Appendix D – Biodiversity Assessment Report

Transport
for NSW

Biodiversity Assessment Report for REF

Mandalong Road Upgrade

February 2025

NSW GOVERNMENT

Document control

Rev	Date	Prepared by	Reviewed by
First draft	8/11/2024	D Landenberger M Brighton T Lambert	T Lambert B Lean
Second draft	29/11/2024	D Landenberger M Brighton T Lambert	T Lambert B Lean
Final	10/12/2024	T Lambert	T Lambert B Lean
Final (revised)	11/12/2024	T Lambert	T Lambert B Lean
Final	07/02/2025	T Lambert	T Lambert B Lean
Final report	26/02/2025	P Karmacharya T Lambert	T Lambert B Lean

Table of contents

Table of contents (continued)

Tables

Tables (continued)

Figures

Appendices

Executive summary

Introduction

Transport for NSW (Transport) proposes to provide upgrades to Mandalong Road between Gimberts Road and Ourimbah Street (the proposal). The proposal is located around 44 kilometres (km) south-west of Newcastle in the suburb of Morisset, within the Lake Macquarie Local government Area (LGA).

Mandalong Road is a critical link within the B53 Morisset to Wallsend transport corridor that connects the Morisset town centre and surrounding urban areas to the M1 Pacific Motorway. A key aim of the proposal is to improve traffic flow and road safety for all road users through increasing the capacity of Mandalong Road and provision of active and public transport improvements, which would support future economic and residential growth in the surrounding area.

Subject to planning approval, construction of the proposal is expected to commence in 2026 and take around 20 months to complete.

This Biodiversity Assessment Report (BAR) has been prepared to assess the potential biodiversity impacts of the proposal. It will support a Review of Environmental Factors (REF) being prepared by Transport under Division 5.1 of the *Environmental Planning and Assessment Act 1979 (*EP&A Act).

Native vegetation

Plant Community Types

Four Plant Community Types (PCTs) have been identified within the biodiversity study area through field verification of the NSW State Vegetation Type Map, including:

- PCT 3583: Hunter Coast Lowland Scribbly Gum Forest
- PCT 3998: Lower North Creekflat Mahogany Swamp Forest
- PCT 4020: Coastal Creekflat Layered Grass-Sedge Swamp Forest
- PCT 4042: Lower North Riverflat Eucalypt Paperbark Forest.

Four miscellaneous ecosystems were also identified within the biodiversity study area; Planted Native Trees, Planted Exotic Trees, Exotic Grassland and Regrowth Native Shrubs.

Threatened ecological communities

Native vegetation within the biodiversity study area is considered to meet the final determination of two endangered ecological communities listed under the *Biodiversity Conservation Act 2016* (BC Act) including:

- Swamp Sclerophyll Forest on Coastal floodplains 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.

One endangered ecological community meets the criteria for listing on *the Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), being:

- Coastal Swamp Sclerophyll Forest of NSW and South East Queensland.

Threatened species

Two threatened flora species were recorded within the biodiversity study area during field surveys being:

- *Angophora inopina* (Charmhaven Apple) listed as vulnerable under the BC Act and EPBC Act
- *Tetratheca juncea* (Black-eyed Susan), listed as vulnerable under the BC Act and EPBC Act.

A further seven threatened flora species are associated with PCTs that have been predicted to occur within the study area, including:

- *Acacia bynoeana* (Bynoe's Wattle)
- *Caladenia tessellata* (Thick-lipped Spider-orchid)
- *Cryptostylis hunteriana* (Leafless Tongue Orchid)
- *Diuris praecox* (Rough Doubletail)
- *Genoplesium insigne* (Variable Midge Orchid)
- *Grevillea parviflora* subsp*. parviflora (*Small-flower Grevillea)
- *Rutidosis heterogama* (Heath Wrinklewort).

These other predicted threatened flora species were not recorded during targeted surveys.

Eleven threatened fauna species were recorded within the biodiversity study area as follows:

- Little Lorikeet (*Glossopsitta pusilla*)
- Powerful Owl (*Ninox strenua*)
- Varied Sitella (*Daphoenositta chrysoptera*)
- Little Eagle (*Hieraaetus morphnoides*)
- Little Bent-winged Bat (*Miniopterus australis*)
- Large Bent-winged Bat (*Miniopterus orianae oceanensis*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*)
- Southern Myotis (*Myotis macropus*)
- Eastern Cave Bat (*Vespadelus troughtoni*)
- Grey-headed Flying Fox (*Pteropus poliocephalus*).

Of these species, all are listed as threatened under the BC Act, with the Grey-headed Flying Fox also being listed as threatened under the EPBC Act.

An additional 11 threatened fauna species have been assessed as having a moderate or higher likelihood of occurrence within the biodiversity study area. These species include:

- Dusky Woodswallow (*Artamus cyanopterus cyanopterus*)
- Gang-gang Cockatoo (*Callocephalon fimbriatum*)
- South-eastern Glossy Black Cockatoo (*Calyptorhynchus lathami lathami*)
- Masked Owl (*Tyto novaehollandiae*)
- Sooty Owl (*Tyto tenebricosa*)
- Swift Parrot (*Lathamus discolor*)

- Regent Honeyeater (*Anthochaera phrygia*)
- Squirrel Glider (*Petaurus norfolcensis*)
- Koala (*Phascolarctos cinereus*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*).

These species were not recorded during targeted surveys, although Mapped Important Habitat occurs within the subject land (the proposal area) for Swift Parrot.

Assessments of significance have been completed for all species that have been recorded or that have a moderate or higher likelihood of occurrence.

Impact assessment

The key impact on biodiversity associated with the proposal would involve the direct removal of up to 0.98 ha of native vegetation and associated habitats. Of this, 0.27 ha consists of regrowth or planted native vegetation. Most of the moderate to good condition vegetation present has been modified to some degree due to past or current land uses.

Assessments of impact significance were conducted for all threatened species and ecological communities considered likely to be affected by the proposal. These impact assessments determined that the proposal is unlikely to lead to a significant impact on threatened species, populations, ecological communities or their habitats. Further, with the implementation of the recommended mitigation measures proposed it is unlikely that residual impact of the proposal would result in a significant impact to biodiversity within the locality.

Given the proposal is not considered likely to lead to a significant impact on threatened species, populations, ecological communities or their habitats, a Species Impact Statement or Biodiversity Development Assessment Report is not required under the BC Act to support this proposal. In respect to Matters of National Environmental Significance including threatened flora, fauna and communities, a referral of this proposal for consideration as a controlled action under the EPBC Act is not required.

Impact avoidance and minimisation

As part of the detailed design phase Transport will consider further avoidance and minimisation options to minimise impacts on biodiversity. These options will include the incorporation of wildlife connectivity measures to minimise impacts on wildlife in accordance with the best practise guidelines outlined in the *Draft Wildlife Connectivity Guidelines for Road Projects* (NSW Roads and Maritime Services, 2012) or equivalent updated NSW Guidelines.

This includes special consideration of Squirrel Glider connectivity across Dora Street from the Cedar Mill event site.

Offsetting

Although efforts have been made to avoid, minimise and mitigate ecological impacts associated with the proposal, some residual impacts would occur. Given the residual impacts associated with the proposal, Transport would be required to provide the following values:

- Biodiversity offsets and/or conservation measures: for impacts on terrestrial biodiversity values that exceed the offset thresholds, Transport would be required to provide offsets in accordance with their *No Net Loss Guidelines* (Transport for NSW, 2022c). No offsets are required under this policy as the relevant thresholds were not exceeded and therefore a Biodiversity Offset Strategy is not required.
- Tree and hollow replacement: All trees within the subject land are required to be offset under the *Tree and Hollow Replacement Guidelines* (Transport for NSW, 2022d). A Tree and Hollow Replacement Plan is required to determine the proposal's tree and hollow replacement requirements or an equivalent payment to the Transport Conservation Fund.

1. Introduction

1.1 Proposal background

Transport for NSW (Transport) is committed to improving connectivity across New South Wales (NSW), with a focus on integrated transport solutions within the Greater Cities Commission's Six Cities Region, as outlined in the Future Transport Strategy (Transport for NSW, 2022). The Six Cities Region consists of the Eastern Harbour City, Central River City, Western Parkland City, Lower Hunter and Greater Newcastle City, Central Coast City, and Illawarra-Shoalhaven City. Of these, the Hunter Region, including Newcastle and Lake Macquarie, is the fastest growing region in NSW outside of Sydney. The current Hunter regional population is expected to increase by 13 percent to 863,000 people by 2041. Consistent with this broader regional growth, the population of the Lake Macquarie Local Government Area (LGA) is expected to grow to 232,000 people by 2041.

Within the Lake Macquarie LGA, Morisset has been identified by the NSW Government as a regionally significant growth area. Over the next twenty years, Morisset is expected to emerge as an important mixed-use centre supporting regional economic growth, as well as opportunities for intensive multi-storey commercial, mixed use and residential development.

In 2019 Transport prepared the *Morisset to Wallsend Corridor Plan* that provided an investigation of the current performance of Mandalong Road/Dora Street and identified future challenges to the NSW Government's vision for the Morisset area. The section of Mandalong Road/Dora Street between the M1 Pacific Highway and Ourimbah Street (refer to Figure 1-1) was identified as having current congestion issues that are likely to be exacerbated by predicted growth in the area without intervention. In particular, the intersection (roundabout) of Mandalong Road/Freemans Drive/Dora Street/Wyee Road was found to be a critical pinch point, both in the immediate area and the broader B53 Morisset to Wallsend Corridor. A failure to address the local congestion issues has the potential to undermine local growth rates and introduce additional travel costs for regional customers.

1.2 The proposal

Transport proposes to provide upgrades to Mandalong Road between Gimberts Road and Ourimbah Street (the proposal). The proposal is located within the suburb of Morisset in the Lake Macquarie local government area (LGA).

Mandalong Road is a critical link within the B53 Morisset to Wallsend transport corridor, that connects the Morisset town centre and surrounding urban areas to the M1 Pacific Motorway. A key aim of the proposal is to improve traffic flow and road safety for all road users through increasing the capacity of Mandalong Road and provision of active and public transport improvements, which would support future economic and residential growth in the surrounding area.

The location of the proposal is shown in Figure 1-1.

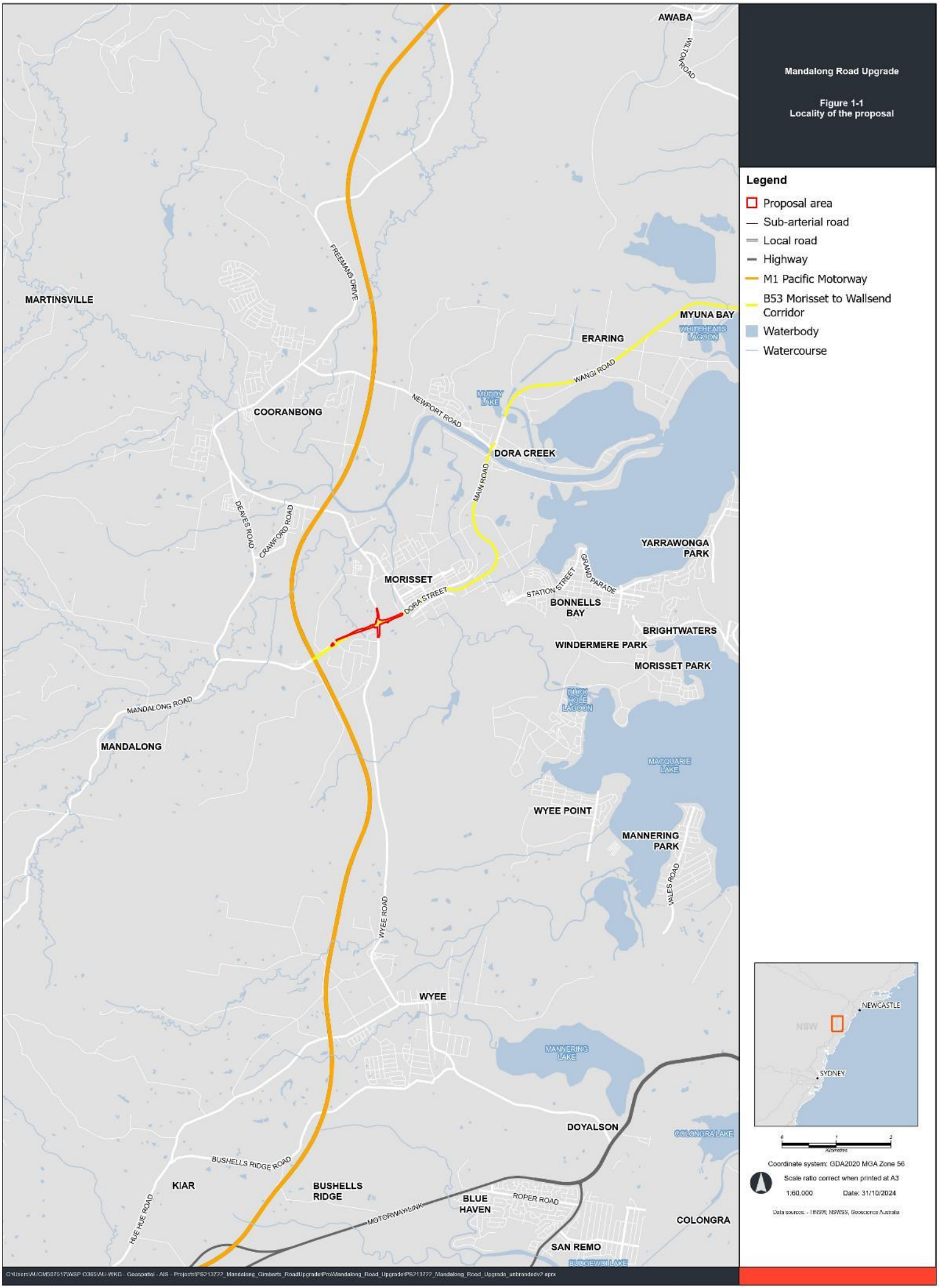
Key features of the proposal include:

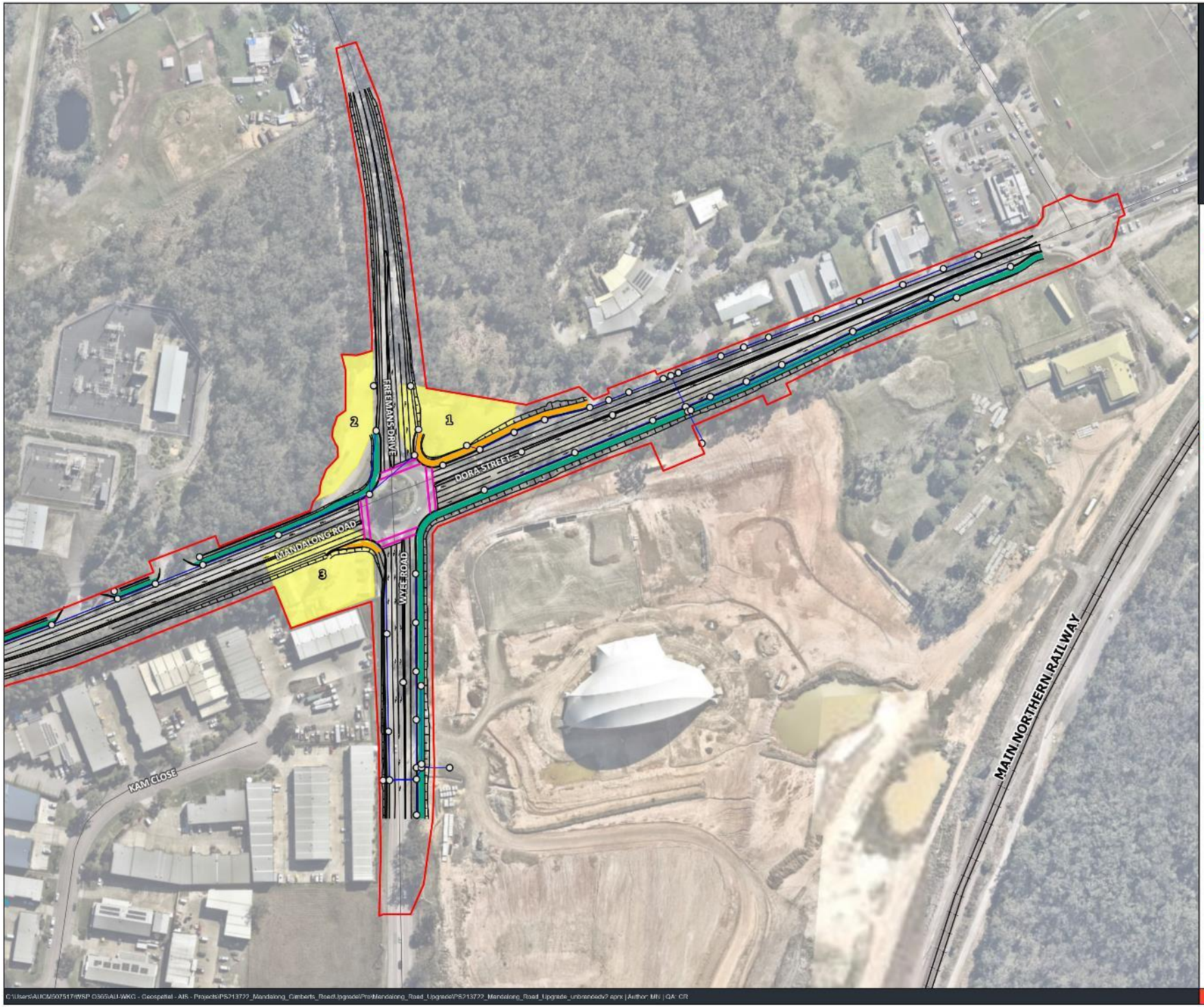
- upgrading the Mandalong Road/Freemans Drive/Dora Street/Wyee Road intersection, including:
  - replacing the existing roundabout with new traffic lights
  - providing additional through and turning lanes on all approaches of the intersection
  - providing a central raised median on all approaches of the intersection
- providing active transport connections, including:
  - a shared user path along the length of the proposal on Mandalong Road and Dora Street
  - a shared user path on the eastern side of Wyee Road
  - a footpath on the north-eastern corner of Dora Street and Freemans Drive
- providing two new bus stop facilities on Dora Street
- installing and/or relocating fauna connectivity structures, such as glider poles
- full and partial property acquisitions, leases and adjustments, including relocating and adjusting property access and private utility connections

- ancillary work for the proposal, including, but not limited to, vegetation clearing, earthworks, landscaping and tie-in works
- relocating and/or adjusting existing public utilities, including electrical, gas, water, sewer and telecommunications
- roadworks, including pavement, line marking, lighting and road furniture (e.g. signs and safety barriers)
- upgrading drainage infrastructure, including culverts, pits, pipes, kerbs and gutters
- temporary ancillary facilities, including site compounds, material storage and laydown areas.

Around 0.98 hectares (ha) of native vegetation would be removed during construction of the proposal.

The key features of the proposal are shown in Figure 1-2 and described in detail in Chapter 3 of the REF. Subject to planning approval, construction is expected to commence in 2026 and take around 20 months to complete.


AWABA
WALTON ROAD
FREEMANS DRIVE
MARTINSVILLE
MYUNA BAY
WHITEHEADS LAGOON
ERARING
WANGI ROAD
MUDDY LAKE
NEWPORT ROAD
COORANBONG
DORA CREEK
MAIN ROAD
DEANES ROAD
CRAWFORD ROAD
YARRAWONGA PARK
GRAND PARADE
STATION STREET
MORISSET
DORA STREET
BONNELLS BAY
BRIGHTWATERS
WINDERMERE PARK
MORISSET PARK
DUCK HOLE LAGOON
MANDALONG ROAD
MANDALONG
MACQUARIE LAKE
WYEE POINT
MANNERING PARK
VALES ROAD
WYEE ROAD
WYEE
MANNERING LAKE
DOYALSON
COLONGRA LAKE
BUSHELLS RIDGE ROAD
KIAR
BUSHELLS RIDGE
HUE HUE ROAD
MOTORWAY/LINK
BLUE HAVEN
ROPER ROAD
COLONGRA
SAN REMO
BUDGEWOI LAKE
Mandalong Road Upgrade
Figure 1-1
Locality of the proposal
Legend
Proposal area
Sub-arterial road
Local road
Highway
M1 Pacific Motorway
B53 Morisset to Wallsend Corridor
Waterbody
Watercourse
NEWCASTLE
NSW
SYDNEY
Kilometres
Coordinate system: GDA2020 MGA Zone 56
Scale ratio correct when printed at A3
1:60,000
Date: 31/10/2024
Data sources: - LINSW, NSWSS, Geoscience Australia
C:\Users\AU\CM5875173\WSP O365\AU-WKG - Geospatial - AIS - Projects\P5213722_Mandalong_Gimberts_RoadUpgrade\Pro\Mandalong_Road_Upgrade\P5213722_Mandalong_Road_Upgrade_unbranded.v2.aprx



Mandalong Road Upgrade

Figure 1-2
Proposal Design

Legend

- Proposal area
- Ancillary facility
- Road
- Railway
- Watercourse

Road design

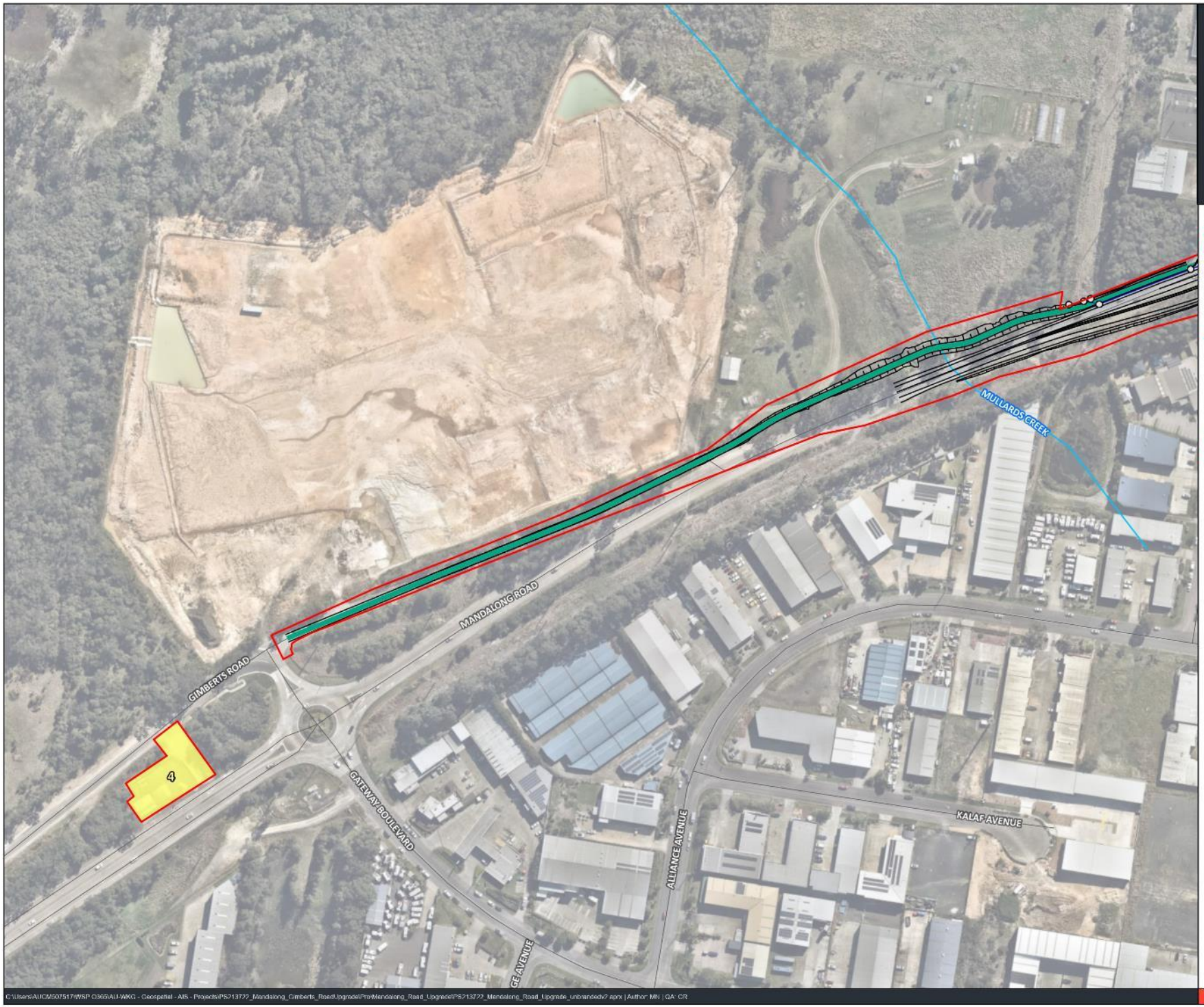
- Drainage pit
- Road alignment
- Pedestrian crossing
- Drainage pipe
- Footpath
- Shared user path

Coordinate system: GDA2020 MGA Zone 56
Scale ratio correct when printed at A3

1:2,250 Date: 31/10/2024

GDA 2020

Data sources: WSP, Nearmap, NSWSS



Mandalong Road Upgrade

Figure 1-2
Proposal Design

Legend

- Proposal area
- Ancillary facility
- Road
- Railway
- Watercourse

Road design

- Drainage pit
- Road alignment
- Drainage pipe
- Shared user path

Coordinate system: GDA2020 MGA Zone 56
Scale ratio correct when printed at A3

1:2,250 Date: 31/10/2024

GDA 2020

Data sources: WSP, Nearmap, NSWSS

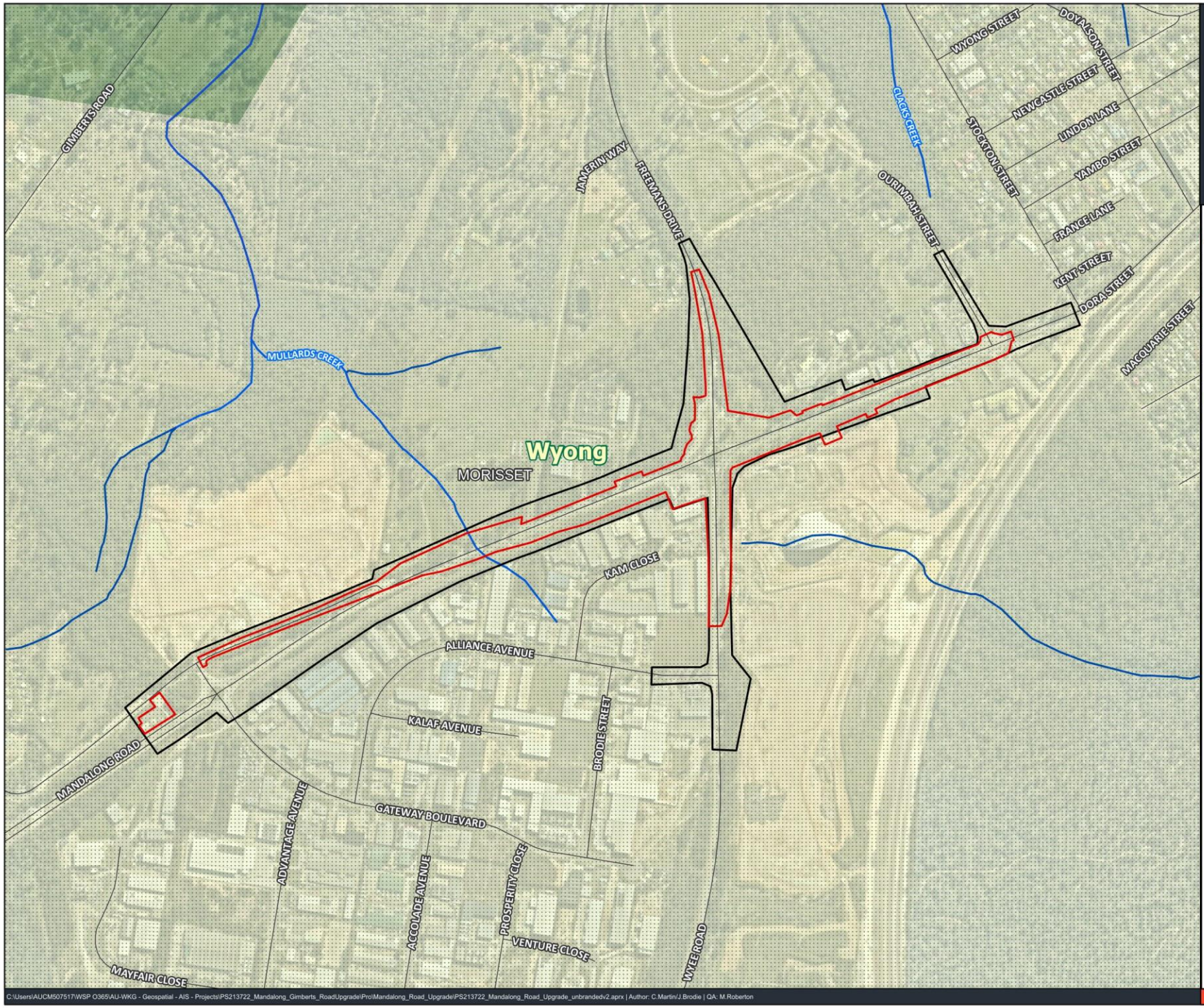
1.3 Assessment areas

The proposal is located around 44 kilometres (km) south-west of Newcastle in the suburb of Morisset, within the Lake Macquarie LGA. Land within the study area is primarily privately owned, with the exception of land zoned RE1 Public Recreation under the Lake Macquarie Local Environmental Plan 2014 (LEP), located on the southern side of Mandalong Road between the Mandalong Road/Gimberts Road intersection and Mandalong Road/Wyee Road intersection, and within and directly adjacent to 143 Dora Street, Morisset (Lot 122 DP881828).

