pylon 3 (refer Figure 6). No other sessile or motile invertebrates /fauna were found utilising the pylons as habitat.



Pylon 3 - 1.5-2.0 m

Possible ascidian (small orange sponge like tubes in centre)

Figure 6. Pylon no. 3 photographic plate




The turpentine / timber remnant pylons are located upstream of the existing road bridge on both sides of the river (four pylons on the south bank and three on the north bank).

Each pylon has been encased by a steel ring infilled with concrete. Aside from opportunistic plant growth on top of these remnant pylons, only barnacle growth on the casings were evident. See photographic plates below in Figure 7.



North bank



	<p>North bank</p>
	<p>South bank (steel and concrete casing evident)</p>
	<p>South bank (Casuarina saplings colonised pylons)</p>



South bank (Casuarina saplings colonised pylons)

Figure 7. Timber pylon remnant photographic plate

### 3. Conclusion

No threatened or protected species, or habitat for threatened or protected species (listed under relevant state and national environmental legislation) were detected in the study area, nor are expected to occur in the study area.

The pylons support abundant growth of barnacles which is consistent with common fouling invertebrate species found on pylons, jetties, boats, etc. The removal/replacement of the existing road pylons is not expected to impact on habitat of any importance to recreational or commercial fish species or other aquatic fauna of significance.

No seaweed, seagrass, saltmarsh, or mangrove occurs in the vicinity and therefore approval (i.e. permit to harm marine vegetation) under the *Fisheries Management Act 1994* (FM Act) is not required.