The biodiversity context for the proposal is shown in Figure 1-3.

The following areas are discussed throughout this Biodiversity Assessment Report (BAR) and are defined as:

- Proposal: proposed upgrade of Mandalong Road/Dora Street between Gimberts Road and Ourimbah Street.
- Subject land: refers to the area that would be directly impacted by the proposal. This comprises the construction area of the proposal and any other areas that would be temporarily disturbed, including ancillary facilities. This is equivalent to the proposal area that is referred to in other project documents, including the REF.
- Biodiversity study area: includes the subject land and adjoining areas surveyed as part of the biodiversity assessment.
- Locality: the 10 km radius surrounding the biodiversity study area used for database searches.



Mandalong Road Upgrade

Figure 1.3
Proposal context

Legend

- Subject Land (Proposal area)
- Biodiversity study area
- Road
- Watercourse

Strahler stream order

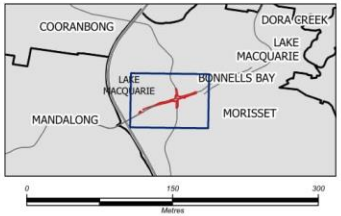
- 1
- 2
- 3

IBRA subregion

- Wyong

Mitchell landscapes

- Gosford - Cooranbong Coastal Slopes
- Sydney - Newcastle Coastal Alluvial Plains



Coordinate system: GDA2020 MGA Zone 56
Scale ratio correct when printed at A3

1:5,500

Date: 26/11/2024

GDA 2020

Data sources: Geoscience Australia, Nearmap, NSWSS, NSW Government

1.4 Legislative context

A Review of Environmental Factors (REF) is prepared to satisfy Transport's responsibilities under Section 5.5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to 'examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity' and Section 5.5 in making decisions on the likely significance of any environmental impacts. This BAR forms part of the REF being prepared for the Mandalong Road upgrade and assesses the biodiversity impacts of the project to meet the requirements of the EP&A Act.

The *Biodiversity Conservation Act 2016* (BC Act) requires that the significance of the impact on threatened species, populations and Threatened Ecological Communities (TECs) is assessed using the test listed in Section 7.3 of the BC Act. Where a significant impact is likely to occur, a Species Impact Statement (SIS) must be prepared in accordance with the requirements of the Environment Agency Head, or a Biodiversity Development Assessment Report (BDAR) must be prepared by an accredited assessor in accordance with the Biodiversity Assessment Method (BAM) (DPIE, 2020a).

In September 2015, a 'strategic assessment' approval was granted by the Federal Minister in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The approval applies to Transport's road activities being assessed under Division 5.1 (formerly Part 5) of the EP&A Act with respect to potential impacts on nationally listed threatened species, ecological communities and migratory species.

As a result, Transport's road projects assessed via an REF:

- must address and consider potential impacts on EPBC Act listed threatened species, populations, ecological communities and migratory species, including application of the 'avoid, minimise, mitigate and offset' hierarchy
- do not require referral to the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) for these matters, even if the activity is likely to have a significant impact
- must use the BAM to calculate credits that would offset significant impacts on EPBC Act listed threatened species, populations, ecological communities and migratory species.

Assessments of impact significance are required for all relevant biodiversity values in accordance with the *Matters of National Environmental Significance: Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999* (DoE, 2013).

2. Methods

The following sections document the methods used in this assessment. The methods described in Section 2.3 and Section 2.4 follow the requirements of Stage 1 of the BAM (DPIE, 2020a).

2.1 Personnel

Contributors to the preparation of this report, their qualifications and roles are summarised in Table 2-1.

Table 2-1 Personnel

Name	Role	Qualifications
Toby Lambert	NSW Ecology Team Lead – Project Manager and Technical Review	Bachelor of Environmental Science; Accredited BAM Assessor (BAAS17046)
Deborah Landenberger	Principal Ecologist – Field survey and report preparation	Bachelor of Science (Hons), Accredited BAM Assessor (BAAS18187)
Allan Richardson	Associate Ecologist – Field survey and report preparation	Bachelor of Environmental Science (Hons)
Madeleine Brighton	Ecologist – Field survey and report preparation	Bachelor of Science (Environmental Biology) (Hons)
Gavin Shelley	Ecologist – field survey	Bachelor of Environmental Science and Management
Sebastian Miller	Ecologist – field survey	Bachelor of Mar. Science (Marine Biology)
Caroline Martin	Graduate GIS Consultant - Map preparation and data analysis	Bachelor of Science
Amanda Lo Cascio	Ecologist – bat call analysis	Bachelor of Science (Zoology), Master of Environment (Conservation)

2.2 Background research

Background research is required to collect and review information on the presence or likelihood of occurrence of:

- threatened terrestrial and aquatic species and their habitat
- threatened ecological communities
- important habitat for migratory species
- areas of outstanding biodiversity value.

The following public databases and information sources were reviewed:

- Recent and relevant surveys and investigations completed in the immediate area and broader locality including:
  - Morisset Event Space Biodiversity Development Assessment Report (Kleinfelder, 2022)
- BioNet Atlas of NSW Wildlife and Threatened Biodiversity Data Collection (TBDC), searched 29 July 2024 (DCCEEW, 2024)
- BioNet Vegetation Classification database (NSW DCCEEW, 2024)
- Flora Online (PlantNet) (The Royal Botanic Gardens and Domain Trust, 2024)
- Commonwealth Protected Matters Search Tool (PMST), searched 29 July 2024 (Commonwealth DCCEEW, 2024)

- NSW Department of Primary Industries (DPI) Fisheries Spatial Data Portal (DPI, 2024)
- Sharing and Enabling Environmental Data in NSW (SEED) Portal (State Vegetation Type Map) (NSW DCCEEW, 2024)
- Commonwealth Atlas of Groundwater Dependent Ecosystems (GDE) (Bureau of Meteorology (BOM), 2024)
- National Flying-fox monitoring viewer (Commonwealth DCCEEW, 2024)
- NSW Planning Portal ePlanning Spatial Viewer (Coastal Wetlands) (NSW DCCEEW, 2024)
- NSW Areas of Outstanding Biodiversity Value Register, searched 3 September 2024 (NSW DCCEEW, 2024)
- Australian Government Critical Habitat Register, searched 3 September 2024 (Commonwealth DCCEEW, 2024)
- NSW Weedwise (DPI 2024).

2.3 Vegetation assessment

Vegetation survey and assessment, including field verification of background research, was completed in accordance with Chapter 4 of the BAM (DIPE, 2020a). Floristic diversity and likely presence of threatened species was assessed using a combination of survey techniques, including vegetation integrity (VI) plots, rapid data assessments, parallel line transects and two-phase grid-based systematic surveys in accordance with the relevant guidelines.

2.3.1 Vegetation mapping

Vegetation within the biodiversity study area has been previously mapped at the regional scale by the NSW State Vegetation Type Map (SVTM) (NSW DCCEEW, 2024) and Lake Macquarie LGA Vegetation Community Map 2022 – Version 2. Preliminary field survey was completed on 6 and 8 August 2024, with further targeted field survey completed and 2 and 3 October 2024 to verify and amend/correct the existing mapping by confirming the dominant canopy species, native diversity and underlying geology of the biodiversity study area. This was based on vegetation integrity plots, rapid data assessments and random meanders.

The information collected during the survey was used to determine the Plant Community Type (PCT) for each vegetation type recorded, as detailed in the BioNet Vegetation Classification System (NSW DCCEEW, 2024), and whether vegetation within the biodiversity study area aligned to any state or commonwealth listed TECs. This was achieved by identifying native vegetation to formation, class and type and its corresponding TEC (where applicable). Other characteristics such as floristic composition, soil type, landform, underlying geology and other descriptive attributes were collected where available and assessed against BioNet Vegetation Classification Database PCT profiles.

2.3.2 Vegetation survey and classification

Vegetation condition

Vegetation within the biodiversity study area was assigned to a PCT and then aligned to a vegetation zone, defined in the BAM (DPIE 2020a) as '*an area of native vegetation on the subject land (subject land) that is the same PCT and has a similar broad condition state'*. A broad condition state infers that the vegetation has a similar tree cover, shrub cover, ground cover, weediness or combinations of these attributes that determine vegetation condition. The broad conditions were used to stratify each PCT into vegetation zones.

The broad condition states that have been applied to vegetation within the subject land are summarised in Table 2-2. These were defined by using factors such as levels of disturbance, weed invasion and resilience.

Table 2-2 Vegetation broad condition states

Broad condition state	Description
Good	• Native vegetation where all tree, shrub, grass and/or forb structural growth form groups expected for a PCT are present • This condition type displays resilience to weed invasion • Weeds may exist in this vegetation type but generally exhibit < 30 per cent (%) foliage cover.
Moderate	• Vegetation where one or more structural understorey components may be either entirely removed or modified • Vegetation has generally retained a native canopy but the understorey and/or groundcover layers are either co-dominated by exotic species or have been structurally modified due to previous and current land use practices • Weed cover throughout this condition type was variable however typically < 50% cover.
Low	• Vegetation that has changed to an alternative stable state because of land management practices since European settlement • Over-storey structural components have either entirely been removed or are severely reduced resulting in derived communities occurring as either derived native grasslands with varying levels of regrowth • Exotic weed cover is variable however generally > 30% with < 50% of ground cover consisting of species listed within the BioNet Vegetation Classification PCT profile.

Importantly, vegetation in low condition must be separated from higher condition areas when determining vegetation zones and subsequently whether offsets are required in accordance with the *'No Net Loss Guidelines'* (Transport, 2022). Where vegetation integrity scores have been calculated, these can be used to identify low condition vegetation i.e. vegetation that is not in moderate to good condition, and therefore does not require offsetting. In accordance with Section 9.2.1 of the BAM (DPIE, 2020a), the following is considered consistent with the classification of low condition vegetation:

- VI < 15, where the PCT is representative of an Endangered Ecological Community (EEC) or a Critically Endangered Ecological Community (CEEC)
- VI < 17, where the PCT is associated with threatened species habitat (as represented by ecosystem credits) or represents a vulnerable ecological community
- VI < 20, where the PCT does not represent a TEC and is not associated with threatened species habitat.

Moderate to good condition vegetation is any vegetation zones with VI scores above these thresholds.

Plot-based vegetation survey

In accordance with Section 4.3.4 of the BAM (DPIE, 2020a), ten VI plots have been completed across the vegetation zones recorded throughout the biodiversity study area. The VI plots included a full floristic survey within a 20 metre(m) x 20 m quadrat, with function data collected using and 20 m x 50 m plot.

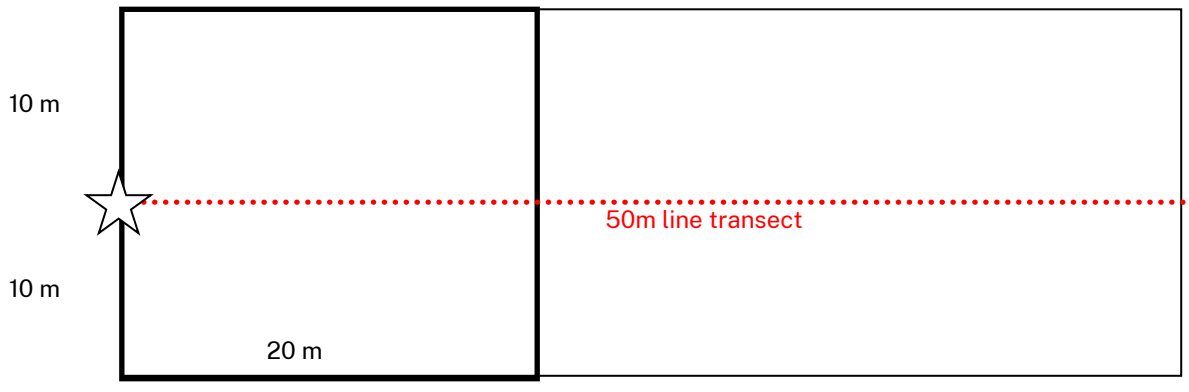


Figure 2-1 Transect/plot design

The following site attributes were recorded at each VI plot location:

- GPS location.
- Vegetation structure, dominant species and vegetation condition: vegetation structure was recorded through estimates of percentage foliage cover, average height and height range for each vegetation layer.
- Native and exotic species richness (400 square metre (m^2) quadrat): this involved recording all species by systematically walking through each 20 m x 20 m plot. The cover and abundance (percentage of area of quadrat covered) of each species was estimated. The growth form, stratum/layer and whether each species was native/exotic/high threat weed was also recorded.
- Number of trees with hollows (1000 m^2 quadrat): the frequency of hollow-bearing trees (living and dead) within each 50 m x 20 m plot. A hollow was only recorded if (a) the entrance could be seen: (b) the estimated entrance width was at least 5 centimetres (cm) across: (c) the hollow appeared to have depth: (d) the hollow was at least one m above the ground and (e) the centre of the tree was located within the sampled quadrat.
- Number of large trees and stem size diversity (1000 m^2 quadrat): tree stem size diversity was calculated by measuring the diameter at breast height (DBH) (i.e. 1.3 m from the ground) of all living trees (greater than 5 cm DBH) within each 50 m x 20 m plot. For multi-stemmed living trees, only the largest stem was included in the count. Number of large trees was determined by comparing living tree stem DBH against the PCTs benchmarks.
- Total length of fallen logs (1000 m^2 quadrat): cumulative total of logs within each 50 m x 20 m plot with a diameter of at least 10 cm and a length of at least 0.5 m.
- Litter cover: involved estimating the average percentage groundcover of litter (i.e. leaves, seeds, twigs, branchlets and branches with a diameter less than 10 cm that is detached from a living plant) from within five 1 m x 1 m sub-plots spaced evenly either side of the 50 m central transect.
- Evaluation of regeneration: estimated as the presence/absence of canopy species within the site that were regenerating (i.e. saplings with a DBH less than or equal to 5 cm).

The number of plots completed for each identified vegetation zone is provided in Table 2-3 and the location of each VI plot is shown in Figure 2-2.

Table 2-3 Minimum number of plots required and completed per vegetation zone

Vegetation zone	PCT	Condition	Area (ha)	No. plots required	No. plots completed
1	PCT 3583: Hunter Coast Lowland Scribbly Gum Forest	Good	0.36	1	2
2		Regrowth	0.02	1	1
3	PCT 3998: Lower North Creekflat Mahogany Swamp Forest	Good	0.01	1	1
4		Moderate	0.23	1	1
5		Planted native vegetation	0.25	1	1
6	PCT 4020: Coastal Creekflat Layered Grass-Sedge Swamp Forest	Good	0.03	1	2
7	PCT 4042: Lower North Riverflat Eucalypt-Paperbark Forest	Moderate	0.08	1	1

2.3.3 Patch size

In accordance with Section 4.3.2 of the BAM, a patch is an area of native vegetation that occurs within the subject land (subject land) and includes native vegetation that has a gap of less than 100 m from the next area of native vegetation, or 30 m for non-woody ecosystems. The patch size for each vegetation zone has been assessed and assigned to one of four classes (<5 ha, 5–<25 ha, 25–<100 ha, >100 ha).

2.3.4 Native vegetation cover

All vegetation within the subject land was mapped and categorised into native vegetation PCT or native regrowth, native planting or exotic vegetation where a PCT could not be assigned to the vegetation present. The native vegetation cover was determined in accordance with Section 3.2 of the BAM whereby GIS software was used to calculate the total areas of native vegetation cover within the subject land. Table 2-4 details the native vegetation cover in the landscape assessment area, which was calculated to fall within the >30–70% class.

Table 2-4 Native vegetation cover in the assessment area

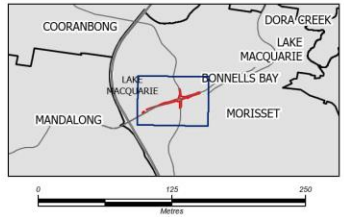
Assessment area (ha)	1.41
Total area of native vegetation cover (ha)	0.93
Percentage of native vegetation cover (%)	66%
Class (0-10, >10-30, >30-70 or >70%)	>30–70%

Mandalong Road Upgrade

Figure 2-2
Vegetation plot-based survey locations

Legend

- Subject Land (Proposal area)
- Biodiversity study area
- Road
- Watercourse
- Vegetation integrity plot



Coordinate system: GDA2020 MGA Zone 56
Scale ratio correct when printed at A3

1:5,000 Date: 26/11/2024

GDA 2020

Data sources: Geoscience Australia, Nearmap, NSWSS

2.4 Threatened species assessment

Threatened species assessments included both database searches, background research and habitat suitability surveys to inform the habitat suitability assessment. The habitat suitability assessments were completed to identify threatened species with a moderate or higher likelihood of occurring within the biodiversity study area, and therefore would require targeted surveys to be completed in accordance with the '*Biodiversity Assessment Guidelines*' (Transport, 2022).

Targeted surveys were completed for all threatened species credit species or dual credit species (if required) with a moderate or higher likelihood of occurrence.

2.4.1 Habitat suitability assessment

A habitat suitability assessment was completed to assess the likelihood of occurrence of each threatened species, population and community identified as having potential to occur within the biodiversity study area. All threatened species identified during background research were considered. The habitat assessment was utilised to inform the identification of appropriate targeted surveys and was updated during and after field surveys were completed based on the habitat components identified in the biodiversity study area.

Habitat assessment was based on the habitat profiles for each species and other habitat information in the TBDC (NSW DCCEEW, 2024). The assessment also considered the dates and locations of nearby records and information about species populations in the locality. The likelihood of occurrence of threatened and migratory species and populations was determined based on the habitat suitability criteria identified in Appendix B.

The habitat suitability assessment results are summarised in Section 3.4 and are provided in Appendix B.

2.4.2 Weather conditions

Weather conditions can affect activity (and therefore detectability) of some species. If adverse weather conditions occur during field surveys, the validity of survey techniques are affected and can impact the probability of detecting a species if present within the biodiversity study area.

During the field survey program weather conditions were variable with low to high temperatures and winds recorded, specifically the highest winds in August was recorded on 28 August 2024 during field survey (north-west(NW)/56 kilometres per hour (km/h)). Generally low amounts of rainfall were received during the survey program; however, the highest amount of rainfall in August 2024 was recorded on 6 August 2024 (10.8 millimetres (mm)). A summary of the field survey weather conditions experienced is provided in Table 2-5.

Table 2-5 Field survey dates and weather conditions

Date	Minimum temperature (degrees Celsius(°C))	Maximum temperate (°C)	Wind direction/ speed (km/hr)	Rain (mm)
6 August 2024	7.3	18.9	WSW / 15	10.8
8 August 2024	3.5	20.2	N / 22	0
27 August 2024	4.2	25.1	N / 22	0
28 August 2024	9.2	29.4	NW / 56	5.4
29 August 2024	8.3	24.4	WNW / 24	0
30 August 2024	8.5	28.9	NNW / 48	0
30 September 2024	14.3	21.4	SSE / 30	6.6
1 October 2024	7.8	22.2	ESE / 24	0.8
2 October 2024	11.1	20.0	ESE / 22	0.8
3 October 2024	12.1	21.0	ESE / 26	0.8
4 October 2024	6.0	24.2	E / 22	0
11 October 2024	10.4	24.9	ESE / 19	0
18 November 2024	19.1	26.1	E / 6	16

2.4.3 Targeted flora surveys

Targeted threatened flora surveys were carried out on a seasonal basis and in accordance with the survey guidelines for threatened flora species that have a moderate or higher likelihood of occurring in the biodiversity study area, based on the habitat suitability assessment criteria (refer to Appendix B). Targeted surveys were completed using a combination of reference checks, parallel line transects, random meanders and BAM VI plots as appropriate and relevant. If identified, the location and extent of the threatened flora species was recorded to obtain a count of individuals, prepare a map of species distribution and to inform the development of a species polygon for the species in accordance with BAM. Two-phase grid surveys were not required due to the relatively small size of the study area and detailed survey coverage was provided by the methods used.

A summary of different survey methods employed is described in the following sections. The threatened species surveys are summarised in Table 2-6. The location of the targeted surveys completed in August, September and November is shown in Figure 2-3, Figure 2-4 and Figure 2-5. Note that the targeted surveys occurred within the areas that were approved for access and which contained suitable habitat for the target species.

Vegetation integrity plots

VI plot surveys were carried out in accordance with the BAM (DPIE, 2020). At each survey location, dedicated 20 minute searches were also conducted for threatened species assessed as having a moderate or high likelihood of occurrence within each vegetation type sampled. The number of plots completed for each identified vegetation zone is provided in Table 2-3.

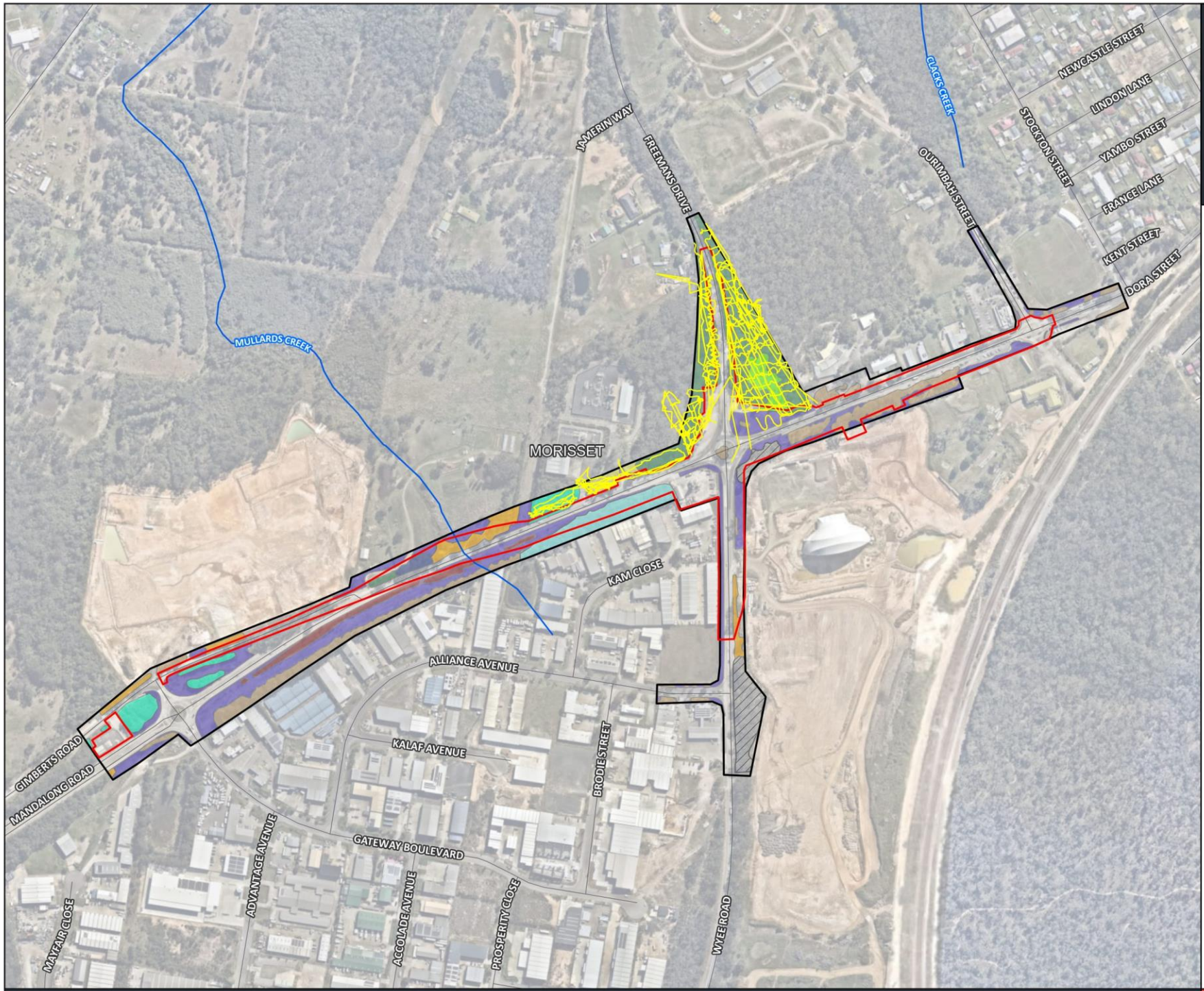
Random meander

Random meander surveys are a variation of the transect type survey and were completed in accordance with the technique described by Cropper (1993), whereby the recorder walks in a random meander throughout the subject land recording dominant and key plant species (e.g. threatened species, priority weeds), boundaries between various vegetation communities and condition of vegetation. The time spent in each vegetation community was generally proportional to the size of the community and its species richness.

Random meander surveys were conducted as the first step in locating candidate threatened species and populations within an area of broadly suitable habitat. If a threatened flora species was recorded, parallel transects were then conducted to determine the size and extent of the population.

Parallel line transects

For small areas of suitable habitat, parallel line transects were used to systematically search for candidate threatened flora species. This involved two ecologists searching along parallel transects (variable in width depending on target species and vegetation density) across the specific areas of habitat. This methodology is consistent with the '*Surveying threatened plants and their habitats*' guideline (DPIE, 2020).



Mandalong Road Upgrade

Figure 2-3
August Targeted Threatened Flora Surveys

Legend

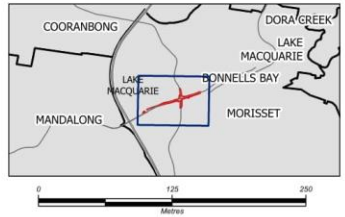
- Subject Land (Proposal area)
- Biodiversity study area
- Road
- August 2024 survey transects

Miscellaneous ecosystems

- Exotic grassland
- Miscellaneous ecosystem: regrowth native shrubs
- Planted exotic trees
- Planted native trees

Plant community types

- Vegetation Zone 1,PCT 3583: Hunter Coast Lowland Scribbly Gum Forest, Good condition
- Vegetation Zone 1,PCT 3583: Hunter Coast Lowland Scribbly Gum Forest, Not ground truthed
- Vegetation Zone 2, PCT 3583: Hunter Coast Lowland Scribbly Gum Forest, Regrowth condition
- Vegetation Zone 3, PCT 3998: Lower North Creek Flat Mahogany Swamp Forest, Good condition
- Vegetation Zone 4, PCT 3998: Lower North Creek Flat Mahogany Swamp Forest, Moderate condition
- Vegetation Zone 5, PCT 3998: Lower North Creek Flat Mahogany Swamp Forest, Planted native vegetation
- Vegetation Zone 6,PCT 4042: Lower North Riverflat Eucalypt Paperbark Forest, Moderate condition
- Vegetation Zone 7,PCT 4020: Coastal Creekflat Layered Grass Sedge Forest, Good condition

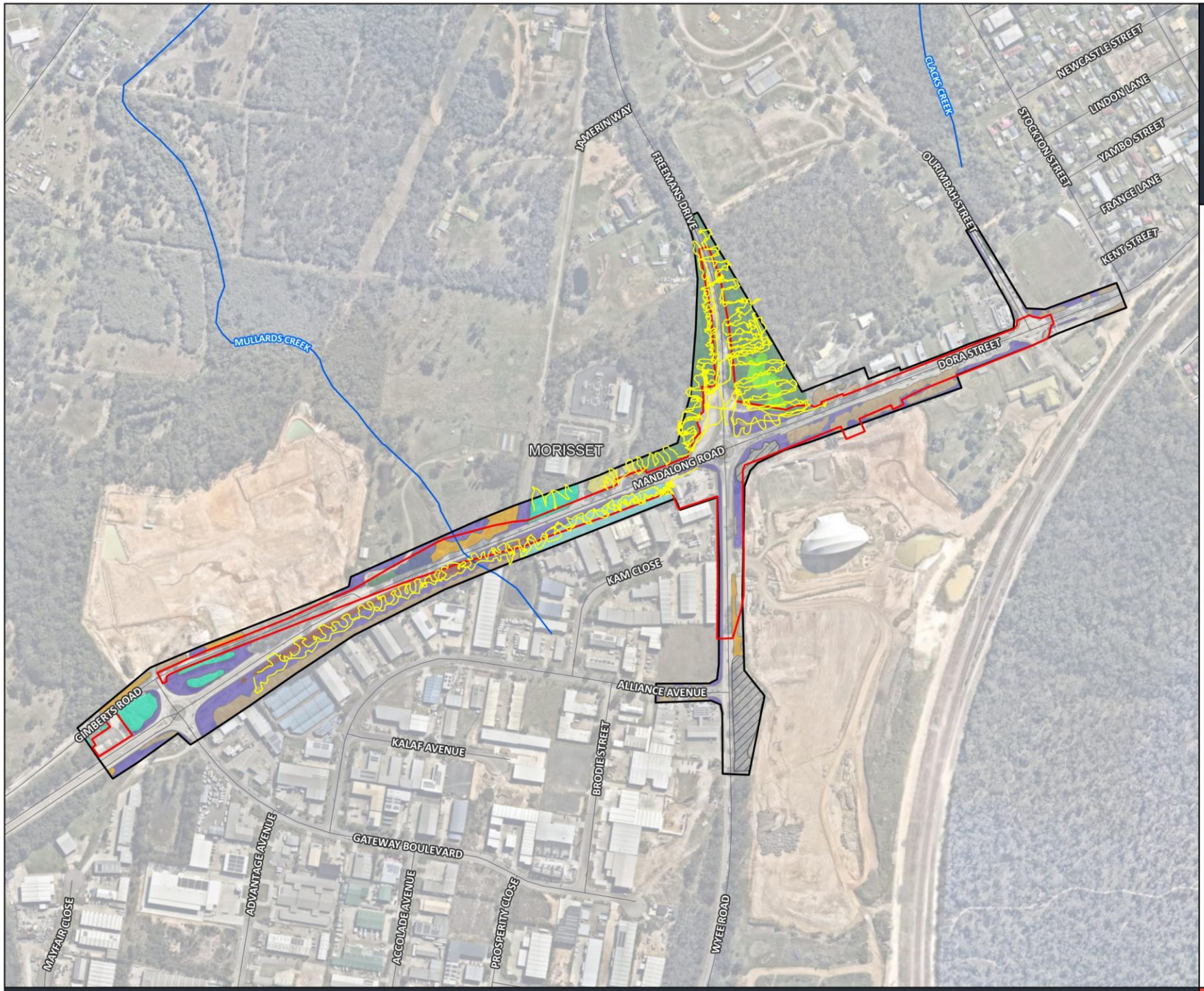


Coordinate system: GDA2020 MGA Zone 56
Scale ratio correct when printed at A3

1:5,000 Date: 26/11/2024

GDA 2020

Data sources: Geoscience Australia, Nearmap, NSWSS



Mandalong Road Upgrade

Figure 2-4
September Targeted Threatened Flora Surveys

Legend

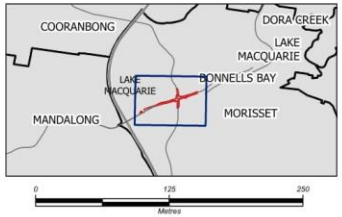
- Subject Land (Proposal area)
- Biodiversity study area
- Road
- September 2024 survey transects

Miscellaneous ecosystems

- Exotic grassland
- Miscellaneous ecosystem: regrowth native shrubs
- Planted native trees

Plant community types

- Vegetation Zone 1,PCT 3583: Hunter Coast Lowland Scribbly Gum Forest, Good condition
- Vegetation Zone 1,PCT 3583: Hunter Coast Lowland Scribbly Gum Forest, Not ground truthed
- Vegetation Zone 2, PCT 3583: Hunter Coast Lowland Scribbly Gum Forest, Regrowth condition
- Vegetation Zone 3, PCT 3998: Lower North Creek Flat Mahogany Swamp Forest, Good condition
- Vegetation Zone 4, PCT 3998: Lower North Creek Flat Mahogany Swamp Forest, Moderate condition
- Vegetation Zone 5, PCT 3998: Lower North Creek Flat Mahogany Swamp Forest, Planted native vegetation
- Vegetation Zone 6,PCT 4042: Lower North Riverflat Eucalypt Paperbark Forest, Moderate condition
- Vegetation Zone 7,PCT 4020: Coastal Creekflat Layered Grass Sedge Forest, Good condition



Coordinate system: GDA2020 MGA Zone 56

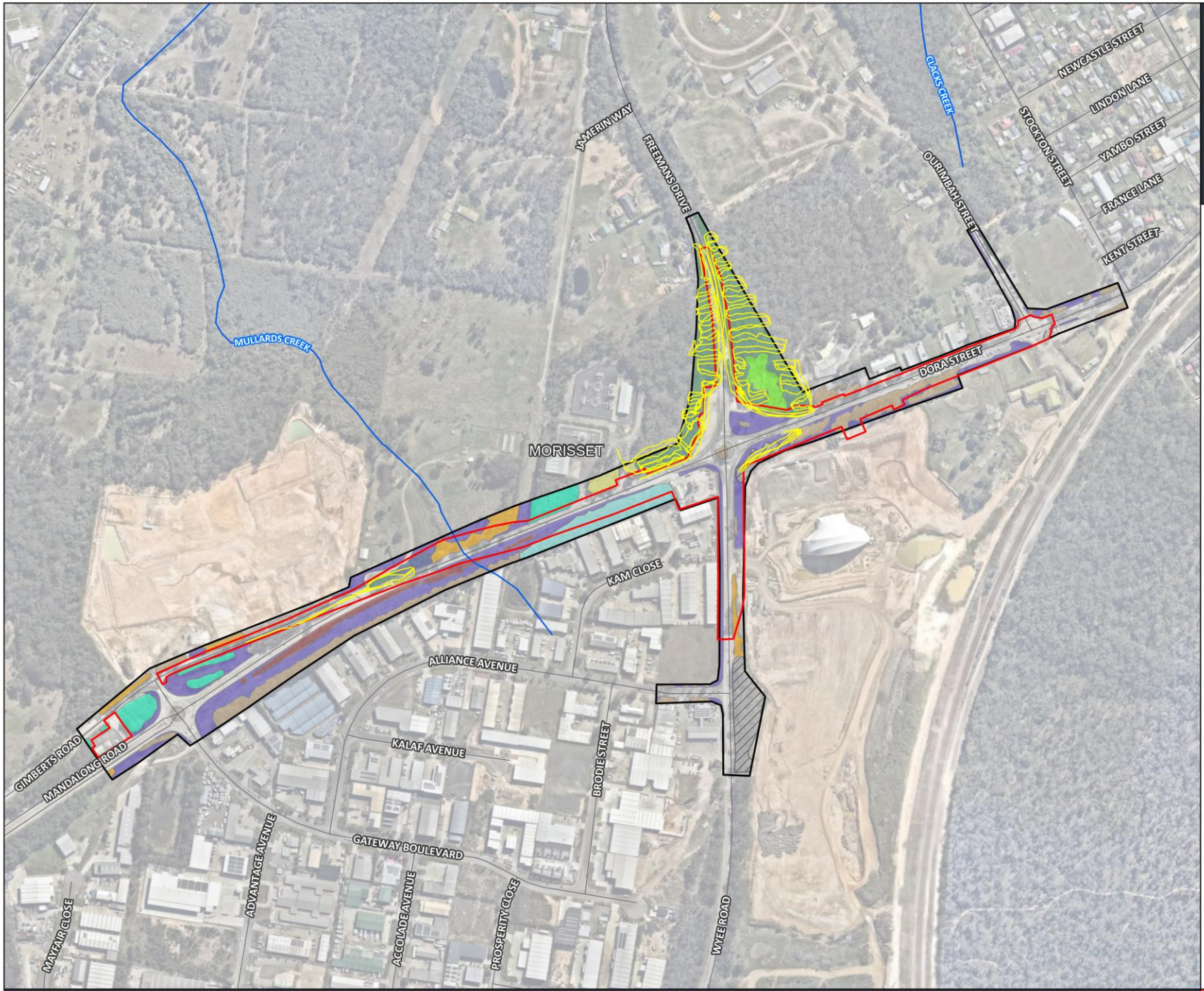
Scale ratio correct when printed at A3

1:5,000

Date: 26/11/2024

GDA 2020

Data sources: Geoscience Australia, Nearmap, NSWSS



Mandalong Road Upgrade

Figure 2-5
November Targeted Threatened Flora Surveys

Legend

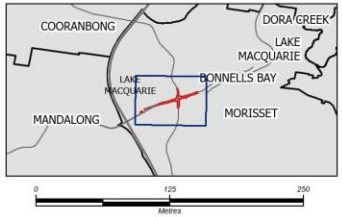
- Proposal area
- Biodiversity study area
- Road
- November 2024 survey transects

Miscellaneous ecosystems

- Exotic grassland
- Miscellaneous ecosystem: regrowth native shrubs
- Planted native trees

Plant community types

- Vegetation Zone 1,PCT 3583: Hunter Coast Lowland Scribbly Gum Forest, Good condition
- Vegetation Zone 1,PCT 3583: Hunter Coast Lowland Scribbly Gum Forest, Not ground truthed
- Vegetation Zone 2, PCT 3583: Hunter Coast Lowland Scribbly Gum Forest, Regrowth condition
- Vegetation Zone 3, PCT 3998: Lower North Creek Flat Mahogany Swamp Forest, Good condition
- Vegetation Zone 4, PCT 3998: Lower North Creek Flat Mahogany Swamp Forest, Moderate condition
- Vegetation Zone 5, PCT 3998: Lower North Creek Flat Mahogany Swamp Forest, Planted native vegetation
- Vegetation Zone 6,PCT 4042: Lower North Riverflat Eucalypt Paperbark Forest, Moderate condition
- Vegetation Zone 7,PCT 4020: Coastal Creekflat Layered Grass Sedge Forest, Good condition



Coordinate system: GDA2020 MGA Zone 56
Scale ratio correct when printed at A3

1:5,000 Date: 27/11/2024

GDA 2020

Data sources: Geoscience Australia, Nearmap, NSWSS

Table 2-6 Targeted threatened flora surveys

Species name	Common name	Required survey period (as updated October 2024 in BAM)	Associated PCTs in the subject land	Minimum survey requirements[1]	Survey completed
Acacia bynoeana	Bynoe's Wattle	All year	PCT 3583 PCT 3998 PCT 4020	Targeted surveys in accordance with guideline. Methods include BAM VI plots, parallel line transects, random meanders and opportunistic sightings.	Survey effort summary: • Random meanders and opportunistic sightings – around 40 person hours in suitable habitat • Parallel transects – around 20 person hours in suitable habitat Survey periods: • 30 September 2024 • 2 – 3 October 2024 • 11 October 2024 • Opportunistic during October fauna surveys • 18 November 2024
Angophora inopina	Charmhaven Apple	All year	PCT 3583 PCT 3998 PCT 4020 PCT 4042	Targeted surveys in accordance with guideline. Methods include BAM VI plots, parallel line transects, random meanders and opportunistic sightings.	Survey effort summary: • Random meanders and opportunistic sightings – around 40 person hours in suitable habitat • Parallel transects – around 20 person hours in suitable habitat. Survey periods: • 30 September 2024 • 2 – 3 October 2024 • 11 October 2024 • Opportunistic during October fauna surveys • 18 November 2024

Species name	Common name	Required survey period (as updated October 2024 in BAM)	Associated PCTs in the subject land	Minimum survey requirements[1]	Survey completed
Caladenia tessellata	Thick-lipped Spider-orchid	September to October	PCT 3583	Targeted surveys in accordance with guideline. Methods include BAM VI plots, parallel line transects, random meanders and opportunistic sightings.	Survey effort summary: • Random meanders and opportunistic sightings – around 40 person hours in suitable habitat • Parallel transects – around 20 person hours in suitable habitat. Survey periods: • 30 September 2024 • 2 – 3 October 2024 • 11 October 2024 • Opportunistic during October fauna surveys.
Cryptostylis hunteriana	Leafless Tongue Orchid	November - January	PCT 3583	Targeted surveys in accordance with guideline. Methods include BAM VI plots, parallel line transects, random meanders and opportunistic sightings.	Survey effort summary • Parallel transects – around 15 person hours in suitable habitat. Survey periods: • 18 November 2024
Diuris praecox	Rough Doubletail	August	PCT 3583	Targeted surveys in accordance with guideline. Methods include BAM VI plots, parallel line transects, random meanders and opportunistic sightings.	Survey effort summary: • Parallel transects – around 20 person hours in suitable habitat • Random meanders and opportunistic sightings – around 40 person hours in suitable habitat. Survey periods: • 6 and 8 August 2024 • 27 – 30 August 2024 • Opportunistic during August fauna surveys.

Species name	Common name	Required survey period (as updated October 2024 in BAM)	Associated PCTs in the subject land	Minimum survey requirements[1]	Survey completed
Genoplesium insigne	Variable Midge Orchid	September to November	PCT 3583 PCT 3998 PCT 4020 PCT 4042	Targeted surveys in accordance with guideline. Methods include BAM VI plots, parallel line transects, random meanders and opportunistic sightings.	Survey effort summary: • Random meanders and opportunistic sightings – around 40 person hours in suitable habitat • Parallel transects – around 20 person hours in suitable habitat. Survey periods: • 30 September 2024 • 2 – 3 October 2024 • 11 October 2024 • Opportunistic during October fauna surveys • 18 November 2024
Grevillea parviflora subsp. parviflora	Small Flower Grevillea	August to November	PCT 3583 PCT 3998	Targeted surveys in accordance with guideline. Methods include BAM VI plots, parallel line transects, random meanders and opportunistic sightings.	Survey effort summary: • Random meanders and opportunistic sightings – around 40 person hours in suitable habitat • Parallel transects – around 20 person hours in suitable habitat. Survey periods: • 30 September 2024 • 2 – 3 October 2024 • 11 October 2024 • Opportunistic during October fauna surveys • 18 November 2024

Species name	Common name	Required survey period (as updated October 2024 in BAM)	Associated PCTs in the subject land	Minimum survey requirements[1]	Survey completed
Rutidosis heterogama	Heath Wrinklewort	All year	PCT 3583	Targeted surveys in accordance with guideline. Methods include BAM VI plots, parallel line transects, random meanders and opportunistic sightings.	Survey effort summary: • Random meanders and opportunistic sightings – around 40 person hours in suitable habitat • Parallel transects – around 20 person hours in suitable habitat. Survey periods: • 30 September 2024 • 2 – 3 October 2024 • 11 October 2024 • Opportunistic during October fauna surveys • 18 November 2024
Tetratheca juncea	Black-eyed Susan	September to October	PCT 3583 PCT 3998	Targeted surveys in accordance with guideline. Methods include BAM VI plots, parallel line transects, random meanders and opportunistic sightings.	Survey effort summary: • Random meanders and opportunistic sightings – around 40 person hours in suitable habitat • Parallel transects – around 20 person hours in suitable habitat. Survey periods: • 30 September 2024 • 2 – 3 October 2024 • 11 October 2024 • Opportunistic during October fauna surveys.

2.4.4 Targeted fauna surveys

Targeted threatened fauna surveys were completed within the biodiversity study area between 27 and 30 August 2024 and between 1 and 3 October 2024. Targeted fauna surveys were completed for threatened species identified during the background research that were considered to have a moderate or higher likelihood of occurrence within the subject land (refer to Appendix B). Survey session seasonality was selected to target candidate species within their seasonal survey requirements and high activity periods. Generally, surveys followed the methods described in the NSW and Commonwealth threatened fauna species guidelines. If identified, the location and extent of the threatened fauna species and their habitat were recorded to inform the development of a species polygon for the species in accordance with BAM (DPIE, 2020).

Some survey techniques such as Eliott trapping and fauna cameras were not able to be undertaken due to the high exposure of the site to traffic and the general public and the high likelihood of damage or theft of equipment.

A summary of different survey methods employed is described in the following sections. The targeted threatened fauna surveys are summarised in Table 2-7 and the location of the surveys is shown in Figure 2-6.

Diurnal bird surveys

Formal 20-minute bird surveys and opportunistic sightings

Bird surveys were completed by actively walking through the nominated site over a period of 20 minutes. All birds were identified to the species level, either through direct observation or identification of calls. Bird surveys were completed during different times of the day, but generally occurred in the morning and afternoon. Birds were also recorded opportunistically during all other surveys.

Blossom nomad targeted surveys

Blossom nomads such as the Regent Honeyeater (*Anthochaera phrygia*) and Little Lorikeet (*Glossopsitta pusilla*) are dependent on the variable mosaic of blossom resources at local, regional and state scales. While the Little Lorikeet is generally locally nomadic in response to blossom resources, the Regent Honeyeater is usually only a winter visitor to coastal NSW regions for blossom. The Swift Parrot retires to Tasmania during the summer breeding period and as such only foraging habitat is likely to occur in NSW.

Opportunistic blossom surveys were undertaken within remnant vegetation in the study area for Little Lorikeet and other blossom nomad activity throughout the survey period. Any habitat and the presence of blossom and/or lerp resources were noted and identified within the biodiversity study area for the potential utilisation by threatened blossom nomads. These surveys occur in August (Winter) and October (Spring).

Predatory bird and woodland bird breeding habitat targeted survey

Predatory birds generally require tall living or dead standing trees (stags) to enable the construction of large stick nests in which they require to reproduce. There are also some woodland bird species which rely on hollow resources to reproduce. Targeted and opportunistic surveys were undertaken within remnant vegetation in the study area for the following predatory and woodland dual species credit bird species:

- Gang-gang Cockatoo (*Callocephalon fimbriatum*)
- South-eastern Glossy Black Cockatoo (*Calyptorhynchus lathami lathami*).

Other raptors such as Little Eagle (*Hieraaetus morphnoides*), Square-tailed kite (*Lophoictinia isura*), White-bellied Sea-Eagle (*Haliaeetus leucogaster*) and Eastern Osprey (*Pandion cristatus*) were also targeted during these surveys.

Specifically, these surveys involved random meanders through potential habitat in search for active or non-active nests/ hollows likely to be used by these species.

Koala Spot Assessment Technique

In addition to habitat assessments and spotlighting, the Spot Assessment Technique (SAT) was undertaken within the study area to identify the presence and/or level of Koala (*Phascolarctos cinereus*) usage within native vegetation. The SAT identifies local Koala tree species preferences by measuring the rate at which each surveyed tree is utilised by Koalas.

The SAT involves measuring activity within the immediate area surrounding a tree of any species known to have been utilised by Koalas, or otherwise considered to be of some importance for Koala conservation and/or assessment purposes. A minimum of 29 surrounding trees are sampled systematically for Koala faecal pellets for 1 metre around the base of each tree. The activity of Koala usage for each SAT is then expressed as the percentage equivalent of the proportion of the surveyed trees within each SAT. The percentage is then compared to prescribed ranges for activity levels for Koalas within NSW (Phillips and Callaghan, 2011).

A total of eleven SAT surveys were completed within the study area.

Nocturnal surveys

Nocturnal surveys were conducted in August and October 2024 and consisted of call playback and spotlighting. The methodologies of each survey technique are described below.

Spotlighting

The objective of this survey technique was to target arboreal, flying and large ground-dwelling mammals, as well as nocturnal birds, reptiles and amphibians. Spotlighting was done after dusk across suitable habitat within the biodiversity study area. Generally, two person hours of survey effort was carried out on each of the six nights on foot using two spotlights. The survey concentrated on areas that contained suitable habitat for nocturnal species, with sighted animals identified to the species level.

Stag watches

Stag watches were undertaken at dusk in areas where large hollow-bearing trees were identified within the subject land. The aim of dusk stag watches is to identify hollow dwelling fauna including owls, yangochiropteran bats and arboreal mammals that are using any hollow-bearing trees for breeding purposes. Following stag watches, spotlighting transects were undertaken near known or likely utilised hollow-bearing trees.

Call playback

Call playback was used to survey for threatened nocturnal birds and threatened arboreal and terrestrial mammals. Call playback was conducted after dusk each night, in suitable habitat within the biodiversity study area. An initial listening period of 10 minutes was completed, followed by a spotlight search for 10 minutes to detect any fauna in the immediate vicinity.

The calls of the target species were then played intermittently for five minutes followed by a 10 minute listening period. After the calls were played, another 10-20 minutes of spotlighting was carried out in the vicinity to check for animals attracted by the calls without vocalising. Calls were broadcast using a portable call playing device and amplified through a megaphone or Bluetooth speaker.

Microchiropteran bat surveys

Diurnal culvert inspections

Potential roost habitat for cave dependent microchiropteran bat species (i.e. limited to culverts) identified throughout the study area were inspected during diurnal hours to gain their potential for use by bats and therefor further surveys. None of the culverts inspected were identified as containing potential roost habitat.

Anabat surveys

Four ultrasonic Anabat detectors (Anabat Express, Titley Scientific QLD) were deployed within the biodiversity study area over four nights at four separate locations within the study area from 30 September to 4 October 2024, to record echolocation calls of microbats. Locations of the Anabat detectors are shown in Figure 2-6 and were chosen based on habitat suitability and site access. Mullards Creek culvert was considered to be an unsuitable location due to the small size of the culvert, steep embankment and close proximity to the roadside. The Anabat detectors recorded bat vocalisations across each night with the recordings starting at dusk. Bat activity is used as a substitute for abundance and is based on the number of microbat calls recorded during the survey period, including those calls assigned to a species complex (i.e. not positively attributable to an individual species).

Microbat call data was analysed by Amanda Lo Cascio, calls are analysed using Anabat Insight software (Version 1.9.1) with reference to ‘Bat calls of NSW: Region based guide to the echolocation calls of Microbats’ (Pennay et al., 2004).

While Anabat surveys were not undertaken in summer months due to time constraints, the survey period was relatively warm and the target species for summer months were still recorded.

Habitat assessments

Hollow-bearing tree survey

A hollow-bearing tree (HBT) survey was undertaken within the biodiversity study area in August 2024. The location of each HBT was recorded using a hand-held GPS. This survey was intended to assist in determining the presence of suitable breeding habitat for forest owls and other fauna dependent species to target during the winter nocturnal surveys as described in the above methodology.

Four hollow size diameter ranges were recorded during the survey to encompass a range of fauna size guilds including:

- very small hollows (<5 cm) typically suited to bats and very small arboreal mammals
- small hollows (6–15 cm) suited to bats, small arboreal mammals and small birds
- medium hollows (15–25 cm) for larger arboreal mammals and medium sized birds
- large hollows (>25 cm) suitable for large birds (i.e. cockatoos and large forest owls).

The tree location, species, diameter of the hollow, approximate height and the location of hollows and other general comments were also recorded (refer to Appendix D).

Fauna habitat assessment

Fauna habitat assessments were completed to assess the likelihood of threatened fauna species (those species known or predicted to occur within the locality from the background research) occurring within the subject land. Fauna habitat assessments were the primary assessment tool in assessing whether threatened species are likely to occur within the subject land if they are not observed during field surveys. Fauna habitat characteristics assessed included:

- structure and floristics of the canopy, understorey and groundcover, including the presence of flowering and fruiting trees representing potential foraging resources
- presence of HBT offering potential roosting and breeding habitat for arboreal mammals, birds and herptiles
- presence of groundcover vegetation, leaf litter, rock outcrops and fallen timber increasing niche opportunity for ground-dwelling mammals, birds and herptiles.

Condition of fauna habitat

The following criteria were used to evaluate the condition of habitat values:

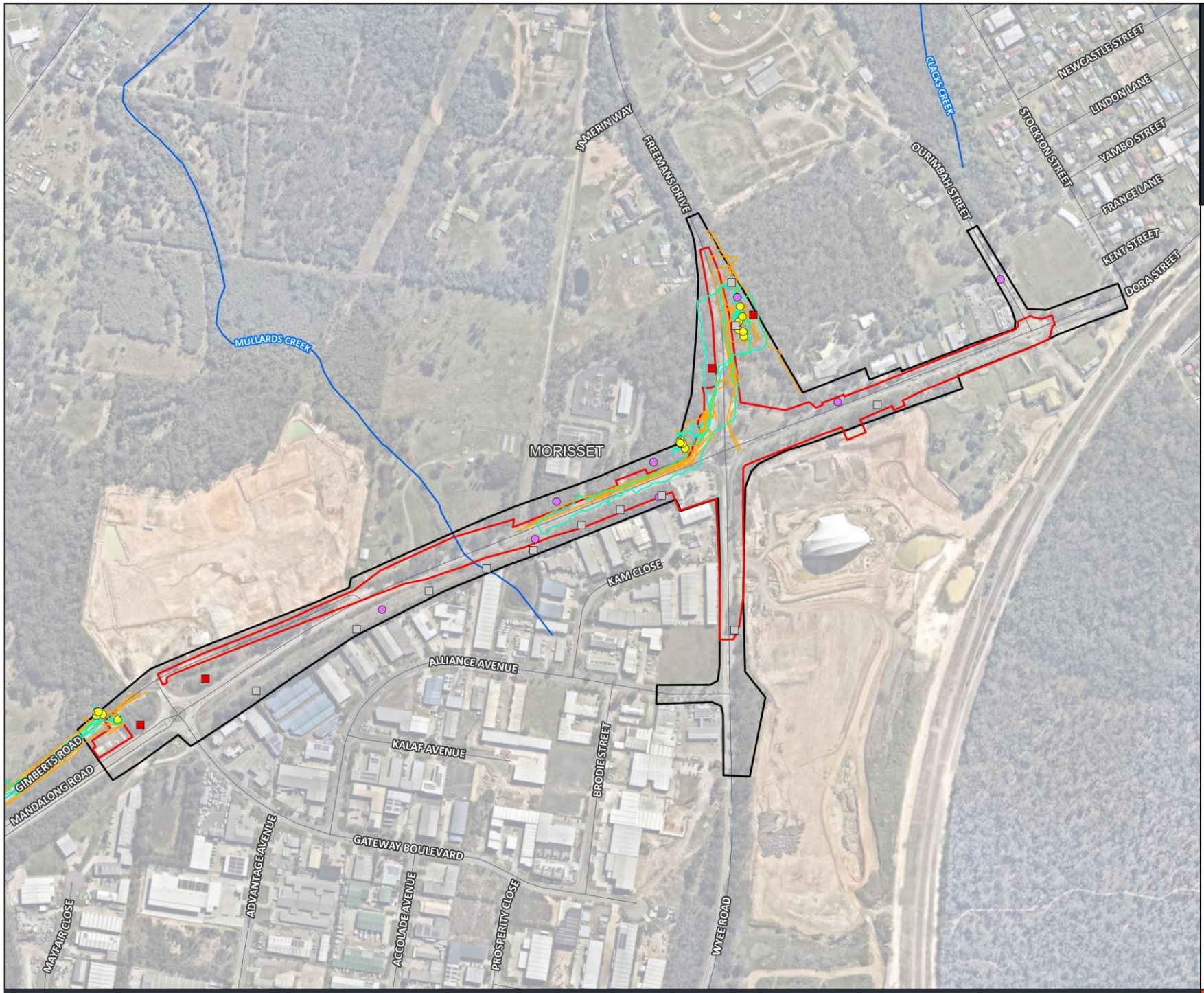
- **Good**: A full range of fauna habitat components are usually present (for example, old growth trees, fallen timber, feeding and roosting resources) and habitat linkages to other remnant ecosystems in the landscape are intact.
- **Moderate**: Some fauna habitat components are missing or greatly reduced (for example, old-growth trees and fallen timber), although linkages with other remnant habitats in the landscape are usually intact, but sometimes degraded.
- **Poor**: Many fauna habitat elements in low quality remnants have been lost, including old growth trees (for example, due to past timber harvesting or land clearing) and fallen timber, and tree canopies are often highly fragmented. Habitat linkages with other remnant ecosystems in the landscape have usually been severely compromised by extensive clearing in the past.

Opportunistic sightings

Opportunistic sightings of fauna were recorded during field surveys. Evidence of animal activity such as scats, diggings, scratch marks, nests/dreys, burrows etc. was also noted, to provide indirect information on animal presence and activity.

This provided indirect information on animal presence and activity. During these surveys, a hand-held GPS was used to record the locations of:

- hollow-bearing trees
- culverts
- drainage/irrigation lines
- aquatic habitats
- rock outcrops.



Mandalong Road Upgrade

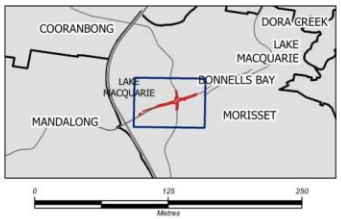
Figure 2.6
Threatened fauna species survey locations and spotlighting transects

Legend

- Subject Land (Proposal area)
- Biodiversity study area
- Road
- Watercourse

Survey location

- Call playback survey
- Diurnal bird survey
- Anabat survey
- Koala SAT survey
- August spotlighting tracks
- October spotlighting transects



Coordinate system: GDA2020 MGA Zone 56
Scale ratio correct when printed at A3

1:5,000 Date: 28/11/2024

GDA 2020

Data sources: Geoscience Australia, Nearmap, NSWSS

Table 2-7 Targeted threatened fauna surveys

Species name	Common name	Required survey period (as updated October 2024 in BAM)	Associated PCTs in the subject land	Minimum survey requirements	Survey completed
Birds					
Anthochaera phrygia	Regent Honeyeater	No required survey period for this species. Survey requirements are determined by the Important Habitat Mapping	PCT 3583 PCT 3998 PCT 4020 PCT 4042	Winter survey utilising point surveys and area searches throughout the biodiversity study area to identify presence and/or suitable habitat.	Survey effort summary: • 7 x 20 minute diurnal bird surveys • Opportunistic sightings – 8 days. Survey periods: • 27 – 30 August 2024 • 1 – 4 October 2024.
Artamus cyanopterus cyanopterus	Dusky Woodswallow	All year	PCT 3583 PCT 3998 PCT 4020 PCT 4042	Winter survey utilising point surveys and area searches throughout the biodiversity study area to identify presence and/or suitable habitat.	Survey effort summary: • 7 x 20 minute diurnal bird surveys • Opportunistic sightings – 8 days. Survey periods: • 27 – 30 August 2024 • 1 – 4 October 2024.
Callocephalon fimbriatum	Gang-gang Cockatoo	October to January	PCT 3583 PCT 3998 PCT 4020 PCT 4042	Spring survey utilising point surveys and area searches throughout the biodiversity study area to identify presence and/or suitable habitat.	Survey effort summary: • 7 x 20 minute diurnal bird surveys • Opportunistic sightings – 8 days including hollow surveys. Survey periods: • 27 – 30 August 2024 • 1 – 4 October 2024.

Species name	Common name	Required survey period (as updated October 2024 in BAM)	Associated PCTs in the subject land	Minimum survey requirements	Survey completed
Calyptorhynchus lathami lathami	South-eastern Glossy Black Cockatoo	April - August	PCT 3583 PCT 3998 PCT 4020 PCT 4042	Winter survey utilising point surveys and area searches throughout the biodiversity study area to identify presence and/or suitable habitat.	Survey effort summary: • 7 x 20 minute diurnal bird surveys • Opportunistic sightings – 8 days including hollow surveys. Survey periods: • 27 – 30 August 2024 • 1 – 4 October 2024.
Daphoenositta chrysoptera	Varied Sitella	All year	PCT 3583 PCT 3998 PCT 4020 PCT 4042	Winter and spring survey utilising point surveys and area searches throughout the biodiversity study area to identify presence and/or suitable habitat.	Survey effort summary: • 7 x 20 minute diurnal bird surveys • Opportunistic sightings – 8 days. Survey periods: • 27 – 30 August 2024 • 1 – 4 October 2024.
Glossopsitta pusilla	Little Lorikeet	All year	PCT 3583 PCT 3998 PCT 4020 PCT 4042	Winter and spring survey utilising point surveys and area searches throughout the biodiversity study area to identify presence and/or suitable habitat.	Survey effort summary: • 7 x 20 minute diurnal bird surveys • Opportunistic sightings – 8 days. Survey periods: • 27 – 30 August 2024 • 1 – 4 October 2024.
Hieraaetus morphnoides	Little Eagle	August - October	PCT 3583 PCT 3998 PCT 4042	Winter and spring survey utilising point surveys and area searches throughout the biodiversity study area to identify presence and/or suitable habitat.	Survey effort summary: • 7 x 20 minute diurnal bird surveys • Opportunistic sightings – 8 days. Survey periods: • 27 – 30 August 2024 • 1 – 4 October 2024.

Species name	Common name	Required survey period (as updated October 2024 in BAM)	Associated PCTs in the subject land	Minimum survey requirements	Survey completed
Lathamus discolor	Swift Parrot	No required survey period for this species. Survey requirements are determined by the Important Habitat Mapping	PCT 3583 PCT 3998 PCT 4020 PCT 4042	Winter survey utilising point surveys and area searches throughout the biodiversity study area to identify presence and/or suitable habitat.	Survey effort summary: • 7 x 20 minute diurnal bird surveys • Opportunistic sightings – 8 days. Survey periods: • 27 – 30 August 2024 • 1 – 4 October 2024.
Ninox strenua	Powerful Owl	All year	PCT 3583 PCT 3998 PCT 4020 PCT 4042	Winter survey utilising point surveys and area searches throughout the biodiversity study area to identify presence and/or suitable habitat.	Survey effort summary: • Nocturnal call playback – 6 nights • Spotlighting – 6 nights • Opportunistic sightings – 6 nights. Survey periods: • 27 – 30 August 2024 • 1 – 4 October 2024.
Tyto novaehollandiae	Masked Owl	All year	PCT 3583 PCT 3998 PCT 4020 PCT 4042	Winter survey utilising point surveys and area searches throughout the biodiversity study area to identify presence and/or suitable habitat.	Survey effort summary: • Nocturnal call playback – 6 nights • Spotlighting – 6 nights • Opportunistic sightings – 6 nights. Survey periods: • 27 – 30 August 2024 • 1 – 4 October 2024.

Species name	Common name	Required survey period (as updated October 2024 in BAM)	Associated PCTs in the subject land	Minimum survey requirements	Survey completed
Tyto tenebricosa	Sooty Owl	All year	PCT 4020 PCT 4042	Winter survey utilising point surveys and area searches throughout the biodiversity study area to identify presence and/or suitable habitat.	Survey effort summary: • Nocturnal call playback – 6 nights • Spotlighting – 6 nights • Opportunistic sightings – 6 nights. Survey periods: • 27 – 30 August 2024 • 1 – 4 October 2024.
Mammals					
Chalinolobus dwyeri	Large-eared Pied Bat	November to January	PCT 3583 PCT 3998 PCT 4020 PCT 4042	Anabat survey utilising point surveys and area searches throughout the biodiversity study area to identify presence and/or suitable habitat. If potential breeding habitat identified, then targeted harp-trapping.	Survey effort summary: • Anabat acoustic wildlife recorders – 4 nights x 4 Anabats. No harp-trapping was required, as no potential breeding habitat was identified. • Whilst the Anabat survey was technically outside of the BAM survey period this species has no breeding habitat on site and as such from a species credit perspective no further surveys are required. Survey periods: • 30 September – 4 October 2024.
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	November to January	PCT 3583 PCT 3998 PCT 4020 PCT 4042	Anabat survey utilising point surveys and area searches throughout the biodiversity study area to identify presence and/or suitable habitat. If potential breeding habitat identified, then targeted harp-trapping.	Survey effort summary: • Anabat acoustic wildlife recorders – 4 nights x 4 Anabats. No harp-trapping was required, as no potential breeding habitat was identified. • Whilst the Anabat survey was technically outside of the BAM survey period this species was still recorded and no further surveys are required. Survey periods: • 30 September – 4 October 2024.

Species name	Common name	Required survey period (as updated October 2024 in BAM)	Associated PCTs in the subject land	Minimum survey requirements	Survey completed
Miniopterus australis	Little Bent-winged Bat	December to February	PCT 3583 PCT 3998 PCT 4020 PCT 4042	Anabat survey utilising point surveys and area searches throughout the biodiversity study area to identify presence and/or suitable habitat. If potential breeding habitat identified, then targeted harp-trapping.	Survey effort summary: • Anabat acoustic wildlife recorders – 4 nights x 4 Anabats. No harp-trapping was required, as no potential breeding habitat was identified. • Whilst the Anabat survey was technically outside of the BAM survey period this species was still recorded and no further surveys are required. Survey periods: • 30 September – 4 October 2024.
Miniopterus orianae oceanensis	Large Bent-winged Bat	December to February	PCT 3583 PCT 3998 PCT 4020 PCT 4042	Anabat survey utilising point surveys and area searches throughout the biodiversity study area to identify presence and/or suitable habitat. If potential breeding habitat identified, then targeted harp-trapping.	Survey effort summary: • Anabat acoustic wildlife recorders – 4 nights x 4 Anabats. No harp-trapping was required, as no potential breeding habitat was identified. • Whilst the Anabat survey was technically outside of the BAM survey period this species was still recorded and no further surveys are required. Survey periods: • 30 September – 4 October 2024.
Petaurus norfolcensis	Squirrel Glider	All year	PCT 3583 PCT 3998 PCT 4020 PCT 4042	Spring survey utilising point surveys and area searches throughout the biodiversity study area to identify presence and/or suitable habitat.	Survey effort summary: • Spotlighting – 6 nights • Opportunistic sightings – 6 nights. Survey periods: • 27 – 30 August 2024 • 1 – 4 October 2024.

Species name	Common name	Required survey period (as updated October 2024 in BAM)	Associated PCTs in the subject land	Minimum survey requirements	Survey completed
Phascolarctos cinereus	Koala	All year	PCT 3583 PCT 3998 PCT 4020 PCT 4042	Winter and spring survey utilising point surveys and area searches throughout the biodiversity study area to identify presence and/or suitable habitat.	Survey effort summary: • Nocturnal call playback – 3 nights • Spotlighting – 3 nights • Opportunistic sightings – 4 days/3 nights • 11 x Koala Spot Assessment Technique (SAT) survey. Survey periods: • 27 – 30 August 2024 • 1 – 4 October 2024.
Pteropus poliocephalus	Grey-headed Flying Fox	October to December	PCT 3583 PCT 3998 PCT 4020 PCT 4042	Spring survey utilising point surveys and area searches throughout the biodiversity study area to identify presence and/or suitable habitat. If breeding camp identified, then targeted harp-trapping.	Survey effort summary: • Spotlighting – 6 nights • Opportunistic sightings – 6 nights • No targeted harp-trapping was required, as no breeding camp was identified. Survey periods: • 27 – 30 August 2024 • 1 – 4 October 2024.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	All year	PCT 3583 PCT 4020	Anabat survey utilising point surveys and area searches throughout the biodiversity study area to identify presence and/or suitable habitat. If potential breeding habitat identified, then targeted harp-trapping.	Survey effort summary: • Anabat acoustic wildlife recorders – 4 nights x 4 Anabats. No harp-trapping was required, as no potential breeding habitat was identified. Survey periods: • 30 September – 4 October 2024.

Species name	Common name	Required survey period (as updated October 2024 in BAM)	Associated PCTs in the subject land	Minimum survey requirements	Survey completed
Scoteanax rueppellii	Greater Broad-nosed Bat	All year	PCT 3583 PCT 3998 PCT 4020 PCT 4042	Anabat survey utilising point surveys and area searches throughout the biodiversity study area to identify presence and/or suitable habitat. If potential breeding habitat identified, then targeted harp-trapping.	Survey effort summary: • Anabat acoustic wildlife recorders – 4 nights x 4 Anabats. No harp-trapping was required, as no potential breeding habitat was identified. Survey periods: • 30 September – 4 October 2024.

2.5 Aquatic surveys

The habitat value of waterways (i.e. habitat sensitivity and classification of waterways for fish passage) is characterised in accordance with the *Policy and Guidelines for fish habitat, conservation and management* (Department of Primary Industries 2013) (Fisheries NSW Policy and Guidelines).

Detailed aquatic fauna survey is warranted if a proposal crosses any Class 1 watercourse (major fish habitat) or a Class 2 watercourse (moderate fish habitat) that has been identified as having a moderate or high potential to be occupied by a threatened aquatic species of animal.

No Key Fish Habitat (KFH) is mapped within the biodiversity study area (DPI, 2024), however Mullards Creek does intersect the subject land. There is also a constructed stormwater channel that occurs under Mandalong Road and adjacent to Gimberts Road at the Gimberts Road/Mandalong Road/Gateway Boulevard roundabout.

Therefore, as a precautionary measure, an aquatic habitat assessment was completed to determine if watercourses within the study area provided potential habitat for threatened aquatic species and to determine if further targeted surveys were required. Two aquatic habitat assessments of the aquatic/riparian habitat adjacent to the stormwater channel at the Gimberts Road/Mandalong Road/Gateway Boulevard roundabout was completed to determine the classification and potential to provide potential habitat for threatened aquatic species in accordance with the Fisheries NSW Policy and Guidelines. The location of the aquatic habitat assessments is depicted in Figure 2-7 and the results are discussed in Section 3.7.

The aquatic surveys included general observations rather than detailed investigations, due to the limited aquatic habitat available in the study area being largely ephemeral and highly disturbed. No chemical analysis of water quality or macro-invertebrate surveys were conducted as part of this survey.

Information collected at each location included the following:

- ecosystem type
- dimensions of the waterway including width and depth
- aquatic and riparian habitat features
- existing infrastructure & barriers to fish movement
- observed water quality (visual only).

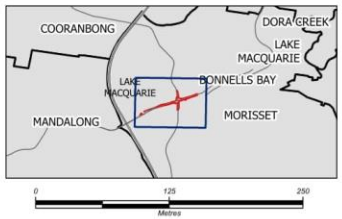
Aquatic surveys and habitat values (i.e. habitat sensitivity and classification of waterways) were characterised and conducted in accordance with the Fisheries NSW Policy and Guidelines.

Mandalong Road Upgrade

Figure 2.7
Aquatic habitat locations

Legend

- Subject Land (Proposal area)
- Biodiversity study area
- Road
- Watercourse
- Aquatic survey location



Coordinate system: GDA2020 MGA Zone 56
Scale ratio correct when printed at A3

1:5,000 Date: 28/11/2024

GDA 2020

Data sources: Geoscience Australia, Nearmap, NSWSS

3. Existing environment

This section describes the environmental context of the landscape within the subject land, including abiotic and biotic features of the landscape area. The context of the landscape assists in assessing likelihood of occurrence for threatened species and determining PCTs.

3.1 Summary of landscape features

The landscape context of the study area, including IBRA bioregions and subregions, Mitchell landscapes, catchment areas and land uses are described in Table 3-1.

Table 3-1 Summary of landscape features

Landscape feature	Subject land
IBRA bioregions and subregions	Sydney Basin bioregion/Wyong subregion
NSW landscape regions (Mitchell landscapes)	Gosford - Cooranbong Coastal Slopes
Local Government Area (LGA)	Lake Macquarie City Council
Native vegetation extent in the buffer area	Native vegetation cover has been identified as 66% within the biodiversity study area.
Cleared areas	Cleared areas are associated with infrastructure and recreation facilities within the suburb of Morisset.
Rivers and watercourses	Mullards Creek intersects the proposal site underneath Mandalong Road.
Wetlands	There are no wetlands or coastal wetlands mapped within the biodiversity study area.
Connectivity features	Native vegetation on the north-east side of the Mandalong Road/Freemans Drive/ Dora Street/Wyee Road roundabout has some broken connectivity south to a large patch of remnant native vegetation association with Pourmalong Creek, Morisset.
Areas of Geological Significance and Soil Hazard Features	There are no areas identified to have geological significance or soil hazard features.
Areas of outstanding biodiversity value	None present.
Key Fish Habitat	There is no Key Fish Habitat (KFH) mapped within the biodiversity study area.

3.2 Plant Community Types and vegetation zones

This section describes the PCTs within the study area in terms of their floristic composition, geological substrate and soils, landscape position, location and relevant regional vegetation classification.

Four PCTs have been identified within the biodiversity study area through field verification of NSW State Vegetation Mapping and other mapping products, as well as reference to other biodiversity assessments previously undertaken by others within the biodiversity study area, such as previous studies by Kleinfelder (2022) for the Cedar Mill event site. Within the Cedar Mill part of the biodiversity study area (south eastern) the native remnant vegetation was described as *PCT 1636: Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast*. The PCT classification system has since been updated and this broadly aligns with the chosen Scribbly Gum dominated vegetation *PCT 3583: Hunter Coast Lowland Scribbly Gum Forest*.

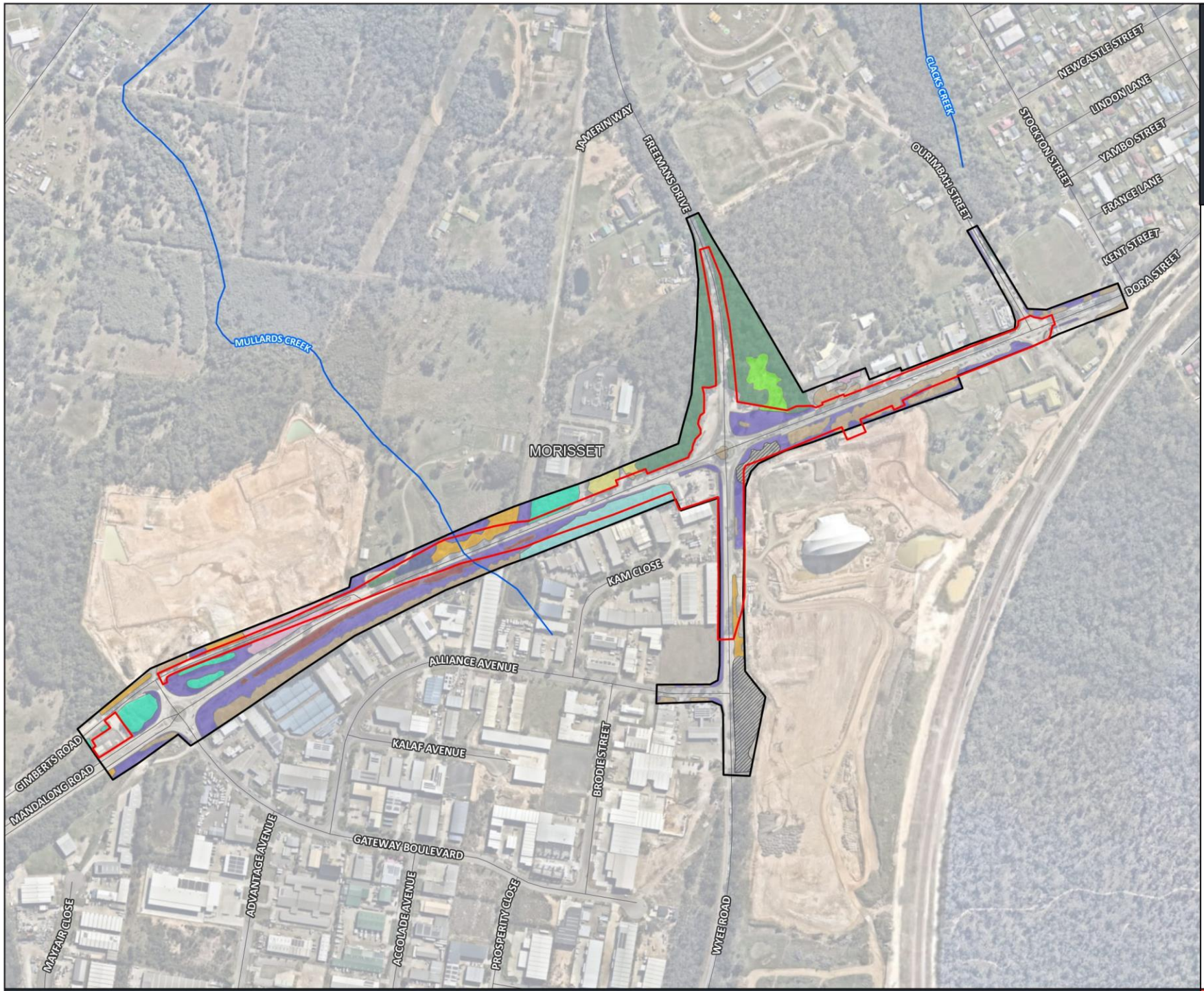
These PCTs have been stratified into four vegetation zones based on their current broad condition, management regimes, species composition and structure. Four miscellaneous ecosystems were also identified within the biodiversity study area.

A summary of the vegetation types and zones recorded within the biodiversity study area is provided in Table 3-2 and are shown in Figure 3-1. Detailed descriptions and justifications for PCT selection in the study area are also provided below.

Table 3-2 Plant community types and vegetation zones including patch size

Veg. zone	PCT	Threatened ecological community	Area (ha)		Patch size class
			Subject land	Biodiversity Study area	
Zone 1[1] Good condition	PCT 3583: Hunter Coast Lowland Scribbly Gum Forest	Not a TEC	0.36	2.46	>30-70%
Zone 2 Regrowth	PCT 3583: Hunter Coast Lowland Scribbly Gum Forest	Not a TEC	0.02	0.24	>30-70%
Zone 3 Good condition	PCT 3998 Lower North Creekflat Mahogany Swamp Forest	Endangered BC Act and EPBC Act	0.01	0.13	>30-70%
Zone 4 Moderate condition	PCT 3998 Lower North Creekflat Mahogany Swamp Forest	Endangered BC Act	0.23	0.46	>30-70%
Zone 5 Planted Native Vegetation	PCT 3998 Lower North Creekflat Mahogany Swamp Forest	Not a TEC	0.25	0.53	>30-70%
Zone 6 Moderate condition	PCT 4042 Lower North Riverflat Eucalypt Paperbark Forest	Endangered BC Act	0.08	0.08	>30-70%
Zone 7 Good Condition	PCT 4020 Coastal Creekflat Layered Grass Sedge Forest	Endangered BC Act and EPBC Act	0.03	0.51	>30-70%
N/A	Miscellaneous Ecosystem: Planted Native Trees	Not a TEC	0.41	1.31	N/A
N/A	Miscellaneous ecosystem: Regrowth Native Shrubs	Not a TEC	0.03	0.33	N/A
N/A	Miscellaneous ecosystem: Exotic Grassland	Not a TEC	1.09	2.87	N/A
N/A	Miscellaneous ecosystem: Planted Exotic Trees	Not a TEC	0.12	0.35	N/A

(1) No access was available on the corner of Mandalong Road and Wyee Road and the southern section of Wyee of PCT 3583 therefore these areas have been assumed to be in good condition.



Mandalong Road Upgrade

Figure 3-1
Plant community types and vegetation zones

Legend

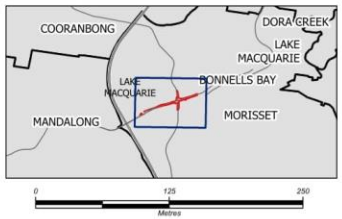
- Subject Land (Proposal area)
- Biodiversity study area
- Road
- Watercourse

Miscellaneous ecosystems

- Exotic grassland
- Regrowth native shrubs
- Planted exotic trees and shrubs
- Planted native trees

Plant community types

- Vegetation Zone 1,PCT 3583: Hunter Coast Lowland Scribbly Gum Forest, Good condition
- Vegetation Zone 1,PCT 3583: Hunter Coast Lowland Scribbly Gum Forest, Not ground truthed
- Vegetation Zone 2, PCT 3583: Hunter Coast Lowland Scribbly Gum Forest, Regrowth condition
- Vegetation Zone 3, PCT 3998: Lower North Creek Flat Mahogany Swamp Forest, Good condition
- Vegetation Zone 4, PCT 3998: Lower North Creek Flat Mahogany Swamp Forest, Moderate condition
- Vegetation Zone 5, PCT 3998: Lower North Creek Flat Mahogany Swamp Forest, Planted native vegetation
- Vegetation Zone 6,PCT 4042: Lower North Riverflat Eucalypt Paperbark Forest, Moderate condition
- Vegetation Zone 7,PCT 4020: Coastal Creekflat Layered Grass Sedge Forest, Good condition



Coordinate system: GDA2020 MGA Zone 56
Scale ratio correct when printed at A3

1:5,000 Date: 26/11/2024

GDA 2020

Data sources: Geoscience Australia, Nearmap, NSWSS

3.2.1 PCT 3583: Hunter Coast Lowland Scribbly Gum Forest

Description

A description of PCT 3583 Hunter Coast Lowland Scribbly Gum Forest recorded within the study area is provided below.

PCT ID	3583
PCT name	Hunter Coast Lowland Scribbly Gum Forest
Vegetation class	Sydney Coastal Dry Sclerophyll Forests
Vegetation formation	KF_CH5B Dry Sclerophyll Forest (Shrubby sub-formation)
Estimate of per cent cleared	64.11 %
Area in subject land	0.38 ha
Conservation status	Not a TEC
Vegetation zones (condition) and plots	Zone 1 (Good) Plot 3 and 4 Zone 2 (regrowth) Plot 9

Justification for PCT selection

The BioNet Vegetation Classification database PCT filter tool was used to identify a shortlist of candidate PCTs. Search criteria entered into the search tool were specific to the study area and vegetation being assessed including the IBRA bioregion, IBRA subregion, vegetation formation and characteristic canopy floristics. A comparison of the candidate PCTs was made against the SVTM within the locality, characteristics of vegetation identified in the study area and each PCTs profile in the BioNet Vegetation Classification database to identify the most suitable PCT.

PCT 3583 was considered the most suitable PCT for this vegetation type for the following key reasons:

- has been mapped extensively throughout the locality by the SVTM (including areas of the biodiversity study area)
- occurred in the Sydney Basin IBRA Bioregion
- contained floristic characteristic of PCT 3583, including a canopy dominated by *Eucalyptus haemastoma* (Scribbly Gum), *Eucalyptus capitellata*, *Corymbia gummifera* and *Banksia serrata*
- occurred as a mid-high to tall open forest with a dense shrub layer on sandy-clay soil.

Floristic and structural summary of PCT 3583 within the study area

Growth form	Typical species
Trees	*Eucalyptus haemastoma, Eucalyptus capitellata*, *Corymbia gummifera, Banksia serrata*
Shrubs	*Lambertia formosa, Leptospermum polygalifolium, Dillwynia retorta, Comesperma ericinum*, *Petrophile pulchella, Hakea dactyloides, Persoonia levis, Acacia suaveolens, Polyscias sambucifolia, Platysace linearifolia, Woollsia pungens, Tetratheca juncea, Banksia oblongifolia, Bossiaea scolopendria*
Grass and grass-like	*Lomandra longifolia, Imperata cylindrica, Themeda triandra, Entolasia stricta, Lomandra obliqua, Tetratheca juncea, Lepidosperma laterale, Aristida ramosa*
Forb	*Gompholobium pinnatum, Patersonia glabra, Gonocarpus tetragynus, Dianella caerula subsp. producta, Tricoryne elatior, Dampiera stricta, Cryptostylis subulata, Dichondra repens, Centella asiatica, Lobelia purpurascens, Patersonia glabrata, Cryptostylis erecta*
Fern	*Pteridium esculentum, Lindsaea microphylla, Lindsaea linearis*
Other	*Cassytha glabella, Billardiera scandens*, *Glycine microphylla*, *Xanthorrhoea latifolia, Parsonsia straminea*
Exotic	*Hypochaeris radicata, Nothoscordum borbonicum*
High threat weeds	*Lantana camara, Rubus fruticosus sp. aggregate*

Condition states

PCT 3583 was identified as being in two conditions being good and regrowth, these conditions are described below:

- Good condition areas of PCT 3583 were structurally intact, weed cover was generally low and characteristic species of the community were present throughout all stratum. The vegetation zone is located along the western and eastern side of Freemans Drive, and along a section of Mandalong Road (refer to Figure 3-1).
- Regrowth condition – this condition was a result of previously clearing and some of the canopy and shrubs species are regrowing. The groundlayer was dominated by a dense layer of *Imperata cylindrica*, with a low density of native herbs and grasses. Exotic Small-leaved privet trees were present in the canopy layer with a small number of pasture weeds.

Photo 3.1 PCT 3583 – Good condition (Plot 3)

Photo 3.2 PCT 3583 – Regrowth condition (Plot 9)

3.2.2 PCT 3998: Lower North Creek Flat Mahogany Swamp Forest

Description

A description of PCT 3998 Lower North Creekflat Mahogany Swamp Forest recorded within the study area is provided below.

PCT ID	3998
PCT name	Lower North Creekflat Mahogany Swamp Forest
Vegetation class	Coastal Swamp Forests
Vegetation formation	KF_CH9 Forested Wetlands
Estimate of per cent cleared	50.74 %
Area in subject land	0.49 ha
Conservation status	Zone 3 and 4 meet the criteria for Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions listed as Endangered on the BC Act. Zone 3 meets the criteria for Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland listed as Endangered on the EPBC Act
Vegetation zones (condition) and plots	Zone 3 Good Plot 2 Zone 4 Moderate Plot 6 Zone 5 Planted Native Vegetation Plot 5

Justification for PCT selection

The BioNet Vegetation Classification database PCT filter tool was used to identify a shortlist of candidate PCTs. Search criteria entered into the search tool were specific to the study area and vegetation being assessed including the IBRA bioregion, IBRA subregion, vegetation formation and characteristic canopy floristics. A comparison of the candidate PCTs was made against the SVTM within the locality, characteristics of vegetation identified in the study area and each PCTs profile in the BioNet Vegetation Classification database to identify the most suitable PCT.

PCT 3998 was considered the most suitable PCT for this vegetation type for the following key reasons:

- occurred in the Sydney Basin IBRA Bioregion
- contained floristic characteristic of PCT 3998, including a canopy dominated by *Eucalyptus robusta* (Swamp Mahogany) and *Allocasuarina littoralis*
- occurred as a tall open forest with a sub-canopy of Melaleuca trees on low-lying creek flats.

Floristic and structural summary of PCT 3998 within the study area

Growth form	Typical species
Trees	*Eucalyptus robusta*, *Allocasuarina littoralis, Glochidion ferdinandi*
Shrubs	*Leptospermum polygalifolium, Melaleuca ericifolia, Melaleuca sieberi, Melaleuca nodosa, Melaleuca linearifolia, Polyscias sambucifolia, Breynia oblongifolia, Dodonaea triquetra, Pittosporum undulatum*
Grass and grass-like	*Gahnia clarkei, Entolasia stricta, Lomandra longifolia, Entolasia marginata, Oplismenus aemulus, Carex inversa*
Forb	*Centella asiatica, Dianella caerulea var. producta, Lobelia purpurascens, Lobelia purpurascens, Oxalis perennans, Goodenia bellidifolia, Convolvulus erubescens, Dichondra repens*
Fern	*Pteridium esculentum, Adiantum aethiopicum*
Other	*Cassytha pubescens, Parsonsia straminea, Eustrephus latifolius, Clematis aristate, Geitonoplesium cymosum, Glycine clandestina*
Exotic	*Verbena bonaerensis, Senecio madagascariensis*
High threat weeds	*Cinnamomum camphora, Lantana camara, Rubus fruticosus sp. aggregate*

Condition states

PCT 3998 is identified as being in three condition states being good, moderate and planted, a description is provided below:

- Good condition area were structurally intact, weed cover was generally low and characteristic species of the community were present throughout all stratum. The vegetation zone is located along a section on the northern side of Mandalong Road in the Ausgrid Land (refer to Figure 3-1).
- Moderate condition – this condition was structurally intact but had a low diversity of native species in the understory and high diversity and high percentage foliage cover of exotic grasses and herbs.
- Planted native vegetation condition – this condition is composed of planted *Casuarina glauca* and *Eucalyptus robusta* trees. This patch contained a high weed density along the side of Mandalong Road. However, away from the edge effects the vegetation stratum was structurally intact with a high percentage foliage cover of native shrubs in the mid stratum. The groundlayer was a mixture of exotic grasses and herbs. The threatened flora species *Angophora inopina* (listed as vulnerable on both the BC Act and the EPBC Act was recorded along the edge of the Mandalong Road. This patch occurs on the south eastern side of Mandalong Road to the west of the intersection of Mandalong Road, Freemans Drive and Wyee Road. This patch of vegetation meets the criteria in Appendix D of the BAM and requires an assessment under the BAM.

Photo 3.3 PCT 3998 – Good condition (Plot 2)

Photo 3.4 PCT 3998 – Moderate condition (Plot 6)

Photo 3.5 PCT 3998 – Planted Native Vegetation condition (Plot 5)

Photo 3.6 PCT 3998 – Planted Native Vegetation condition (Plot 5)

3.2.3 PCT 4042: Lower North Riverflat Eucalypt Paperbark Forest

Description

A description of PCT 4042 Lower North Riverflat Eucalypt Paperbark Forest recorded within the study area is provided below.

PCT ID	4042
PCT name	Lower North Riverflat Eucalypt Paperbark Forest
Vegetation class	Coastal Floodplain Wetlands
Vegetation formation	KF_CH9 Forested Wetlands
Estimate of percent cleared	73.11 %
Area in subject land	0.08 ha
Conservation status	River Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (Endangered – BC Act)
Vegetation zones (condition) and plots	Zone 6 (Good) Plot 7

Justification for PCT selection

The BioNet Vegetation Classification database PCT filter tool was used to identify a shortlist of candidate PCTs. Search criteria entered into the search tool were specific to the study area and vegetation being assessed including the IBRA bioregion, IBRA subregion, vegetation formation and characteristic canopy floristics. A comparison of the candidate PCTs was made against the SVTM within the locality, characteristics of vegetation identified in the study area and each PCTs profile in the BioNet Vegetation Classification database to identify the most suitable PCT.

PCT 4042 was considered the most suitable PCT for this vegetation type for the following key reasons:

- occurred in the Sydney Basin IBRA Bioregion
- contained floristic characteristic of PCT 4042, a canopy dominated by *Eucalyptus tereticornis*
- occurs on low-lying coastal alluvial soils associated with Mullards Creek.

Floristic and structural summary of PCT 4042 within the study area

Growth form	Typical species
Trees	*Eucalyptus tereticornis, Eucalyptus amplifolia, Eucalyptus robusta*
Shrubs	*Pittosporum undulatum, Leptospermum polygalifolium*
Grass and grass-like	*Imperata cylindrica, Cynodon dactylon, Gahnia clarkei, Sporobolus creber*
Forb	*Centella asiatica, Dianella caerulea var. producta, Lobelia purpurascens, Rumex brownii*
Fern	*Pteridium esculentum*
Other	*Glycine tabacina, Clematis glycinoides*
Exotic	*Solanum mauritianum, Hydrocotyle bonariensis, Cinnamomum camphora, Ligustrum sinense, Pinus radiata, Sida rhombifolia, Cirsium vulgare, Setaria parviflora, Cenchrus clandestinus, Trifolium repens, Verbena bonariensis, Bromus hordeaceus, Sonchus oleraceus, Briza subaristata, Avena fatua, Bidens pilosa, Vicia sativa*
High threat weeds	*Cinnamomum camphora, Ligustrum sinense, Lantana camara, Eragrostis curvula, Rubus fruticosus sp. aggregate, Paspalum dilatatum*

Condition states

PCT 4042 is identified as being in moderate condition, as all areas of PCT 4042 contained an intact canopy, but the understorey and groundcover stratum had been structurally modified. Native species diversity and cover in the understorey and groundcover were generally low with the groundlayer dominated by exotic grasses and pasture weeds. The vegetation zone is located along a small section on the northern side of Mandalong Road (refer to Figure 3-1).

Photo 3.7 PCT 4042 – Moderate condition (Plot 7)

Photo 3.8 PCT 4042 – Moderate condition (Plot 7)

3.2.4 PCT 4020: Coastal Creekflat Layered Grass-Sedge Swamp Forest

Description

A description of PCT 4020 Coastal Creekflat Layered Grass-sedge Swamp Forest recorded within the biodiversity study area is provided below.

PCT ID	4020
PCT name	Coastal Creekflat Layered Grass-Sedge Swamp Forest
Vegetation class	Coastal Floodplain Wetlands
Vegetation formation	KF_CH9 Forested Wetlands
Estimate of per cent cleared	65.28 %
Area in subject land	0.03 ha
Conservation status	Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions – Endangered (BC Act) Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland (Endangered – EPBC Act)
Vegetation zones (condition) and plots	Zone 7 (Moderate) Plots 1 and 8

Justification for PCT selection

The BioNet Vegetation Classification database PCT filter tool was used to identify a shortlist of candidate PCTs. Search criteria entered into the search tool were specific to the study area and vegetation being assessed including the IBRA bioregion, IBRA subregion, vegetation formation and characteristic canopy floristics. A comparison of the candidate PCTs was made against the SVTM within the locality, characteristics of vegetation identified in the study area and each PCTs profile in the BioNet Vegetation Classification database to identify the most suitable PCT.

PCT 4020 was considered the most suitable PCT for this vegetation type for the following key reasons:

- has been mapped extensively throughout the locality by the SVTM (including areas of the biodiversity study area)
- occurred in the Sydney Basin IBRA Bioregion
- contained floristic characteristic of PCT 4020, the canopy was dominated by *Melaleuca nodosa, Melaleuca sieberi* and *Glochidion ferdinandi. Eucalyptus robusta* (Swamp Mahogany) was scattered throughout the PCT but not dominant
- occurred as a tall open forest with a percentage foliage cover of greater than 60% on low-lying silty alluvial soils.
- occurs on a floodplain associated with Mullards Creek

Floristic and structural summary of PCT 4020 within the biodiversity study area

Growth form	Typical species
Trees	*Eucalyptus robusta, Glochidion ferdinandi, Melaleuca nodosa*, *Melaleuca sieberi*
Shrubs	*Polyscias sambucifolia, Breynia oblongifolia, Acacia irrorata, Acacia maidenii*
Grass and grass-like	*Gahnia clarkei, Carex inversa, Entolasia marginata, Imperata cylindrica, Microlaena stipoides, Oplismenus imbecillis*
Forb	*Centella asiatica, Dianella caerulea var. producta, Lobelia purpurascens,*
Fern	*Pteridium esculentum*
Other	*Glycine microphylla, Geitonoplesium cymosum, Clematis aristida, Parsonsia straminea, Hibbertia scandens, Lomandra longifolia*
Exotic	*Conyza bonariensis*
High threat weeds	*Lantana camara, , Rubus fruticosus sp. aggregate*

Condition states

One vegetation condition being good zone 7 has been assigned for PCT 4020 based on the broad condition states in which it occurred within the biodiversity study area, including:

- Good (vegetation zone) – good condition areas of PCT 4020 were structurally intact, weed cover was generally low and characteristic species of the community were present throughout all stratums. Three patches of this PCT were identified one being within the Ausgrid Land to the north of Mandalong Road, the remaining two patches occur in the south west along Gimberts Road (refer to Figure 3-1).

Photo 3.9 PCT 4020 – Good condition (Plot 1)

Photo 3.10 PCT 4020 – Good condition (Plot 8)

3.2.5 Miscellaneous ecosystems

Planted native trees

Planted trees are located to the south of Dora Street and south of Mandalong Road (refer to Figure 3-1). The area located to the south of Dora Street is comprised of *Lophostemon confertus,* and *Eucalyptus botryoides.* There is no midstorey, with the groundlayer comprised of management lawn. The area to the south of Mandalong Road is comprised of *Eucalyptus saligna Melaleuca nodosa, Allocasuarina littoralis* and *Casuarina glauca* in the canopy layer. The groundlayer is dominated by *Gahnia sieberi, Lomandra longifolia* and *Entolasia stricta*.

Photo 3.11 Planted Native Trees to the south of Dora Street with *Lophostemon confertus* in the canopy layer

Photo 3.12 Planted Native Trees to the east of Mandalong Road

Planted exotic trees

Planted exotic trees occurs to the north of Gimberts Road and comprises of *Pinus radiata* and *Cupressus lusitanica.* The groundlayer was generally sparse with occasional occurrences of *Lomandra longifolia.*

Photo 3.13 Planted Exotic Trees on the north side of Gimberts Road

Regrowth native shrubs

Regrowth Native Shrubs occurs on the eastern side of Mandalong Road. This vegetation is a result of previous clearing for Mandalong Road and is a mixture of shrub plantings natural regeneration from the soil seed bank. Species present include *Callistemon citrinus, Pultenaea villosa, Grevillea robusta, Acacia fimbriata, Pinus radiata, Acacia longifolia* and *Melaleuca nodosa.*

Photo 3.14 Regrowth Native Shrubs to the east of the roundabout at Mandalong Road, Gimberts Road and Gateway Boulevard

Exotic grassland

Exotic Grassland occurs in an electricity easement adjoining the planted native vegetation and adjoining native vegetation to the north of Mandalong Road. Exotic grassland is dominated by *Hyparrhenia hirta, Eragrostis curvula, Paspalum dilatatum, Briza major, Verbena bonariensis* and *Cenchrus clandestinus.*

Photo 3.15 Exotic grassland to the east of the roundabout at Mandalong Road, Gimberts Road and Gateway Boulevard

3.3 Threatened ecological communities

Two TECs listed under the BC Act were identified as being commensurate with three PCTs within the biodiversity study area. A summary of these is outlined in Table 3-3.

Table 3-3 TECs listed under the BC Act

Threatened ecological community	Associated PCTs	Condition	BC Act listing	Biodiversity study area extent (ha)	Subject land extent (ha)
Swamp Sclerophyll Forest on Coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	PCT 3998	Good	Endangered	0.13	0.01
		Moderate		0.46	0.23
	PCT 4020	Good		0.51	0.03
River Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	PCT 4042	Moderate	Endangered	0.08	0.08

3.3.1 Swamp Sclerophyll Forest on Coastal Floodplains Assessment

An assessment of PCTs 3998 (good and moderation condition) and 4020 was undertaken (refer to Table 3-4) against the scientific determination for Swamp Sclerophyll Forest on Coastal Floodplains listed as an endangered ecological community under the BC Act. These were considered the most likely PCT's to comprise this TEC. This assessment concluded that both PCTs 3998 and 4020 meet the criteria for listing as this TEC.

Table 3-4 Swamp Sclerophyll Forest on Coastal Floodplains Assessment

Final determination listing criteria	Swamp Sclerophyll Forest on Coastal Floodplains	PCT 3998 – Good and moderate condition	PCT 4020 - Good condition
Area occupied by the EEC	Occurs in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Yes occurs in the Sydney Basin IBRA Bioregion	Yes occurs in the Sydney Basin IBRA Bioregion
Soils	The community is associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains	Yes occurs on humic clay sandy soils on the alluvial flats of Mullards Creek	Yes occurs on humic clay sandy soils on the alluvial flats of Mullards Creek
Elevation	Swamp Sclerophyll Forest on Coastal Floodplains generally occurs below 20 m (though sometimes up to 50 m) elevation, often on small floodplains or where the larger floodplains adjoin lithic substrates or coastal sand plains in the NSW North Coast, Sydney Basin and South East Corner bioregions	Yes PCT 3998 occur at elevations between 20 m and 27 m on the floodplains associated with Mullards Creek	Yes PCT 4020 occur at an elevation of between 20 m and 23m on the floodplains associated with Mullards Creek
Floristic Structure	The community typically occurs as an open forest but can be reduced to scattered trees based on inundation frequency, salinity, soil quality and dominant tree species. In some areas, the tree stratum is low and dense, so the community takes on the structure of a scrub.	Yes this PCT is an open forest	Yes this PCT is an open forest
Assemblage of Species	59 characteristic species of Swamp Sclerophyll Forest on Coastal Floodplains are listed in the Scientific Determination. The composition of Swamp Sclerophyll Forest on Coastal Floodplains is primarily determined by the frequency and duration of waterlogging and the texture, salinity nutrient and moisture content of the soil.	Yes This PCT has a canopy dominated by Eucalyptus robusta and Melaleuca nodosa, which are characteristic canopy species for this TEC	Yes This PCT has a canopy dominated by *Melaleuca nodosa* and *Melaleuca sieberi*, with a dense layer of *Gahnia clarkei* within the groundlayer. These are characteristic canopy and groundlayer species for this TEC
Location within LGAs	Previously recorded from the local government areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, Lake Macquarie, Wyong, Gosford, Hornsby, Pittwater, Warringah, Manly, Liverpool, Rockdale, Botany Bay, Randwick, Sutherland, Wollongong, Shellharbour, Kiama and Shoalhaven but may occur elsewhere in these bioregions.	Yes this PCT occurs within the Lake Macquarie LGA.	Yes this PCT occurs within the Lake Macquarie LGA.
Does the PCT meet the criteria for this EEC?		**Yes**	**Yes**

3.3.2 River Flat Eucalypt Forest on Coastal Floodplains

An assessment of PCT 4042 was undertaken (refer to Table 3-5) against the scientific determination criteria for River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions listed as an endangered ecological community under the BC Act. This assessment concluded that PCT 4042 meets the criteria for listing as this endangered ecological community.

Table 3-5 River-Flat Eucalypt Forest on Coastal Floodplains Assessment

Final determination listing criteria	River-flat Eucalypt Forest on Coastal Floodplains	PCT 4042 – Moderate condition
Area occupied by the EEC	Occurs in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Yes, occurs in the Sydney Basin IBRA Bioregion
Soils	The community is associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains	Yes, occurs on humic clay sandy soils on the alluvial flats of Mullards Creek
Elevation	River-flat Eucalypt Forest on Coastal Floodplains generally occurs below 20 m (though sometimes up to 50 m) elevation, often on small floodplains or where the larger floodplains adjoin lithic substrates or coastal sand plains in the NSW North Coast, Sydney Basin and South East Corner bioregions	Yes, this PCT occur at elevation of 42 m in the biodiversity study area. Occurs on the floodplains associated with Mullards Creek and is periodically inundated during high rainfall.
Floristic Structure	The community varies from tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees.	Yes, the structure of this PCT is an open forest. Canopy layer is sparse due to land clearing.
Assemblage of Species	88 characteristic species of River-flat eucalypt forest on Coastal Floodplains are listed in the Scientific Determination. The composition of this TEC is primarily determined by the frequency and duration of waterlogging and the texture, salinity nutrient and moisture content of the soil.	Yes This PCT has the dominant canopy layer species of *Eucalyptus tereticornis* and *Eucalyptus amplifolia*
Location within LGAs	Previously recorded from the local government areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, Lake Macquarie, Wyong, Gosford, Hornsby, Pittwater, Warringah, Manly, Liverpool, Rockdale, Botany Bay, Randwick, Sutherland, Wollongong, Shellharbour, Kiama and Shoalhaven but may occur elsewhere in these bioregions.	Yes, this PCT occurs within the Lake Macquarie LGA.
Does the PCT meet the criteria for this EEC?		**Yes**

Mandalong Road Upgrade

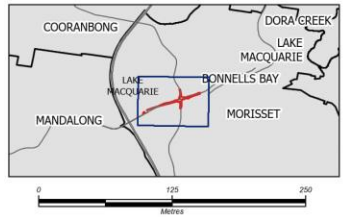
Figure 3-2
Threatened ecological communities

Legend

- Subject Land (Proposal area)
- Biodiversity study area
- Watercourse
- Road

Threatened ecological community (BC Act)

- Swamp Sclerophyll Forest on Coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions, Endangered
- River Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions, Endangered



Coordinate system: GDA2020 MGA Zone 56

Scale ratio correct when printed at A3

1:5,000

Date: 26/11/2024

GDA 2020

Data sources: Geoscience Australia, Nearmap, NSWSS

3.4 Priority weeds

Ten exotic species recorded are listed as Priority Weeds under the NSW *Biosecurity Act 2015* (Biosecurity Act) or the Greater Hunter Local Land Service region and three are listed as Weeds of National Significance (WONS) (refer to Table 3-6). Under the Biosecurity Act, land managers are required to follow the regional and non-regional duties which have been allocated to each Priority Weed.

Table 3-6 Weeds of concern recorded within the biodiversity study area

Scientific name	Common name	Priority weed duty	WONS
Senecio madagascariensis	Fireweed	**Prohibition on dealings** Must not be imported into the state, sold, bartered, exchanged or offered for sale.	Yes
Cinnamomum camphora	Camphor Laurel	**Regional Recommended Measure** Land managers should mitigate the risk of the plant being introduced to their land. Land managers should mitigate spread of the plant from their land. A person should not buy, sell, move, carry or release the plant into the environment. Land managers should reduce the impact of the plant on assets of high economic, environmental and/or social value.	No
Eragrostis curvula	African Lovegrass		No
Hyparrhenia hirta	Coolatai Grass		No
Ageratina adenophora	Crofton Weed		No
Rubus fruticosus species aggregate	Blackberry	**Regional Recommended Measure** Land managers should mitigate the risk of the plant being introduced to their land. Land managers should mitigate spread of the plant from their land. A person should not buy, sell, move, carry or release the plant into the environment. Land managers should reduce the impact of the plant on assets of high economic, environmental and/or social value. **Prohibition on dealings** Must not be imported into the state, sold, bartered, exchanged or offered for sale.	Yes
Lantana camara	Lantana		Yes
Cortaderia selloana	Pampas Grass	**Regional Recommended Measure** An exclusion zone is established for all land in the region, except the core infestation which includes parts of: Lake Macquarie Local Government Area. Entire Hunter Local Land Services region: Land managers should mitigate the risk of the plant being introduced to their land. Exclusion zone: Notify local control authority if found. Land managers should eradicate the plant from the land and keep the land free of the plant. A person should not deal with the plant, where dealings include but are not limited to buying, selling, growing, moving, carrying or releasing the plant. Core infestation: Land managers should mitigate spread of the plant from their land. A person should not buy, sell, move, carry or release the plant into the environment. Land managers should reduce the impact of the plant on assets of high economic, environmental and/or social value.	No
Ligustrum sinense	Narrow-leaf Privet	**General Biosecurity Duty** All pest plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.	No
Cirsium vulgare	Spear Thistle		No

3.5 Threatened species

3.5.1 Threatened flora

The desktop assessment identified 29 listed threatened flora species as being known or predicted to occur in the locality of the proposal. Of these, 10 were considered to have a moderate or higher likelihood of occurring within the biodiversity study area based on available habitat, previous records and the habitat suitability assessment criteria (refer to Appendix B). These species were the candidates for detailed targeted surveys.

Two candidate listed threatened flora species were recorded within the biodiversity study area during field surveys; *Angophora inopina* (Charmhaven Apple) and *Tetratheca juncea* (Black-eyed Susan). All other remaining candidate species were not recorded during the survey program.

Table 3-7 outlines the candidate species, their conservation status, potential occurrence and whether they are likely to be impacted by the proposal. Descriptions of the *Angophora inopina and Tetratheca juncea* are provided below.

Significance assessments have been completed for species that will be or are predicted to be impacted by the proposal and have been provided in Appendix D and Appendix E.

Species polygons have been created for these recorded threatened flora species on the subject land in accordance with the BAM and specific requirements listed for each species in their TBDC profile. This approach is outlined below for each species.

***Angophora inopina* (Charmhaven Apple)**

Angophora inopina is listed as vulnerable on both the BC Act and EPBC Act. This species is a small tree to 8 m in height and grows on deep white sandy soils over sandstone. A population of 20 individuals were recorded within the biodiversity study area during the targeted flora surveys. These individuals were recorded within PCT 3583 Hunter Coast Lowland Scribbly Gum Forest and PCT 3998 Lower North Creek Flat Mahogany Swamp Forest.

The population recorded within the biodiversity study area and is part of a large regional population which occurs in the Wyong and Lake Macquarie LGAs, where around 1250 ha of habitat has been mapped (Commonwealth of Australia, 2008). This species is part of a larger substantial local population the locality. Two local developments have recorded this species as part of their biodiversity development assessment reports. The Morisset Event Space development (Kleinfelder, 2020) adjoining the biodiversity study area on the intersection of Dora Street and Wyee Road, recorded a population of 20 individuals, with all of these being impacted by the proposal. Construction for this development has been commenced and all the individuals have been removed. The Caravan Park – Long-term Living development (Kleinfelder, 2021), which is located to the south of the biodiversity study area to the east of Wyee Road, recorded a population of 5,312 individuals of which 1,235 individuals will be impacted.

Bionet and BAM identifies that *Angophora inopina* is an Area species, which means that its area of occurrence is to be mapped via Area.

The BAM *Surveying threatened plants and their habitats guideline* states:

"Where individuals are identified by point locations, each must be buffered by a 30-metre radius (BAM Paragraph 6.4.1.29). If individuals are spaced less than 30 metres apart, overlapping areas of buffer can be combined to form the boundary of the species polygon (Appendix B)."

Twenty three *Angophora inopina* trees were identified within the biodiversity study area, of these, three will be directly impacted by the proposal within the subject land, and twenty will be retained. Area of species polygon to be impacted is calculated as 0. 19 ha and retention of 0.61 ha. The occurrence of this species and the species polygon developed for it in accordance with BAM is illustrated in Figure 3-3.

***Tetratheca juncea* (Black-eyed Susan)**

Tetratheca juncea is listed as vulnerable on both the BC Act and the EPBC Act. A population of 25 clumps were recorded within the biodiversity study area, ranging in numbers of plants from one to 13. *Tetratheca juncea* was recorded within PCT 3583 Hunter Coast Lowland Scribbly Gum Forest – good condition.

This species is a low growing shrub which occurs in restricted coastal districts from Lake Macquarie to Bulahdelah.

Bionet and BAM identifies that *Tetratheca juncea* is an Area species, which means that its area of occurrence is to be mapped via Area.

Bionet indicates "*Species polygon: When Tetratheca juncea is recorded within an assessment area, the species polygon does not necessarily need to extend over the whole zone for a given Plant Community Type where the species is detected. Suitable habitat may be modified to restrict the polygon to low nutrient, well drained soils on substrates that are generally sandy skeletal soil on sandstone or sandy-loam, or pH neutral clayey soil from conglomerates. The annual rainfall is between 1000 – 1200 mm.*"

The BAM *Surveying threatened plants and their habitats guideline* states:

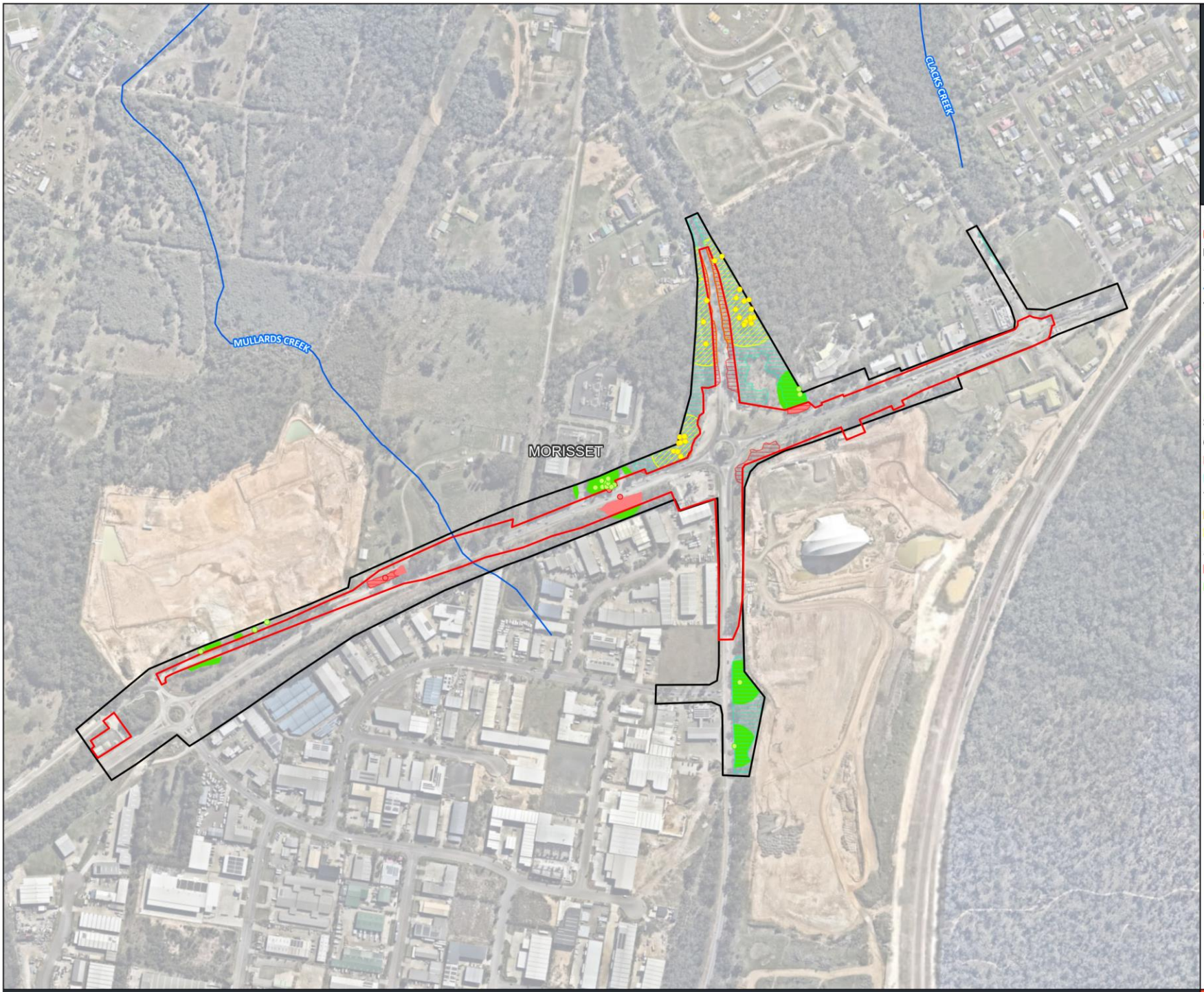
"Where individuals are identified by point locations, each must be buffered by a 30-metre radius (BAM Paragraph 6.4.1.29). If individuals are spaced less than 30 metres apart, overlapping areas of buffer can be combined to form the boundary of the species polygon (Appendix B)."

No *Tetratheca juncea* clumps will be directly impacted by the proposal within the subject land. Twenty six clumps will be retained. Area of species polygon to be directly impacted is calculated as 0.15 ha within the subject land, compared to retention of 0.89 ha outside of the subject land but within the biodiversity study area. The occurrence of this species and the species polygon developed for it in accordance with BAM is illustrated in Figure 3-3.

Table 3-7 Threatened flora species surveys results

Species name	EPBC Act	BC Act	Identification method (not recorded, assumed, recorded, expert report)	Survey effort compliant?	Results
Acacia bynoeana (Bynoe's Wattle)	V	E	Not recorded	Yes – targeted surveys completed in September 2024	Non impacted species. Species not recorded during targeted surveys in September 2024
Angophora inopina (Charmhaven Apple)	V	V	Recorded	Yes – targeted surveys completed in August 2024 and September 2024	Impacted species. A total of 23 individuals were recorded within the biodiversity study area. Three of these (around 0.19 ha) will be directly impacted by the proposal.
Caladenia tessellata (Thick-lipped Spider-orchid)	V	V	Not recorded	Yes – targeted surveys completed in September 2024	Non impacted species. Species not recorded during targeted surveys in September 2024
Cryptostylis hunteriana (Leafless Tongue Orchid)	V	V	Not recorded	Yes – targeted survey completed in November 2024	Non impacted species. Species not recorded during targeted surveys in November 2024.
Diuris praecox (Rough Doubletail)	V	V	Not recorded	Yes – targeted surveys completed in August 2024	Non impacted species. Targeted survey completed in August 2024 and species not recorded.
Genoplesium insigne (Variable Midge Orchid)	CE	CE	Not recorded	Yes – targeted surveys completed in September 2024	Non impacted species. Species not recorded during targeted surveys in September 2024
Grevillea parviflora subsp. *Parviflora* (Small-flower Grevillea)	V	V	Not recorded	Yes – targeted surveys completed in September 2024	Non impacted species. Species not recorded during targeted surveys in September 2024

Species name	EPBC Act	BC Act	Identification method (not recorded, assumed, recorded, expert report)	Survey effort compliant?	Results
Rutidosis heterogama (Heath Wrinklewort)	V	V	Not recorded	Yes – targeted surveys completed in September 2024	Non impacted species. Species not recorded during targeted surveys in September 2024
Tetratheca juncea (Black-eyed Susan)	V	V	Recorded	Yes – targeted surveys completed in September 2024	Impacted species. No Tetratheca juncea clumps will be directly impacted by the proposal within the subject land. Twenty six clumps will be retained. Area of species polygon to be impacted is calculated as 0.15 ha compared to retention of 0.89 ha.



Mandalong Road Upgrade

Figure 3-3
Recorded threatened flora

Legend

- Subject Land (Proposal area)
- Biodiversity study area
- Road
- Watercourse

Threatened flora survey

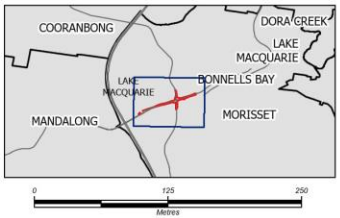
- Retained *Tetratheca juncea record* - Vunerable (BC Act and EPBC Act)
- Impacted *Angophora inopina record* - Vunerable (BC Act and EPBC Act)
- Retained *Angophora inopina record* - Vunerable (BC Act and EPBC Act)

Species polygon

Cryptostylis hunteriana species polygon
- Impacted
- Retained

Tetratheca juncea species polygon
- Impacted
- Retained

Angophora inopia species polygon
- Impacted
- Retained



Coordinate system: GDA2020 MGA Zone 56
Scale ratio correct when printed at A3

1:5,000 Date: 26/11/2024

GDA 2020

Data sources: Geoscience Australia, Nearmap, NSWSS

3.5.2 Threatened fauna

The desktop assessment identified 87 listed threatened fauna species as being known or predicted to occur in the locality of the proposal. Of these, twenty-one were considered to have a moderate or higher likelihood of occurring within the biodiversity study area based on available habitat, previous records and the habitat suitability assessment criteria (refer to Appendix B).

Twelve threatened fauna species were recorded within the biodiversity study area, being 4 birds and 8 mammals. Two threatened fauna species being the Swift Parrot, and the Squirrel Glider are assumed to be present. The remaining threatened fauna species were not recorded during the field surveys and are not required to be further considered.

Table 3-8 outlines the candidate species, their conservation status, potential occurrence and whether they are likely to be affected by the proposal. The occurrence of each species recorded and associated polygons is illustrated in Figure 3-4 and . Each species affected is considered further with respect to Section 7.3 of the BC Act and MNES significant assessments which are provided in Appendix D and Appendix E.

Species polygons have been created (if required for species credit species) for these recorded threatened fauna species (including where species are assumed present in the absence of adequate survey) on the subject land in accordance with the BAM and specific requirements listed for each species in their TBDC profile. This approach is outlined below for each species.

Varied Sittella – *Daphoenositta chrysoptera*

The Varied Sittella is listed as Vulnerable under the BC Act. This species Biodiversity Credit Class is Ecosystem Credit Species so a species polygon is not required for this species.

It is a sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy.

The species was recorded on two occasions within the northern portion, to the east of Freemans Drive within the biodiversity study area during the survey program. The species is likely to use forested habitat within the study area and immediate locality.

Little Lorikeet – *Glossopsitta pusilla*

The Little Lorikeet is listed as Vulnerable under the BC Act. This species Biodiversity Credit Class is Ecosystem Credit Species so a species polygon is not required for this species.

It is dependent on the blossom resources of myrtaceous canopy trees and are quite nomadic in regard to accessing those foraging resources. This species migrates during different times of year to forage on blossom species across south-eastern Australia. While in some years, individuals can be spoilt for resource choice, there are some years in which blossom availability is relatively low. During those low-blossom seasons small areas of blossom that are flowering can be of great importance to Little Lorikeet.

This species was recorded on four occasions, two to the east of Freemans Drive, and two occasions to the south of Dora Street and Mandalong Road during the survey program. The species is likely to use forested habitat, including the planted native vegetation containing blossoming trees that represent foraging habitat and potential breeding habitat for the species within the biodiversity study area and immediate locality.

Little Eagle – *Hieraaetus morphnoides*

The Little Eagle is listed as vulnerable under the BC Act. This species Biodiversity Credit Class is Dual Species/Ecosystem Credit Species.

Breeding habitat is live (occasionally dead) large old trees within suitable vegetation AND the presence of a male and female; or any adult with nesting material; or an individual on a large stick nest in the top half of the tree canopy; or pairs displaying (soaring, diving, engaging in chases, or a male observed calling in flight with a female begging from tree).

The Little Eagle is distributed throughout the Australian mainland occupying habitats rich in prey within open eucalypt forest, woodland or open woodland. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring. Prey includes birds, reptiles and mammals, with the occasional large insect and carrion. Most of its former native mammalian prey species in inland NSW are extinct and rabbits now form a major part of the diet.

The Little Eagle was recorded flying over exotic grassland to the north of Mandalong Road. No breeding habitat in the form of stick nests or other behaviours noted in the descriptions above in Bionet were recorded so a species polygon is not required for this species. The proposal will result in a reduction in foraging habitat for this species.

Powerful Owl – *Ninox strenua*

The Powerful Owl is listed as vulnerable under the BC Act. This species Biodiversity Credit Class is Species Credit Species.

The Powerful Owl usually inhabits the moist forests of eastern Australia. A sedentary species with a home range of around 1000 ha it occurs within open Eucalypt, Casuarina or Callitris pine forest and woodland. It often roosts in denser vegetation including rainforest of exotic pine plantations. Generally, feeds on medium-sized mammals such as possums and gliders but will also eat birds, flying-foxes, rats and insects. Prey are generally hollow dwelling and require a shrub layer and owls are more often found in areas with more old trees and hollows than average stands. The Powerful Owl requires hollows, living or dead with a diameter of greater than 20cm.

The Powerful Owl was recorded in two locations, within PCT 3583 during the survey program. No hollows greater than 20 cm diameter were recorded within the biodiversity study area. The Ring-tailed Possum was commonly recorded during spotlighting surveys, which is a prey species for the Powerful Owl. The proposal will result in the removal of only foraging habitat for this species.

Species polygon: The species polygon must be drawn to include all vegetation zones:

1 within 800 m from the location of a detected owl and
2 containing a living or dead tree with a hollow >20 cm diameter that occurs >4 m above the ground. The location of the detected owl should be determined by estimating the distance and direction of the call.

As no hollows greater than 20 cm diameter were recorded within the biodiversity study area, in accordance with the BAM, a species polygon is not required.

Swift Parrot – *Lathamus discolor*

The Swift Parrot is listed as critically endangered on both the BC Act and EPBC Act and a Serious and Irreversible Impact (SAII entity under the BC Act. This species Biodiversity Credit Class is Species Credit Species where Mapped Important Habitat exists and Ecosystem Credit Species in other suitable native vegetation.

It is a migratory species with breeding occurring in Tasmania, majority migrates to mainland Australia in autumn, over-wintering, particularly in Victoria and central and eastern NSW, but also south-eastern Queensland as far north as Duaringa. Until recently it was believed that in New South Wales, swift parrots forage mostly in the western slopes region along the inland slopes of the Great Dividing Range but are patchily distributed along the north and south coasts including the Sydney region, but new evidence indicates that the forests on the coastal plains from southern to northern NSW are also extremely important. In mainland Australia it is semi-nomadic, foraging in flowering eucalypts in eucalypt associations, particularly box-ironbark forests and woodlands. Preference for sites with highly fertile soils where large trees have high nectar production, including along drainage lines and isolated rural or urban remnants. Sites used vary from year to year.

Technically no survey is required for this species as the species is assessed for species credits via the Important Habitat Map in BOAMS.

While August survey did not detect this species, Mapped Important Habitat occurs within the biodiversity study area and subject land and as a result this species is assumed to be present as a species credit species. This species is also listed as a Serious and Irreversible Impact species under the BAM. The Mapped Important Habitat in BOAMS is shown in Figure 3-4.

Squirrel Glider – *Petaurus norfolcensis*

The Squirrel Glider is listed as Vulnerable under the BC Act. This species Biodiversity Credit Class is Species Credit Species.

It is a small glider species, which is widely but sporadically distributed in eastern Australia, ranging from north-east Queensland to western Victoria. Squirrel Gliders favours mature or old growth Bog, Box-Ironbark and River Red Gum woodland and forests, typically with shrub or Acacia midstorey. Their distribution is dependent on abundance of suitable tree hollows for refuge and nesting sites.

There are numerous records for the species within the locality and the species is likely to use the habitat present for foraging and possibly use hollow-bearing tree resources for shelter and breeding requirements. This species has been a focus of Lake Macquarie City Council for urban developments in the immediate locality and a number of Squirrel Glider poles have recently been installed within the subject land.

Cameras and Eliott traps could not be used due to the high exposure of the site to the public however this species has been assumed to be present as it is known to occur locally. This species was not recorded during spotlighting, although possible chew marks were recorded in within the biodiversity study area to the east of Freemans Drive.

A species polygon has been developed for this species in accordance with BAM. The species polygon was developed to include all areas of native vegetation habitat associated with the species in the TBDC.

Cave-dwelling microchiropteran bat species

The subject land contains culverts and drainage pipes, which are sometimes used by cave- dwelling microchiropteran bat species, but inspection of the culverts found no features, which would offer suitable roosting sites for such species. No bats were recorded within the culverts. Nevertheless, the woodland habitats of the subject land provide foraging opportunities for all microchiropteran bat species, due to the insect populations they attract and support.

Four cave-dependent microchiropteran bat species were recorded within the biodiversity study area during the survey program (i.e. Eastern Cave Bat, Little Bent-wing Bat, Large Bent-wing Bat and Southern Myotis). Eastern Cave Bat and Southern Myotis were also identified multiple times as probable records during the Anabat analysis conducted post-survey and have subsequently been included as recorded species. All of these species are dependent on cave habitats or bridges or culverts for roosting purposes, which are not present in the subject land or its vicinity, so local occurrences are dependent only upon aerial foraging resources associated with onsite vegetation.

The removal of any native vegetation within the subject land would represent a reduction in potential foraging habitat for cave-dependent microchiropteran bat species.

In terms of species credit requirements, the following applies for each of these species:

- Eastern Cave Bat: Biodiversity Credit Class is Species Credit Species when breeding habitat is present. No breeding habitat was identified as being present so a species polygon is not required.
- Little Bent-wing Bat and Large Bent-wing Bat: Biodiversity Credit Class is Dual Species / Ecosystem Credit Species. No breeding habitat was identified as being present so a species polygon is not required.
- Southern Myotis: Biodiversity Credit Class is Species Credit Species. For this species the habitat feature is any medium to large permanent creek, river, lake or other waterway and the buffer is 200 metres (m). These features are not present within the subject land or biodiversity study area and so no species polygon is required. While Mullards Creek is shown on the figures it is not natural or substantial in the immediate locality of the subject land.

In addition, the Large-eared Pied Bat (*Chalinolobus dwyeri*) was identified as having moderate potential for foraging habitat only and is a Species Credit Species when breeding habitat is present. For this species the breeding habitat features are PCTs associated with the species within 100 m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings. No suitable breeding habitat was identified as being present, so a species polygon is not required.

As such, no species polygons are required for these bat species.

Hollow-dwelling microchiropteran bat species

There are trees within the subject land that contain hollows represent roosting opportunities for hollow-dwelling microbats (Figure 3-4). Furthermore, the subject land's forest and woodland provide foraging opportunities for hollow-dwelling microchiropteran bat species, due to the insect populations they attract and support.

A total of three hollow-dependent microchiropteran bat species were recorded within the biodiversity study area during the survey program (i.e. Greater Broad-nosed Bat, Eastern False Pipistrelle and Eastern Coastal Free-tailed Bat). Two of these species (Greater Broad-nosed Bat, Eastern Coastal Free-tail Bat) have been included as a positive record following a probable and possible identification result during the Anabat analysis from biodiversity the study area. The Southern Myotis, also recorded and described above in the 'Cave-dwelling microchiropteran bat species' section, is also known to use hollow bearing trees as roosting habitat sometimes.

The removal of hollow-bearing trees, and the removal of any native vegetation within the subject land, would represent a reduction in potential roosting and breeding habitat for hollow-dwelling microbats, respectively.

In terms of species credit requirements, the following applies for each of these species:

- Greater Broad-nosed Bat: Biodiversity Credit Class is Ecosystem Credit Species so a species polygon is not required.
- Eastern False Pipistrelle: Biodiversity Credit Class is Ecosystem Credit Species so a species polygon is not required.
- Eastern Coastal Free-tailed Bat: Biodiversity Credit Class is Ecosystem Credit Species so a species polygon is not required.

As such, no species polygons are required for these bat species.

Grey-headed Flying-fox – *Pteropus poliocephalus*

The Grey-headed Flying-fox is listed as Vulnerable under the BC Act and EPBC Act. This species Biodiversity Credit Class is Dual Species/Ecosystem Credit Species.

It is the largest Australian bat and can be distinguished from other flying-foxes by the leg fur, which extends to the ankle. They occupy the eastern coast of Australia, their range extending 200 km inland but in times of resource shortages can be found beyond this range. This species is known to occur in a variety of habitats, including subtropical and temperate rainforests, tall sclerophyll forests and woodland, heathland and swamps. Roosting camps are located within a 20 km radius of a regular food source but are typically found in gullies and vegetation with a dense canopy, close to a water source.

The species was recorded within the biodiversity study area during spotlighting surveys in the west of the biodiversity study area on Gimberts Road. No known camps occur or were recorded for the species within the study area. Areas of the subject land are comprised of forested habitats in which the canopy is dominated by myrtaceous tree species represented by the Eucalyptus and Melaleuca genera which are likely to be used by the species. The subject land is unlikely to be important to Grey-headed Flying-fox populations, but they may utilise this area for foraging if it is within range of local roosting camps. The removal of native vegetation within the subject land will result in a reduction in potential foraging habitat for this species.

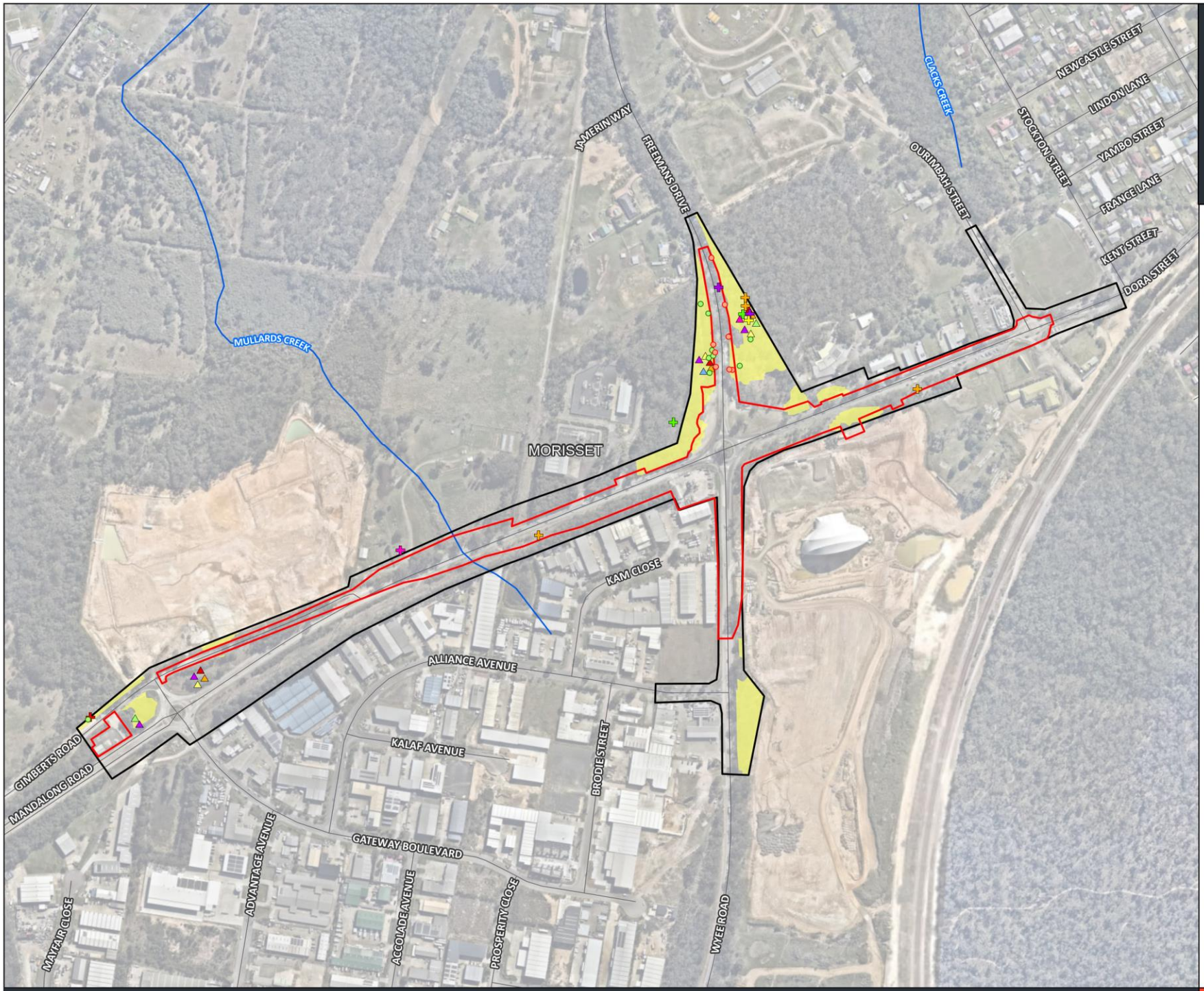
In terms of species credit requirements, no camps are present or likely to be present in the future and as such no species polygon is required.

Table 3-8 Threatened fauna species surveys results

Species name	EPBC Act	BC Act	Identification method (not recorded, assumed, recorded, expert report)	Survey effort compliant?	Results
Birds					
Dusky Woodswallow (*Artamus cyanopterus cyanopterus*)	–	V	Not recorded	Yes	Non impacted species. Targeted survey completed in August and species not recorded.
Gang-gang Cockatoo (*Callocephalon fimbriatum*)	E	E	Not recorded	Yes	Non impacted species. Targeted survey completed in August and species not recorded.
South-eastern Glossy Black Cockatoo (*Calyptorhynchus lathami lathami*)	V	V	Not recorded	Yes	Non impacted species. Targeted survey completed in August and species not recorded.
Varied Sitella (*Daphoenositta chrysoptera*)	–	V	Recorded	Yes	Ecosystem Credit Species Impacted species. Foraging and breeding habitat present
Little Lorikeet (*Glossopsitta pusilla*)	–	V	Recorded	Yes	Ecosystem Credit Species Impacted species. Foraging and breeding habitat present
Little Eagle (*Hieraaetus morphnoides*)	V	–	Recorded	Yes	Dual Species / Ecosystem Credit Species Impacted species. Foraging habitat present, no nests were recorded and no breeding behaviour so species polygon not required.
Powerful Owl (*Ninox strenua*)	–	V	Recorded	Yes	Species Credit Species Impacted species Foraging habitat on site, no breeding trees were recorded. As no suitable nesting hollows were recorded and no breeding behaviour was observed a species polygon is not required.
Masked Owl (*Tyto novaehollandiae*)	–	V	Not recorded	Yes	Non impacted species. Targeted survey completed in August and species not recorded.
Sooty Owl (*Tyto tenebricosa)*	–	V	Not recorded	Yes	Non impacted species. Targeted survey completed in August and species not recorded.
Regent Honeyeater (*Anthochaera phrygia*)	CE	CE	Not recorded	Yes	Non impacted species. Targeted survey completed in August and species not recorded.

Species name	EPBC Act	BC Act	Identification method (not recorded, assumed, recorded, expert report)	Survey effort compliant?	Results
Swift Parrot (*Lathamus discolor*)	CE	E	Assumed – Important Swift Parrot habitat mapping	Yes	Impacted species. Important Swift Parrot habitat is mapped within the biodiversity study area. Species polygon determined. The proposal will impact upon 0.27 ha of potential foraging habitat compared to retention of 2.08 ha. Not some of the impacted habitat is in fact a cleared unofficial car park on the north western corner of the Freemans Drive and Mandalong Rd intersection.
Microbats					
Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*)	-	V	Recorded	Yes	Ecosystem Credit Species Impacted species Suitable foraging and breeding habitat present within the biodiversity study area.
Large-eared Pied Bat (*Chalinolobus dwyeri*)	V	V	Not recorded	Yes	Non impacted species. Targeted surveys completed in August and species not recorded.
Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)	–	V	Recorded	Yes	Ecosystem Credit Species Impacted species Suitable foraging and breeding habitat present within the biodiversity study area.
Little Bent-winged Bat (*Miniopterus australia*)	–	V	Recorded	Yes	Dual Species/Ecosystem Credit Species Impacted species Suitable foraging habitat within the biodiversity study area. No breeding habitat present so no species polygon required.
Large Bent-winged Bat (*Miniopterus Orianae oceanensis*)	–	V	Recorded	Yes	Dual Species/Ecosystem Credit Species Impacted species Suitable foraging habitat within the biodiversity study area. No breeding habitat present so no species polygon required.
Southern Myotis (*Myotis macropus*)	–	V	Recorded	Yes	Species Credit Species Impacted species No breeding habitat present or quality riparian foraging habitat so no species polygon required.

Species name	EPBC Act	BC Act	Identification method (not recorded, assumed, recorded, expert report)	Survey effort compliant?	Results
Greater Broad-nosed Bat (*Scoteanax rueppellii*)	–	V	Recorded	Yes	Ecosystem Credit Species Impacted species Suitable foraging and breeding habitat present within the biodiversity study area.
Eastern Cave Bat (*Vespadelus troughtoni*)	–	V	Recorded	Yes	Species Credit Species Impacted species Suitable foraging habitat within the biodiversity study area. No breeding habitat present so no species polygon required.
Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)	–	V	Not recorded	Yes	Non impacted species. Targeted survey completed in October and species not recorded.
Mammals excluding microbats					
Squirrel Glider (*Petaurus norfolcensis*)	–	V	Assumed	Partial	Species Credit Species Impacted species. This species has been previously recorded and is known to occur within the biodiversity study area. Therefore, it has been assumed present as a precautionary measure. Species polygon determined. The proposal will impact upon 0.69 ha of potential foraging habitat compared to retention of 3.47 ha. 9 hollow-bearing trees will require removal and ten will be retained.
Koala (*Phascolarctos cinereus*)	E	E	Not recorded	Yes	Non impacted species. Targeted surveys completed in August and October and this species was not recorded.
Grey-headed Flying Fox (*Pteropus poliocephalus*)	V	V	Recorded	Yes	Dual Species/Ecosystem Credit Species Impacted species One individual was recorded on the northern side of Gimberts Road within the biodiversity study area. Suitable foraging habitat within the biodiversity study area. No breeding habitat present so no species polygon required.



Mandalong Road Upgrade

Figure 3-4
Threatened fauna records

Legend

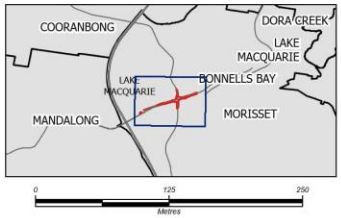
- Subject Land (Proposal area)
- Biodiversity study area
- Road
- Watercourse
- Hollow bearing tree - to be retained
- Hollow bearing tree - to be removed
- Swift Parrot important habitat

Threatened fauna species

- Grey-headed Flying Fox - vulnerable (BC Act & EPBC Act)
- Little Eagle - vulnerable (BC Act)
- Little Lorikeet - vulnerable (BC Act)
- Powerful Owl - vulnerable (BC Act)
- Varied Sittella - vulnerable (BC Act)
- Squirrel Glider - vulnerable (BC Act)

Microbats

- Eastern Cave Bat – Vulnerable (BC Act)
- Eastern False Pipistrelle – Vulnerable (BC Act)
- Southern Myotis – Vulnerable (BC Act)
- Greater Broad-nosed Bat – Vulnerable (BC Act)
- Little Bent-winged Bat – Vulnerable (BC Act)
- Large Bent-winged Bat – Vulnerable (BC Act)
- Eastern Coastal Free-tailed Bat – Vulnerable (BC Act)

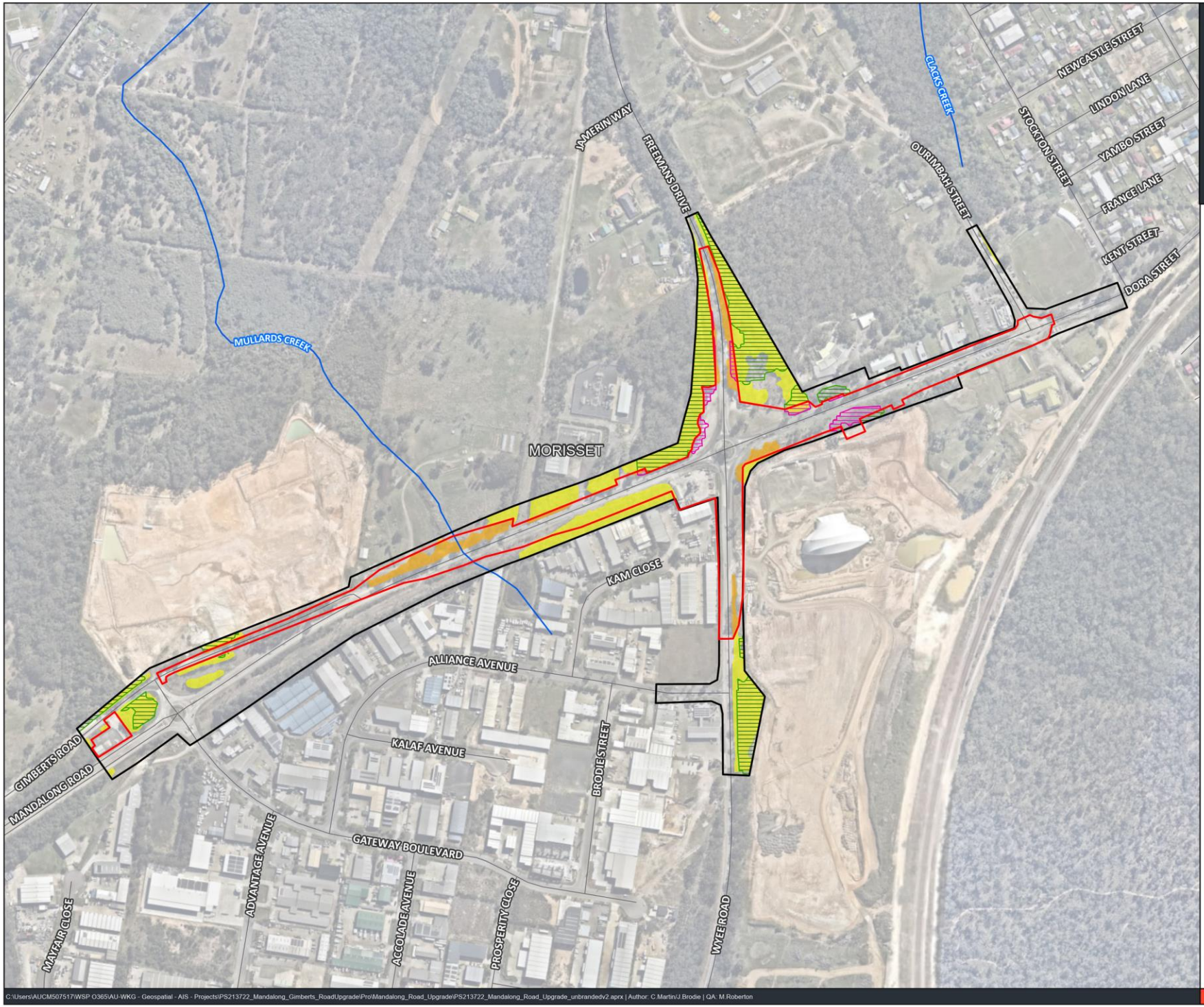


Coordinate system: GDA2020 MGA Zone 56
Scale ratio correct when printed at A3

1:5,000 Date: 26/11/2024

GDA 2020

Data sources: Geoscience Australia, Nearmap, NSWSS



Mandalong Road Upgrade

Figure 3-5
Threatened fauna species polygons

Legend

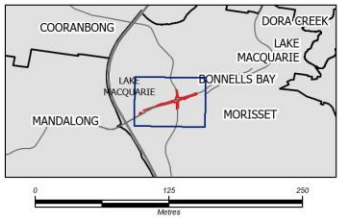
- Subject Land (Proposal area)
- Biodiversity study area
- Road
- Watercourse

Swift Parrot important habitat

- Impacted
- Retained

Squirrel Glider species polygon

- Impacted
- Retained



Coordinate system: GDA2020 MGA Zone 56
Scale ratio correct when printed at A3

1:5,000 Date: 26/11/2024

GDA 2020

Data sources: Geoscience Australia, Nearmap, NSWSS

3.6 Groundwater dependent ecosystems

Groundwater Dependent Ecosystems (GDEs) are communities of plants, animals and other organisms whose extent and life processes are dependent on groundwater (Department of Land and Water Conservation, 2002). When considering GDEs, groundwater is generally defined as the saturated zone of the regolith (the layer of loose rock resting on bedrock, constituting the surface of most land) and its associated capillary fringe, however it excludes soil water held under tension in soil pore spaces (the unsaturated zone or vadose zone) (Eamus et al., 2006).

GDEs include a diverse range of ecosystems from those entirely dependent on groundwater to those that may use groundwater while not having a dependency on it for survival (i.e. ecosystems or organisms that use groundwater opportunistically or as a supplementary source of water) (Hatton and Evans, 1998). Eamus et al. (2006) considers the following broad classes of these ecosystems:

- Aquifer and cave ecosystems, where stygofauna (groundwater-inhabiting organisms) may reside within the groundwater resource. The hyporheic zones (refer to ecosystem 5 of Figure 3-6) of rivers and floodplains are also included in this category because these ecotones often support stygobites (obligate groundwater inhabitants).
- All ecosystems dependent on the surface expression of groundwater. This category includes base-flow rivers and streams, wetlands (refer to ecosystems 2 and 3, Figure 3-6) some floodplains and mound springs and estuarine seagrass beds. While it is acknowledged that plant roots are generally below ground, this class of GDEs requires a surface expression of groundwater, that may in many cases, then soak below the soil surface and thereby become available to plant roots.
- All ecosystems dependent on the subsurface presence of groundwater, often accessed via the capillary fringe (non-saturated zone above the saturated zone of the water table) when roots penetrate this zone. This class includes terrestrial ecosystems such as River Red Gum (*Eucalyptus camaldulensis*) forests on the Murray–Darling basin (refer to ecosystems 1 and 4, Figure 3-6). No surface expression of groundwater is required in this class of GDEs.

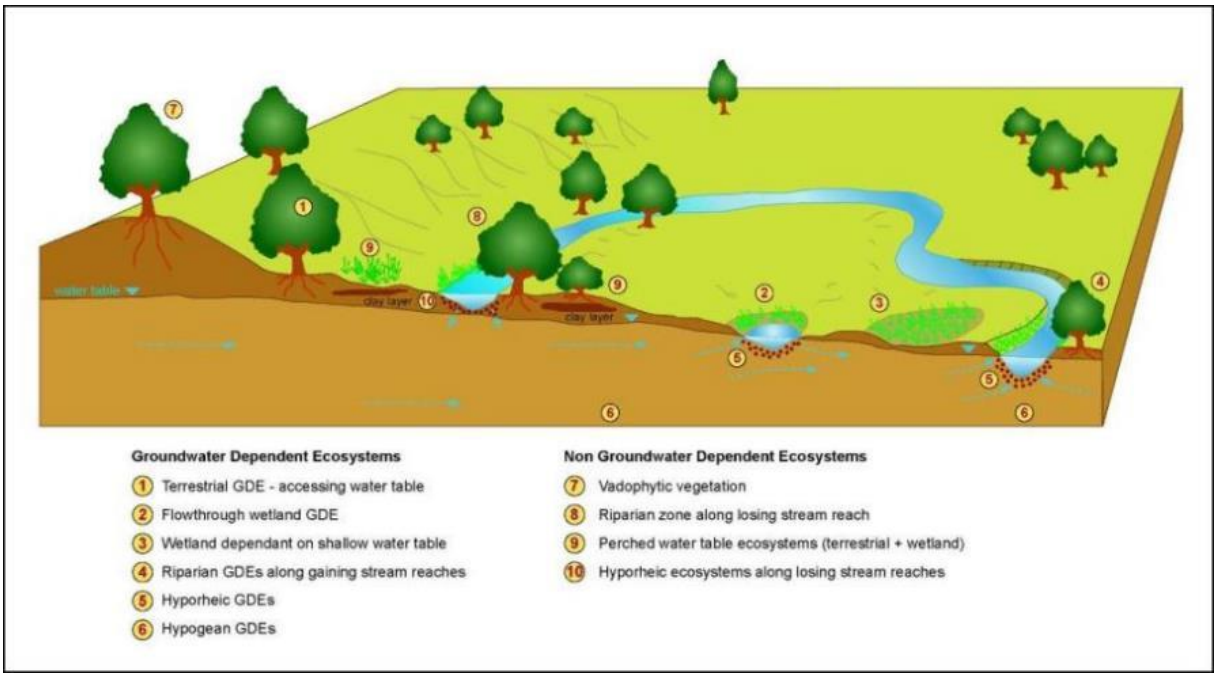


Figure 3-6 Conceptual biophysical model of groundwater dependent ecosystems

GDEs possess a range of values, including being important and sometimes rare ecosystems in themselves, as well as providing important ecosystem services such as water purification (Department of Land and Water Conservation, 2002).

The dependence (or interaction) of the vegetation communities identified within the study area, on groundwater was determined by aligning them with the GDE types identified by Eamus et al. (2006), their likely groundwater dependence in accordance with Volume 1, Section 3 of the *Risk Assessment Guidelines for Ground Dependent Ecosystems* (Serov et al., 2012).

PCTs identified within the biodiversity study area are considered likely to be classified as the following:

- PCT 3583: the Bureau of Meteorology has identified this PCT as having a low potential to be a GDE within the biodiversity study area. This PCT is classified as a Dry Sclerophyll Forest and has the potential to be a terrestrial GDEs that may depend on subsurface presence of groundwater intermittently in times of drought (often accessed via the capillary fringe – subsurface water just above the water table) however is considered largely to be vadophytic vegetation not reliant on groundwater.
- PCTs 4020, 4042 and 3998 were not identified by the BOM (2024) as having potential to be groundwater dependent. However, PCTs 4020, 4042 and 3998 recorded within the study area are all broadly classed as forested wetlands and are likely to be reliant on surface or subsurface water. Therefore, these are terrestrial or riparian GDEs dependent on where they are situated in the landscape.

No groundwater aquifer or cave systems were identified within the study area from the desktop assessment and/or field surveys.

The Bureau of Meteorology GDE Atlas identifies small areas of a moderate potential GDE on the north-eastern and north-western sides of the Mandalong Road/Freemans Drive intersection, in the location of PCT 3583 Hunter Coast Lowland Scribbly Gum Forest.

Three groundwater boreholes registered for stock and domestic use have been identified within 500 m of the subject land (WaterNSW, 2024). Groundwater levels in these boreholes are recorded as ranging from between 5 m to 7 m below ground level. The proposal is likely to be constructed to a depth of around 1.8 metres, the proposal is unlikely to have to require any dewatering and impacts to groundwater water quality impacts would be minimal. Therefore, impacts to the GDE's within the biodiversity study are likely to be minimal.

The deepest works would be a simple extension of an ephemeral culvert that would excavate 100-100 mm deeper than the existing drainage line invert.

Overall, the proposal has negligible potential to directly or indirectly interact with subsurface and/or groundwater flows associated with the GDEs identified above within the biodiversity study area.

3.7 Aquatic results

Mullards Creek occurs within the biodiversity study area. There is also a constructed stormwater channel that occurs under Mandalong Road and adjacent to Gimberts Road at the existing Gimberts Road/Mandalong Road/Gateway Boulevard roundabout.

In accordance with the Fisheries NSW Spatial Data Portal (DPI, 2024), there are no areas of Key Fish Habitat (KFH) mapped within the biodiversity study area. However, KFH is mapped around 350 m north of Gimberts Road.

Habitat assessment of the aquatic/riparian habitat adjacent to the stormwater channel at the Gimberts Road/ Mandalong Road/Gateway Boulevard roundabout and at Mullards Creek adjoining Vegetation Integrity Plot 6 was completed to determine the classification and potential to provide potential habitat for threatened aquatic species in accordance with the Fisheries NSW Policy and Guidelines (DPI, 2013). Figure 2-7 shows the locations of the aquatic habitat assessments.

3.7.1 Mullards Creek

Vegetation within Mullards Creek is classified as the vegetation formation of forested wetlands and assigned to PCT 4020: Coastal Creekflat Layered Grass-Sedge Swamp Forest. Mullards Creek is not mapped as KFH, and the habitat is not considered likely to provide habitat for any threatened aquatic species listed under the FM Act based on the habitat suitability criteria (refer to Appendix B).

Although Mullards Creek is mapped as rising from the south of Mandalong Road and flowing naturally through the private lands to the north of Mandalong Road, this is not actually the case. To the south of Mandalong Road is a constructed wetland within the existing industrial estate, where Mullards Creek would have originally risen. To the north of Mandalong Road the drainage from the constructed wetland flows in a controlled manner and does not become "natural" until it is well north of the biodiversity study area.

A description of the aquatic habitat within Mullards Creek on the northern side of Mandalong Road is provided in Table 3-9.

Table 3-9 Aquatic survey results for Mullards Creek

Habitat attribute	Mullards Creek
Location	Easting 357702 Northing 6335064
DPI Fish Policy Classification	Type 3, Class 4
Habitat features	Ephemeral drain, no instream habitat features or aquatic vegetation. Native trees in canopy, exotic plants along stream bank, with exotic grassland occurring to the west and north of the creekline.
Flow characteristics	None, limited to stagnant pools in soaks.
Bed substrate	Silty clay soils
Existing Infrastructure / barriers to fish movement	Dense vegetation (Typha) Culvert to the south and constructed wetland / detention basin blocking any fish passage
Width (m)	1–2 m
Depth (m)	Estimated to be around 0.5 – 0.8 m deep.
Observed water quality	Dark brown, low visibility and turbid. Limited to stagnant turbid pool.
Upper canopy	*Eucalyptus robusta, Allocasuarina littoralis, Melaleuca nodosa*

3.7.2 Stormwater drain adjoining Mandalong Road

The drainage line that is associated with the stormwater drain occurs within the forested wetland vegetation of PCT 4020: Coastal Creekflat Layered Grass-Sedge Swamp Forest. The stormwater drain is not classified as Key Fish Habitat under the Fisheries NSW Policy and Guidelines (DPI, 2013) and its water source is a constructed wetland to the south of Mandalong Road within the industrial estate area.

A description of the aquatic habitat within the stormwater drain is provided in Table 3-10. A photo of the stormwater drain is provided in Photo 3.16. Figure 2-7 shows the locations of the aquatic habitat assessments, including the aquatic habitat at the western end of the study area.

Table 3-10 Aquatic survey results for the stormwater drain

Habitat attribute	Stormwater drain
Location	Easting 357234 Northing 6334767
DPI Fish Policy Classification	Not classified as Key Fish Habitat
Habitat features	Stormwater drain, no instream habitat features or aquatic vegetation. Native trees in canopy along bank, with native groundcover vegetation along the banks
Flow characteristics	None, limited to stagnant pool between stormwater drain.
Bed substrate	Silty clay soils
Existing Infrastructure / barriers to fish movement	No fish movement likely as the stormwater drain contains urban runoff from a constructed wetland to the south of Mandalong Road.
Width (m)	1–3 m
Depth (m)	Estimated to be around 0.4 – 0.8 m deep.
Observed water quality	Dark brown, low visibility and turbid. Limited to stagnant turbid pool.
Upper canopy	*Melaleuca nodosa, Glochidion ferdinandi*

Photo 3.16 Stormwater drain in the Biodiversity Study Area adjoining Mandalong Road

3.8 Areas of outstanding biodiversity value

In accordance with the NSW Planning Portal ePlanning Spatial Viewer (NSW DCCEEW, 2024), vegetation within and adjacent to the biodiversity study area is mapped as having biodiversity values.

Areas mapped on the Biodiversity Values Map includes the following:

- the northern side of Gimberts Road
- the north-western corner of the Gimberts Road/Mandalong Road/Gateway Boulevard roundabout
- the north-western corner of the Mandalong Road/Freemans Drive/Dora Street/Wyee Road roundabout
- the eastern and western sides of Freemans Drive
- a section of the eastern side of Wyee Road.

However, no declared areas of outstanding biodiversity value are located within or adjacent to the biodiversity study area.

3.9 Wildlife connectivity corridors

Wildlife corridors are generally links of native vegetation that join two or more areas of similar habitat and are critical for sustaining ecological processes, such as provision for animal movement and the maintenance of viable populations (Department of Environment, 2016). The study area is already impacted by fragmentation due to the existing road network, associated power easements, and established and new urban developments.

However, some connectivity does exist. The native vegetation within the north of the study area has some connectivity west, north and east to remnant patches of native vegetation associated with historical rural/forested areas.

Freemans Drive and Mandalong Road are relatively narrow at key crossing points with no median barrier and are permeable for ground level fauna movement, although vehicle strike risk remains.

For arboreal movements, there is a gap in existing connectivity at corridor locations that varies between 10 to 35 m in width between launch points on adjacent trees. Tree canopy does not close over Freemans Drive and Mandalong Road at any location.

The key issue in relation to wildlife connectivity for the proposal is the local Squirrel Glider population and this is discussed hereunder.

3.9.1 Squirrel Glider connectivity

The following is a discussion regarding fauna connectivity for arboreal fauna, focusing on the Squirrel Glider (*Petaurus norfolcensis*) movements/connectivity, associated with the wider Morisset locality in relation to the proposal.

The Lake Macquarie Squirrel Glider Planning and Management Guidelines (2015) were also consulted for guidance regarding populations and movement corridors in the Morisset locality.

Background

In relation to fauna movements in the landscape, the proposal occurs in an area of Morisset that has experienced much growth and development in the preceding decades. The western area of Morisset saw the development of the M1 Pacific Motorway in the late 80's and due to its increased accessibility industrial areas associated with the proposal location have grown considerably.

In relation to the proposal, industrial land-uses dominate lands that were previously dominated by grassy paddocks in the south-west sector, the previous golf course lands in the south-east sector are currently being redeveloped for the Cedar Mill project, the north-east sector has a line of community and business-related buildings along the north side of Dora Street, with a backdrop of pre-existing native open woodland. The north-west sector retains native bushland habitats with incursions of industrial infrastructure (Ausgrid lands), vehicle park up areas at the roundabout and larger residential blocks in the north-western background.

Fauna movement potential in the wider environment

Remnant vegetation areas, which are used by the Squirrel Glider (Bionet and Atlas of Living Australia, 2024), and that are associated with the wider corridor for this species include the following areas:

- To the south and east of the railway line there are continuous areas of open and shrubby woodlands and forests, with extensive areas of swamp sclerophyll forests associated with Dillwynia Creek, Pourmalong Creek, and their tributaries. Records continue out onto the Morisset peninsula to the Woods Point area and Bonnells Bay.
- To the south of the intersection and west of the railway line, straddling Wyee Road west to the M1 Pacific Motorway, lands dominated by native vegetation contain many Squirrel Glider records.
- Beyond the M1 Pacific Motorway to lower ridges of the Watagan Mountain, which are dominated by sclerophyllous forests, Squirrel Glider records continue in less dense numbers, although this may be due to a lack of survey effort in these bushland habitats.
- To the northeast of the subject land, within Morisset, the woodlands associated with Clack's Creek, and Dora Creek further east, there are Squirrel Glider records throughout the area and to the northwest near Gimberts Road there are Squirrel Glider records.

Therefore, the long existing roadways associated with the subject land occur within an area that has long supported Squirrel Glider populations.

Current Squirrel Glider movement potentials associated with the subject land

Squirrel Glider movement corridor opportunities associated with the proposal's road upgrades are as follows in Table 3-11, which are described in more detail following the table.

Table 3-11 Squirrel Glider habitat connection summary

Location	Existing connectivity	Tree canopy gap (m)	Identified by LMCC (Lake Macquarie City Council, 2022)	Importance
North: Freemans Drive	Broad connectivity	< 10	Yes	High
West: Mandalong Road and Gimberts Road	Poor and fragmented	> 20	No	Low
South: Wyee Road	None – western side is industrial	N/A	No, except north – south connectivity on eastern side	Low
East: Dora Street	Single linkage, including existing Squirrel Glider poles	15	Yes	High

Detailed explanation of each of the above locations is provided below, including excerpts of the LMCC (2022) corridor mapping.

Freemans Drive

Wooded vegetation suitable for Squirrel Glider movements and habitation occurs on both the eastern and the western sides of Freemans Drive. In the east, the roadside vegetation is continuous with a relatively large patch of vegetation dominated by Scribbly Gum woodland, extending north as far as the Morisset Showground boundary and east to the rear of private lands. At its eastern boundary there are small vegetation linkages to large vegetation remnants associated with the Clacks Creek corridor east of Ourimbah Street extending beyond Stockton Street.

On the western side of Freemans Drive similar native vegetation communities occur as moderate sizes patches and roadside strips with westward more scant linkages to larger patches of vegetation along the drainage lines associated with Mullards Creek (refer to Figure 3-7) and beyond to Stockton Creek.

Currently the limited separation of vegetation across Freemans Drive, beyond the initial crest, allows for easy glider access across Freemans Drive and gliders have been observed crossing the road in this location in the past (WSP Ecologist *pers. obs.*). At the southern end of Freemans Drive the separation of vegetation is beyond the gliding capabilities of Squirrel Gliders, due to the extensive cleared areas associated with informal vehicle parking areas (east and west) and managed edges of the roundabout and Dora Street (east).

Current linkages for gliders across Freemans Drive would not be significantly diminished by the proposed works associated with the intersection upgrade.

Native Vegetation Corridors_2022

- Riparian Corridor - Native vegetation adjacent to creeks and drainage lines, where visible in aerial photographs.
- Corridor narrowed to less than 200 metres in width.
- Crossing Point - Cleared potential barrier of approximately 10-70 metres width that interrupts native vegetation but could be crossed by mobile fauna.
- Rehabilitation Corridor - Partly cleared native vegetation and crossing points that are strategically located and could be rehabilitated to enhance fauna movement.
- Rehabilitation Urban Corridor - Urban land that interrupts fauna movement lines but may be enhanced with individual trees or pockets of trees to assist fauna movement. Full rehabilitation difficult or unlikely.

LMCC Native Vegetation and Corridors 2022_V3

- Corridor of Remnant Native Vegetation that contributes significantly to movement & viability of flora & fauna in Lake Macquarie City.
- Corridor of Partially Cleared Remnant Native Vegetation that contributes significantly to movement & viability of flora & fauna in Lake Macquarie City.
- Corridor of Partially Cleared Remnant Native Vegetation within an easement that contributes significantly to movement & viability of flora & fauna in Lake Macquarie City.
- Remnant Native Vegetation that has a minor role in flora & fauna movement however may contribute to flora & fauna viability in other ways.
- Partially Cleared Remnant Native Vegetation that has a minor role in flora & fauna movement however may contribute to flora & fauna viability in other ways.
- Partially Cleared Remnant Native Vegetation within an easement that has a minor role in flora & fauna movement however may contribute to flora & fauna viability in other ways.
- Plantation

Figure 3-7 Squirrel Glider movement corridors associated with Freeman's Drive and associated bushland habitats (Lake Macquarie City Council, 2022)

Mandalong Road and Gimberts Road

Vegetation from the western side of Freemans Drive extends west through Ausgrid land along the northern side of Mandalong Road. Within Ausgrid land the naturally occurring Scribbly Gum community is replaced by planted vegetation dominated by Prickly Paperbark (*Melaleuca nodosa*) and occasional occurrences of Black She-Oak (*Allocasuarina littoralis*), Rough-barked Apple (*Angophora floribunda*) and Swamp Oak (*Casuarina glauca*). Beyond its western boundary the Ausgrid vegetation gives way to a 30 m power easement (Jamerin Way) dominated by grasses. Due to the high density and relatively low height of vegetation in the Ausgrid land it is unlikely that Squirrel Gliders could span the distance between vegetation across the Jamerin Way power easement. Further west Forest Red Gum (*E. tereticornis*) individuals continue along the roadway to Prickly Paperbark stands associated with the Mandalong Road/Gateway Boulevard roundabout and Gimberts Road, with further breaks in vegetation that may be difficult for Squirrel Gliders to span.

Swamp Sclerophyll communities dominated by Swamp Mahogany (*E. robusta*) extend north from the eastern end of Gimberts Road near the current roundabout, which is populated by gliders, but there are limited linkages to the vegetation strip between Gimberts Road and the off ramp of the M1 Pacific Motorway for gliders. The M1 ramp itself represents a break in vegetation between its northern and southern sides of around 30 m. Vegetation in this location is unlikely to have sufficient height to aid gliders in crossing the roadway.

East of Gateway Boulevard on the southern side of Mandalong Road there is a transmission line easement that separates the roadway from the industrial area and its easement is managed to keep vegetation low due to potential fire risks. Although there is a continuous planted row of tall Sydney Blue Gum (*E. saligna*) along the edge of the industrial area, the gap between this stand and vegetation on the southern side of Mandalong Road is too wide to allow gliders to cross the road.

In summary, there are currently no linkages across Mandalong Road which might aid Squirrel Gliders to cross the roadway. This is due to the excessive distances between vegetation either side of the road and insufficient tree height for them to glide across the road (refer to Figure 3-8). Therefore, the proposed works will not diminish current access and movements for gliders across Mandalong Road.

Nevertheless, there is a vegetation community corridor extending south between the industrial area and the M1 (west of Mayfair Close, which would benefit from linkages across the M1 ramp to the forest associated with Gimberts Road.

Figure 3-8 The lack of Squirrel Glider movement corridors associated with Mandalong Road and its associated habitats (Lake Macquarie City Council, 2022)

Wyee Road

There is no native canopy vegetation along the western side of Wyee Road until some 170 m south of Alliance Avenue. On the eastern side of Wyee Road, associated with the Cedar Mill event site land, there is a strip of trees dominated by White Stringybark (*E. globoidea*) that extends south beyond the commencement of western Wyee Road canopies but does not continue north sufficient distance to reach Dora Street on the eastern side of the roundabout. Previously occurring native vegetation linkages, with swamp sclerophyll elements, along the north-eastern side of Wyee Road have been removed by the Cedar Mill event site development, and in their place a series of glider poles have been installed to replace the linkages represented by native vegetation where the pink dashed line occurs in the map below (refer to Figure 3-9). The proposed works will not prevent movements for gliders across Wyee Road beyond its current limitations. The location of the existing Squirrel Glider poles is shown in Figure 3-10.

Native Vegetation Corridors_2022

- Riparian Corridor - Native vegetation adjacent to creeks and drainage lines, where visible in aerial photographs.
- Corridor narrowed to less than 200 metres in width.
- Crossing Point - Cleared potential barrier of approximately 10-70 metres width that interrupts native vegetation but could be crossed by mobile fauna.
- Rehabilitation Corridor - Partly cleared native vegetation and crossing points that are strategically located and could be rehabilitated to enhance fauna movement.
- Rehabilitation Urban Corridor - Urban land that interrupts fauna movement lines but may be enhanced with individual trees or pockets of trees to assist fauna movement. Full rehabilitation difficult or unlikely.

LMCC Native Vegetation and Corridors 2022_V3

- Corridor of Remnant Native Vegetation that contributes significantly to movement & viability of flora & fauna in Lake Macquarie City.
- Corridor of Partially Cleared Remnant Native Vegetation that contributes significantly to movement & viability of flora & fauna in Lake Macquarie City.
- Corridor of Partially Cleared Remnant Native Vegetation within an easement that contributes significantly to movement & viability of flora & fauna in Lake Macquarie City.
- Remnant Native Vegetation that has a minor role in flora & fauna movement however may contribute to flora & fauna viability in other ways.
- Partially Cleared Remnant Native Vegetation that has a minor role in flora & fauna movement however may contribute to flora & fauna viability in other ways.
- Partially Cleared Remnant Native Vegetation within an easement that has a minor role in flora & fauna movement however may contribute to flora & fauna viability in other ways.
- Plantation

Figure 3-9 Squirrel Glider movement corridors associated with Wyee Road and Dora Street and its associated habitats (Lake Macquarie City Council, 2022)

Dora Street

Historically, prior to the Cedar Mill event site development occurring, the previous Morisset Golf Course would have provided good connectivity for the local Squirrel Glider population via the extensive remnant tree patches between fairways. These have all be removed as part of the Cedar Mill event site development and replaced by a glider pole network that aims to connect native vegetation from the south across Dora Street to the north.

There is currently a single linkage for gliders across Dora Street from the south across to where the remnant patch of Scribbly Gum woodland extends south toward the road some 70m from the Mandalong/Dora Street roundabout intersection on the northern side of Dora Street (refer to eastern end of B53 in Figure 3-9).

Currently the vegetation on the northern side of the road is somewhat shorter than the planted trees on the southern side of the road. Therefore, movements for Squirrel Gliders from the south to the north might be more easily accomplished than movements from the north to the south. Field observations of the crossing found that the current extent of vegetation was not widely separated by the existing roadway, with the gap being around 15 m, so the crossing looks to be functional and also have future potential for enhancement.

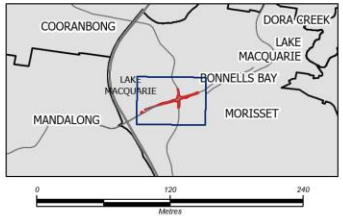
The existing connectivity is also facilitated by the glider poles which have recently been installed on the Cedar Mill event site as part of mitigation measures for the new development. LMCC has identified this crossing as a key crossing and connection point for the local Squirrel Glider population.

Mandalong Road Upgrade

Figure 3-10
Existing Squirrel Glider Pole Locations

Legend

- Subject Land (Proposal area)
- Biodiversity study area
- Watercourse
- Road
- Existing squirrel glider pole locations



Coordinate system: GDA2020 MGA Zone 56
Scale ratio correct when printed at A3

1:4,837 Date: 26/11/2024

GDA 2020

Data sources: Geoscience Australia, Nearmap, NSWSS

3.10 State Environmental Planning Policies

There are currently two State Environmental Planning Policies (SEPPs) that relate to biodiversity that are considered relevant to the proposal, including:

- State Environment Planning Policy (Resilience and Hazards) 2021 (Resilience and Hazards SEPP)
- State Environmental Planning Policy (Biodiversity and Conservation) 2021.

3.10.1 State Environmental Planning Policy (Resilience and Hazards) 2021

The Resilience and Hazards SEPP was introduced to provide an integrated policy for coastal assets. Under Chapter 2 of the Resilience and Hazards SEPP, areas of coastal wetlands and proximity to coastal wetlands (100 m buffer) have been mapped across NSW.

In accordance with the NSW Planning Portal ePlanning Spatial Viewer (NSW DCCEEW, 2024), there are no mapped areas of coastal wetlands or proximity to coastal wetlands located within the biodiversity study area. However, there is a mapped area of coastal wetlands located around 1 km north of Mandalong Road that is connected to Mullards Creek.

Overall, there is potential for indirect impacts to coastal wetlands, however mitigation measures will be implemented to avoid impacts to coastal wetlands.

3.10.2 State Environmental Planning Policy (Biodiversity and Conservation) 2021

Chapters 3 and 4 of the Biodiversity and Conservation SEPP aim 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.

Although the Lake Macquarie LGA is listed under Schedule 2 of the SEPP, the proposal does not require assessment in accordance with the SEPP as it is an activity being considered under Division 5.1 of the EP&A Act.

Targeted surveys, including spotlighting and call playback, have been completed to determine the presence of Koalas in the biodiversity study area. Koalas were not recorded within the biodiversity study area during field surveys, and therefore are not considered to be present or a substantive biodiversity concern for the proposal.

3.11 Matters of national environmental significance

Biodiversity Matters of National Environmental Significance (MNES) protected under the EPBC Act include:

- listed threatened species and ecological communities
- listed migratory species (protected under international agreements)
- biodiversity values that are protected as either World Heritage Properties or National Heritage Places
- the environment where actions are being taken on Commonwealth land or impact upon Commonwealth land.

Refer to Figure 3-11 for the location of recorded MNES.

3.11.1 Threatened ecological communities

The results of the PMST report indicate that four EPBC listed TECs are known or considered to have potential to occur in the locality. These ecological communities include:

- Subtropical and Temperate Coastal Saltmarsh
- Coastal Swamp Sclerophyll Forest of NSW and South East Queensland
- River-flat eucalypt forest on coastal floodplains of southern NSW and eastern Victoria
- Coastal Swamp Oak (Casuarina glauca) Forest of NSW and South East Queensland ecological community.

Of these, one EPBC Act listed TEC was confirmed as occurring within the biodiversity study area by field validation surveys being Coastal Swamp Sclerophyll Forest of NSW and South East Queensland, as outlined in the following sections.

Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland

Two PCTs were considered as candidates as being commensurate with this TEC, being:

- PCT 3998 Lower North Creek Flat Mahogany Swamp Forest – Good and Moderate condition
- PCT 4020 Coastal Creekflat Layered Grass-Sedge Swamp Forest – Good condition.

In order to be considered a MNES, the patches of PCT 3998 and PCT 4020 must be consistent with the criteria outlined in the conservation advice (incorporating listing advice) for the Coastal Swamp Sclerophyll Forest of NSW and South East Queensland ecological community (Department of Agriculture, Water and the Environment 2021). Specifically, the vegetation must meet:

- the key diagnostic characteristics; and
- at least the minimum condition thresholds.

A comparison of PCT 3998 and PCT 4020 patches within the biodiversity study area against the key diagnostic characteristics for Coastal Swamp Sclerophyll Forest of NSW and South East Queensland ecological community is provided in Table 3-13. This assessment concludes that all the patches of PCT 3998 (good condition) and PCT 4020 (good condition) meet the key diagnostic criteria for Coastal Swamp Sclerophyll Forest of NSW and South East Queensland.

A condition assessment (refer to Table 3-14) was conducted to determine if PCT 3998 (good and moderate condition) and PCT 4020 patches meet the condition criteria for listing as this EEC. Based on the Vegetation Integrity plot data collected from within the biodiversity study area, all the patches of PCT 3998 good condition and PCT 4020 meets the condition criteria for Class B2 - small patch that meets key diagnostics and has a predominantly native ground layer and is contiguous with another large area of native vegetation. PCT 3998 moderate condition does not meet the condition criteria for listing as this EEC as it has a groundcover of 88% exotic vegetation.

Table 3-12 Extent of Coastal Swamp Sclerophyll Forest of NSW and South East Queensland within the subject land and the biodiversity study area

Associated PCT	Condition class	Extent in the biodiversity study area that meets final determination criteria (ha)	Extent in the subject land that meets final determination criteria (ha)
PCT 3998 Lower North Creekflat Mahogany Swamp Forest	Good	0.13	0.01
PCT 4020 Coastal Creekflat Layered Grass Sedge Forest	Good	0.51	0.03
Total		**0.64**	**0.04**

Table 3-13 Comparison of Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland key diagnostic characteristics against PCT 3998 and PCT 4020 within the study area

Key diagnostic characteristics	PCT 4020	PCT 3998
	Good	Good
Occurs on the mainland and islands near to the coast (within 20 km) from South East Queensland to south-eastern NSW specifically within these IBRA Bioregions: South Eastern Queensland; NSW North Coast; Sydney Basin and the Bateman sub-region of the South East Corner.	Yes, occurs on the mainland within 20 km of the coast within the Sydney Basin IBRA Bioregion.	
Occurs in coastal catchments typically below 20 m asl, but occasionally up to 220 m asl.	Yes, occurs in a coastal catchment below 20 m asl.	

Key diagnostic characteristics	PCT 4020	PCT 3998
	Good	Good
Occurs on hydric soils with inundation patterns ranging from intermittent to episodic.	Yes, occurs on hydric soils subject to periodic inundation.	Yes, occurs on hydric soils subject to periodic inundation.
The vegetation structure varies from tall closed to open forest to woodland, to dense (closed) shrubland or scrub forest. Minimum crown cover (see footnote 5, p. 4) is at least 10%, but it is more typically in the range 50% to 70%.	Yes, This PCT has a vegetation structure of closed forest. This PCT has a canopy cover of 50% to 70% crown cover	Yes, This PCT has a vegetation structure of open forest. This PCT has a canopy cover of 40% to 60%.
From South East Queensland to the Sydney Basin Bioregion, the canopy is typically dominated or co-dominated by *Melaleuca quinquenervia* and/or *Eucalyptus robusta*. In some areas, the canopy may be locally dominated by other melaleuca species including M. dealbata (SEQ bioregion) (rarely); *M. biconvexa* (mid-NSW coast to south of Sydney); M. decora (north of Shoalhaven), frequently with Parsonsia straminea climbing on the trunks of canopy species. In the SEC bioregion, *M. ericifolia* may occur as a dominant canopy or sub-canopy species.	Yes, This PCT is dominated by *Melaleuca nodosa and Melaleuca sieberi.* *Eucalyptus robusta* occurs as a co-dominant species with *Parsonsia straminea* commonly occurring throughout the PCT.	Yes, This PCT is dominated by *Eucalyptus robusta and Melaleuca nodosa.* *Parsonsia straminea* commonly occurs throughout the PCT.
Other tree species may occur in the canopy (or sub-canopy) in some areas, but they are not dominant across a patch, including *Casuarina glauca*, Banksia spp., *Callistemon salignus, Corymbia intermedia* (Pink Bloodwood), *E. tereticornis*, (Forest Red Gum/Queensland Blue Gum), *E. longifolia* (Woollybutt), E. *botryoides* (Southern Mahogany/Bangalay), *E. ovata* (Swamp Gum), *Livistona australis* and/or Lophostemon spp	Yes, None of these species occur within this PCT or are dominant	Yes, *Banksia oblongifolia* occurred within this PCT but is not dominant
The understorey typically includes a variable ground layer, depending on the canopy cover and inundation rate/period. Tall sedges (typically Gahnia spp.) and/or ferns often dominate the ground layer, mixed with graminoids and other herbs, especially *Imperata cylindrica* (Blady Grass).	Yes, The groundlayer is very variable depending upon the canopy layer and inundation rate/period. Tall sedges (*Gahnia spp.*), is dominant with ferns, grasses and herbs are present.	Yes, The groundlayer is variable with a high diversity of herbs, sedges and grasses.
While they can occur regularly in the ground layer, the ecological community is not present if halophytic species, more typically associated with estuarine/saltmarsh areas, dominate the ground layer of a patch, for example, *Appium prostratum, Atriplex cineria, Chenopodium glaucum, Rhagodia candolleaus* and *Samolus repens.*	The ground layer is not dominated by halophytic species. See Appendix A for species recorded.	The ground layer is not dominated by halophytic species. See Appendix A for species recorded.
Does this condition type meet the EPBC Act listing key diagnostic characteristics?	**Yes**	**Yes**

Table 3-14 Coastal Swamp Sclerophyll Forest of NSW and South East Queensland minimum condition thresholds, classes and categories

Biotic thresholds	Patch size thresholds					
	Large patch The patch is at least 5 ha. It may or may not be contiguous with other native vegetation.	Medium patch The patch is at least 2 ha and less than 5 ha. It may or may not be contiguous with other native vegetation	Small contiguous patch The patch is at least 0.25 ha and less than 2 ha and is part of a larger area of native vegetation of at least 5 ha.	Small patch The patch is at least 0.5 ha and less than 2 ha which is isolated or part of a small native vegetation remnant less than 5 ha in total.	PCT 4020	PCT 3998
High condition Non-native species comprise < 20% of total ground layer vegetation cover	CLASS A A large patch that meets key diagnostics and has a predominantly native ground layer.	CLASS B1 A medium patch that meets key diagnostics and has a predominantly native ground layer.	CLASS B2 A small patch that meets key diagnostics and has a predominantly native ground layer and is contiguous with another large area of native vegetation.	CLASS C1 A small patch which meets key diagnostics and has a predominantly native ground layer.	Vegetation Integrity plots 1 has < 20% of total ground layer vegetation cover comprised of non-native species: This patch **meets** Class B2. Vegetation integrity plot 8 < 20% of total ground layer vegetation cover comprised of non-native species: This patch **meets** Class B2.	Vegetation Integrity Plot 2: has < 20% of total ground layer vegetation cover comprised of non-native species: This patch **meets** Class B2.
Good condition Non-native species comprise 20% to 50% of total ground layer vegetation cover	CLASS B1 A large patch that meets key diagnostics and the ground layer is mostly native.	CLASS C1 A medium patch that meets key diagnostics and the ground layer is mostly native.	CLASS C2 A small patch that meets key diagnostics and has a mostly native ground layer and is contiguous with another large area of native vegetation.	CLASS C2 A small patch that meets key diagnostics and has a mostly native ground layer	None of the Vegetation Integrity plots done in the biodiversity study area fall into the good condition biotic threshold.	None of the Vegetation Integrity plots done in the biodiversity study area fall into the good condition biotic threshold.

Biotic thresholds	Patch size thresholds					
	Large patch The patch is at least 5 ha. It may or may not be contiguous with other native vegetation.	Medium patch The patch is at least 2 ha and less than 5 ha. It may or may not be contiguous with other native vegetation	Small contiguous patch The patch is at least 0.25 ha and less than 2 ha and is part of a larger area of native vegetation of at least 5 ha.	Small patch The patch is at least 0.5 ha and less than 2 ha which is isolated or part of a small native vegetation remnant less than 5 ha in total.	PCT 4020	PCT 3998
Moderate condition Non-native species comprise 50% - 80% of total ground layer vegetation cover	CLASS C1 A large patch which meets key diagnostics, and the ground layer has at least 20% native vegetation cover.	CLASS C2 A medium patch that meets key diagnostics and the ground layer has at least 20% native vegetation cover.	Not protected.	Not protected.	None of the Vegetation Integrity plots done in the biodiversity study area fall into the moderate condition biotic threshold.	None of the Vegetation Integrity plots done in the biodiversity study area fall into the moderate condition biotic threshold.
Low condition non-native species comprise more than 80% of total ground layer vegetation cover	CLASS C2 A large patch which meets key diagnostics, but the ground layer has low native vegetation cover.	Not protected.	Not protected.	Not protected.	None of the Vegetation Integrity plots done in the biodiversity study area fall into the low condition biotic threshold.	Vegetation Integrity Plot 6 has a non-native vegetation cover of 88% and is less than 5 ha in size. Therefore, it **does not meet** the low condition threshold

Source: Conservation advice (incorporating listing advice) for the Coastal Swamp Sclerophyll Forest of NSW and South East Queensland ecological community (Department of Agriculture, Water and the Environment, 2021).

3.11.2 Threatened species

Threatened flora species

The desktop assessment identified 29 listed threatened flora species as being known or predicted to occur in the locality of the proposal. Of these, 10 were considered to have a moderate or higher likelihood of occurring within the biodiversity study area based on available habitat, previous records and the habitat suitability assessment criteria (refer to Appendix B). These species were the candidates for detailed targeted surveys.

Two candidate listed threatened flora species were recorded within the biodiversity study area during field surveys; *Angophora inopina* (Charmhaven Apple) and *Tetratheca juncea* (Black-eyed Susan). All other remaining candidate species were not recorded during the survey.

Table 3-15 outlines the candidate species, their conservation status, potential occurrence and whether they are likely to be impacted by the proposal. Each species impacted or predicted to potentially be impacted is considered further with respect to MNES significant assessments (refer to Appendix E).

Table 3-15 EPBC Act listed threatened flora species survey results

Species name	EPBC Act	Potential occurrence	Affected species?
Angophora inopina (Charmhaven Apple)	V	Recorded	Yes. A total of 23 individuals were recorded within the biodiversity study area. Three of these will be impacted directly by the proposal, with the remainder to be retained within the biodiversity study area.
Caladenia tessellata (Thick-lipped Spider-orchid)	V	Moderate	No - surveyed
Cryptostylis hunteriana (Leafless Tongue Orchid)	V	Moderate	No - surveyed
Diuris praecox (Rough Doubletail)	V	Moderate	No - surveyed
Genoplesium insigne (Variable Midge Orchid)	CE	Moderate	No - surveyed
Grevillea parviflora subsp. *Parviflora* (Small-flower Grevillea)	V	Moderate	No - surveyed
Rutidosis heterogama (Heath Wrinklewort)	V	Moderate	No - surveyed
Tetratheca juncea (Black-eyed Susan)	V	Recorded	Yes. Impacted species. No known Tetratheca juncea clumps will be directly impacted by the proposal within the subject land. Twenty-six clumps will be retained. Area of species polygon to be impacted is calculated as 0.15 ha compared to retention of 0.89 ha within the biodiversity study area.

Threatened fauna species

The desktop assessment identified 87 listed threatened fauna species as being known or predicted to occur in the locality of the proposal. Of these, six EPBC Act listed threatened fauna species were considered to have a moderate or higher likelihood of occurring within the biodiversity study area based on available habitat, previous records and the habitat suitability assessment criteria (refer to Appendix B).

One candidate listed threatened fauna species was recorded within the biodiversity study area during field surveys; Grey-headed Flying Fox (*Pteropus poliocephalus*). All other remaining EPBC Act listed candidate species were not recorded during the survey program.

Table 3-16 outlines the candidate species, their conservation status, potential occurrence and whether they are likely to be impacted by the proposal. Each species impacted or predicted to potentially be impacted is considered further with respect to MNES significant assessments (refer to Appendix E).

Table 3-16 EPBC Act listed threatened fauna species survey results

Species name	EPBC Act	Credit Type	Potential occurrence	Affected species?
Gang-gang Cockatoo (*Callocephalon fimbriatum*)	E	Ecosystem/ Species	Moderate	Species not recorded within the study area during targeted surveys. Evidence of breeding habitat was also not recorded within the study area during the survey program. Impacts associated with the proposal are limited to potential foraging habitat that may be used intermittingly by the species.
South-eastern Glossy Black Cockatoo (*Calyptorhynchus lathami lathami*)	V	Ecosystem/ Species	Moderate	Species not recorded within the study area during targeted surveys. Evidence of breeding habitat was also not recorded within the study area during the survey program. Impacts associated with the proposal are limited to potential foraging habitat that may be used intermittingly by the species.
Regent Honeyeater (*Anthochaera phrygia*)	CE	Ecosystem/ Species	Moderate	Species not recorded within the study area during field survey. No Important Habitat is mapped within the study area and no breeding habitat was identified during the survey program. Impacts associated with the proposal are limited to potential foraging habitat that may be used intermittingly by the species.
Swift Parrot (*Lathamus discolor*)	CE	Ecosystem/ Species	Moderate	Species not recorded within the study area during field survey. Important Habitat is mapped within the biodiversity study. Impacts associated with the proposal are limited to potential foraging habitat that may be used by the species. The proposal will impact upon 0.27 ha of potential foraging habitat compared to retention of 2.08 ha. Not some of the impacted habitat is in fact a cleared unofficial car park on the north western corner of the Freemans Drive and Mandalong Rd intersection.
Koala (*Phascolarctos cinereus*)	E	Species	Moderate	No - surveyed
Large-Pied Eared Bat (*Chalinolobus dwyeri*)	V	Species	Moderate	No - surveyed
Grey-headed Flying Fox (*Pteropus poliocephalus*)	V	Ecosystem/ Species	Recorded	Species was recorded foraging within the biodiversity study area. No evidence of breeding habitat (i.e. camps) was recorded within the biodiversity study area throughout the survey program. Impacts associated with the proposal are limited to potential foraging habitat that would be used intermittingly by the species. The proposal will impact upon 0.69 ha of potential foraging habitat compared to retention of 3.47 ha.

3.11.3 Migratory species

Migratory species are protected under international agreements, to which Australia is a signatory, including JAMBA, CAMBA, ROKAMBA and the Bonn Convention on the Convention of Migratory Species of Wild Animals. Migratory species are considered MNES and are protected under the EPBC Act.

Database searches identified 21 migratory species to potentially occur within the locality, with two species considered to have a moderate likelihood of occurring within the biodiversity study area based on habitat available, previous records and the habitat suitability assessment criteria (refer to Appendix B).

The Swift Parrot is largely attracted to stands of Swamp Mahogany (*Eucalyptus robusta*) dues to its winter flowering habits. This species is also well known to use lerps where infestations occur, however no evidence of lerp infestations were observed in habitats associated within the project areas, or surrounding habitats.

Swift Parrot and Regent Honeyeater habitats within the biodiversity study area are unlikely to constitute actual important habitat, due to the habitat present being unlikely to support significant proportions of the population nor are they habitats critical to any life stages of the species, due to their mobile nature. Therefore, the proposal is considered unlikely to significantly impact on these species.

Migratory species are protected under international agreements, to which Australia is a signatory, including JAMBA, CAMBA, RoKAMBA and the Bonn Convention on the Convention of Migratory Species of Wild Animals. Migratory species are considered MNES and are protected under the EPBC Act.

While some migratory species of bird are likely to use the subject land and locality, the subject land would not be classed as an 'important habitat' for these species. The habitats within the study area are unlikely to constitute important habitat for any of these species, due to the habitat present being unlikely to support significant proportions of the population of any migratory species nor are they habitats critical to any life stages of the species, due to their mobile nature, and where more extensive tracts of native vegetation occur. Thus, the proposal is unlikely to significantly impact these species.

Table 3-17 Migratory fauna species with a moderate to high likelihood of occurrence

Scientific name	Common name	EPBC Act[1]	Potential occurrence
Anthochaera phrygia	Regent Honeyeater	CE, M	Moderate
Lathamus discolor	Swift Parrot	CE, M	Moderate

(1) M = Migratory, V = Vulnerable and CE = Critically Endangered under the EPBC Act.

3.11.4 Critical habitat

A review of the EPBC Act critical habitat register did not identify any critical habitat to be known or considered likely to occur within the biodiversity study area.

3.11.5 Wetlands of international importance

The PMST report identified no Wetlands of International Importance (Ramsar Wetlands) within the locality.

3.11.6 World heritage properties and national heritage places

The PMST report identified no World Heritage Properties or National Heritage Places within the locality.

3.11.7 Commonwealth owned land

The PMST report identified no Commonwealth owned land within the biodiversity study area.

Mandalong Road Upgrade

Figure 3-11
Matters of national environment significance

Legend

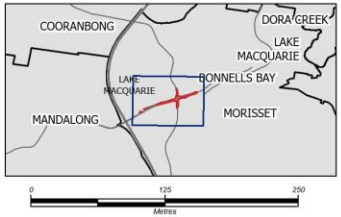
- Subject Land (Proposal area)
- Biodiversity study area
- Watercourse
- Road

Threatened species

- *Tetratheca juncea* - vulnerable
- *Angophora inopina* - vulnerable
- Grey-headed Flying Fox - vulnerable

Threatened ecological community

- Coastal Swamp Sclerophyll Forest of NSW and South East Queensland – endangered



Coordinate system: GDA2020 MGA Zone 56
Scale ratio correct when printed at A3

1:5,000 Date: 26/11/2024

GDA 2020

Data sources: Geoscience Australia, Nearmap, NSWSS

4. Avoidance and minimisation

In managing biodiversity, Transport aims to achieve a balanced outcome, taking account of environmental considerations together with economic and community objectives. This includes a balanced approach to examining the environmental consequences of an activity, recognising that achieving an optimal outcome often requires compromise and decisions regarding environmental values. A key part of Transport's management of biodiversity for this proposal is the application of the 'avoid, minimise, mitigate and offset' hierarchy, as follows:

- avoid and minimise impacts as the highest priority
- mitigate impacts where avoidance is not feasible or practicable in the circumstance
- offset where residual, significant unavoidable impacts would occur.

Avoiding environmental impacts as the first step is consistent with the application of the precautionary principle. Transport's priority is to avoid impacts to the environment. This can be achieved by early consideration of environmental issues from identification of constraints at project inception through to options analysis and selection of a preferred option, design investigation and assessment of the preferred option, detailed design, and implementation of on-ground safeguards during construction and operation and maintenance of the activity.

The primary method to avoid impacts is to where possible, locate activities away from areas of known or potential high biodiversity value. However, opportunities have been limited in scope as the proposal involves the widening of the existing road corridor and some impacts cannot be avoided with the design restricted to the location of the current roads.

In identifying suitable work sites, the first preference is to locate existing cleared and disturbed areas that have good access, are not within immediate proximity to waterways, and that support good site management practices (for example, management of material stockpiles). The ancillary sites have been located to avoid impacts to biodiversity. Four ancillary sites are proposed in which three are in cleared areas and one ancillary site is proposed to be located as part of the property acquisition for the proposal.

The subject land area was minimised in two locations, being:

- near the ancillary facility AF4 on Mandalong Road, which reduced edge impacts to PCT 4020: Coastal Creekflat Layered Grass Sedge Forest (listed TEC under BC Act and EPBC Act)
- at ancillary facility AF2 at the intersection of Mandalong Road and Freemans Drive, where edge impacts to PCT 3583: Hunter Coast Lowland Scribbly Gum Forest were reduced.

The opportunities for avoidance were otherwise limited due to the location of the existing infrastructure and design requirements of the proposal.

Additionally, subsequent detailed design stages include opportunity to maintain fauna connectivity at targeted locations by limiting tree clearing and focusing on canopy trimming as well as providing glider connectivity measures.

5. Impact assessment

A description of potential impacts to biodiversity as a result of the proposal during the construction and operational phases are summarised in this chapter. The impacts have been separated into direct, indirect and cumulative impact categories and include the following:

- construction direct impacts:
  - removal of native vegetation and TECs
  - removal of threatened fauna habitat and habitat features
  - removal of threatened flora
  - injury and mortality
  - GDEs
- indirect/operational impacts:
  - edge effects on adjacent native vegetation and habitat
  - wildlife connectivity and habitat fragmentation
  - invasion and spread of weeds
  - invasion and spread of pests
  - invasion and spread of pathogens and disease
  - injury and mortality
  - changes to hydrology
  - noise, light and vibration
  - cumulative impacts.

Where applicable, impacts are also correlated with relevant key threatening processes, impact evaluation and significance assessments.

5.1 Construction direct impacts

5.1.1 Removal of native vegetation

The proposal is expected remove around 1 ha of native vegetation within the subject land. A breakdown of approximate native vegetation removal of each PCT and vegetation zone is provided below in Table 5-1.

Table 5-1 Summary of direct impacts on native vegetation

Veg. zone	PCT	Broad condition class	BC Act Status	EPBC Act Status	Area to be impacted (ha)
1	PCT 3583: Hunter Coast Lowland Scribbly Gum Forest	Good	Not listed	Not listed	0.36
2		Regrowth	Not listed	Not listed	0.02
3	PCT 3998 Lower North Creekflat Mahogany Swamp Forest	Good	Endangered	Endangered	0.01
4		Moderate	Endangered	Does not meet listing criteria	0.23
5		Planted Native Vegetation	Does not meet listing criteria	Does not meet listing criteria	0.25
6	PCT 4020 Coastal Creekflat Layered Grass Sedge Forest	Good	Endangered	Endangered	0.08
7	PCT 4042 Lower North Riverflat Eucalypt Paperbark Forest	Moderate	Endangered	–	0.03
Total					**0.98 ha**

5.1.2 Removal of threatened fauna habitat

The extent of vegetation removal estimated to result from the proposal is outlined in Section 5.1.1. This vegetation provides suitable habitat and habitat features for a range of threatened fauna species listed under the BC Act and/or EPBC Act. Therefore, direct impacts to habitat for threatened fauna species would occur during construction.

A breakdown of the direct impacts on threatened fauna species is provided in Table 5-2.

Table 5-2 Summary of direct impacts on threatened fauna and habitat

Species name	EPBC Act	BC Act	Credit type[e]	Potential occurrence (Moderate, High, Recorded)	Associated habitat in subject land	Impact based on Bionet associated PCT (ha)
Dusky Woodswallow (*Artamus cyanopterus cyanopterus*)	–	V	Ecosystem	Moderate	PCT 3583, PCT 3998, PCT 4020, PCT 4042	0.98 ha of foraging habitat
Gang-gang Cockatoo (*Callocephalon fimbriatum*)	E	E	Ecosystem/ Species no nests present assessed as an ecosystem species	Moderate	PCT 3583, PCT 3998, PCT 4020, PCT 4042	0.98 ha of foraging habitat
South-eastern Glossy Black Cockatoo (*Calyptorhynchus lathami lathami*)	V	V	Ecosystem/Species no nests present assessed as an ecosystem species	Moderate	PCT 3998	0.49 ha of foraging habitat
Varied Sittella (*Daphoenositta chrysoptera*)	–	V	Ecosystem	Recorded	PCT 3583 (Good Condition) PCT 3998 (all conditions) PCT 4020	0.85 ha of foraging habitat
Little Lorikeet (*Glossopsitta pusilla*)	–	V	Ecosystem	Recorded	PCT 3583, PCT 3998, PCT 4020, PCT 4042	0.98 ha of foraging habitat
Little Eagle (*Hieraaetus morphnoides*)	–	V	Ecosystem/species no nests recorded so assessed as an ecosystem credit species	Recorded	PCT 3583 – good condition	0.36 ha of foraging habitat
Powerful Owl (*Ninox strenua*)	–	V	Species	Recorded	PCT 3583, PCT 3998, PCT 4020, PCT 4042	0.98 ha of foraging habitat
Masked Owl (*Tyto novaehollandiae*)	–	V	Species	Moderate	PCT 3583, PCT 3998, PCT 4020, PCT 4042	0.98 ha of foraging habitat
Sooty Owl (*Tyto tenebricosa*)	–	V	Species	Moderate	PCT 4020, PCT 4042	0.11 ha of foraging habitat

Species name	EPBC Act	BC Act	Credit type[e]	Potential occurrence (Moderate, High, Recorded)	Associated habitat in subject land	Impact based on Bionet associated PCT (ha)
Regent Honeyeater (*Anthochaera phrygia*)	CE	CE	Ecosystem/ Species No breeding habitat therefore assessed as an ecosystem credit species	Moderate – Foraging habitat present on site	PCT 3583, PCT 3998, PCT 4020, PCT 4042	0.98 ha of foraging habitat
Swift Parrot (*Lathamus discolor*)	CE	E	Ecosystem/ Species No breeding habitat assessed as an ecosystem credit species	Assumed Previously recorded Impacted – area to the north of Mandalong Road is mapped as Swift Parrot Important habitat.	Important Mapped Habitat	0.27 ha of foraging habitat
Eastern False Pipistrelle (*Falsistrellus tasmaniensis*	–	V	Ecosystem	Recorded	PCT 3583, PCT 3998, PCT 4020, PCT 4042	0.98 ha of foraging habitat
Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*)	–	V	Ecosystem	Recorded	PCT 3583, PCT 3998, PCT 4020, PCT 4042	0.98 ha of foraging habitat
Little Bent-winged Bat (*Miniopterus australia*)	–	V	Ecosystem/Species No breeding habitat assessed as an ecosystem credit species	Recorded	PCT 3583, PCT 3998, PCT 4020, PCT 4042	0.98 ha of foraging habitat
Large Bent-winged Bat (*Miniopterus Orianae oceanensis*)	–	V	Ecosystem/Species No breeding habitat assessed as an ecosystem credit species	Recorded	PCT 3583, PCT 3998, PCT 4020, PCT 4042	0.98 ha of foraging habitat
Greater Broad-nosed Bat (*Scoteanax rueppellii*)	–	V	Ecosystem	Recorded	PCT 3583, PCT 3998, PCT 4020, PCT 4042	0.98 ha of foraging habitat
Southern Myotis (*Myotis macropus*)	–	V	Species	Recorded	PCT 3583, PCT 3998, PCT 4020, PCT 4042	0.98 ha of foraging habitat
Eastern Cave Bat (*Vespadelus troughtoni*)	–	V	Species	Recorded	PCT 3583, PCT 3998, PCT 4020, PCT 4042	0.98 ha of foraging habitat
Squirrel Glider (*Petaurus norfolcensis*)	–	V	Species	Recorded	PCT 3583, PCT 3998, PCT 4020, PCT 4042	0.98 ha of foraging habitat
Koala (*Phascolarctos cinereus*)	E	E	Species	Moderate	PCT 3583, PCT 3998, PCT 4020, PCT 4042	0.98 ha of foraging habitat

Species name	EPBC Act	BC Act	Credit type[e]	Potential occurrence (Moderate, High, Recorded)	Associated habitat in subject land	Impact based on Bionet associated PCT (ha)
Grey-headed Flying-fox (*Pteropus poliocephalus*)	V	V	Ecosystem/Species No breeding habitat assessed as an ecosystem credit species	Recorded	PCT 3583, PCT 3998, PCT 4020, PCT 4042	0.98 ha of foraging habitat
Yellow-bellied Sheathtail-bat (Saccolaimus flaviventris)	–	V	Ecosystem	Moderate	PCT 3583, PCT 4020	0.40 ha of foraging habitat

5.1.3 Removal of hollow-bearing trees

Nineteen hollow-bearing trees were recorded within the biodiversity study area. Of these 9 trees will be impacted by the proposal. No large hollows will be removed as much of the vegetation is regrowth that has not been growing long enough to result in large hollows. The inventory of hollow-bearing trees, including number of size classes in each hollow-bearing tree, is included in Table F-2 in Appendix F.

5.1.4 Removal of threatened flora

The proposal is expected to directly impact three *Angophora inopina* (Charmhaven Apple) (0.19 ha of mapped habitat) and 0.15 ha of *Tetratheca juncea* (Black-eyed Susan) habitat within the subject land.

A breakdown of the direct impacts to threatened flora species and their habitats is provided in Table 5-3.

Table 5-3 Summary of direct impacts on threatened flora

Species name	EPBC Act	BC Act	Potential occurrence	Associated habitat in subject land	Impact within subject land (ha or individuals)
Acacia bynoeana (Bynoe's Wattle)	V	E	Moderate	PCT 3583, PCT 3998, PCT 4020	0.90 ha
Angophora inopina (Charmhaven Apple)	V	V	Recorded	PCT 3583, PCT 3998, PCT 4020, PCT 4042	0.19 ha (approximately 3 individuals)
Caladenia tessellata (Thick-lipped Spider-orchid)	V	V	Moderate	PCT 3583	0.39 ha
Cryptostylis hunteriana (Leafless Tongue Orchid)	V	V	Moderate	PCT 3583	0.39 ha
Diuris praecox (Rough Doubletail)	V	V	Moderate	PCT 3583	0.39 ha
Genoplesium insigne (Variable Midge Orchid)	CE	CE	Moderate	PCT 3583, PCT 3998, PCT 4020, PCT 4042	0.98 ha
Grevillea parviflora subsp. *parviflora* (Small-flower Grevillea)	V	V	Moderate	PCT 3583, PCT 3998,	0.87 ha
Rutidosis heterogama (Heath Wrinklewort)	V	V	Moderate	PCT 3583	0.39 ha
Tetratheca juncea (Black-eyed Susan)	V	V	Recorded	PCT 3583, PCT 3998	0.15 ha (no known clumps)

5.1.5 Aquatic impacts

No key fish habitat, threatened aquatic species or TECs occur within the biodiversity study area therefore there are no aquatic species impacts.

5.1.6 Injury and mortality

Injury and mortality of fauna could occur during both construction activities and during operation of the road. Specifically, injury and mortality may occur:

- during construction when vegetation and habitat is being cleared and when ground disturbance/earthworks are commenced
- when machinery and plant is moved to, from and on-site
- during public use of the road during the operational phase of the proposal.

These impacts in relation to the construction phase of the proposal are discussed in this section, and the operational impacts are described in Section 5.2.3.

Fauna injury or death has the greatest potential to occur during construction when vegetation clearing would occur. The extent of this impact would be proportionate to the extent of vegetation that is cleared. Less mobile species (e.g. ground-dwelling reptiles), or those that are nocturnal and nest or roost in trees during the day (e.g. arboreal mammals and microchiropteran bat species), may find it difficult to rapidly move away from the clearing when disturbed.

Entrapment of wildlife in any trenches or trenches that are dug is a possibility if the trenches are deep and steep sided. Wildlife may also become trapped in or may choose to shelter in machinery that is stored in the proposal area overnight. If these animals were to remain inside the machinery, or under the wheels or tracks, they may be injured or may die once the machinery is in use.

A summary of wildlife injury and mortality impacts during the construction phase of the proposal is provided in Table 5-4.

Table 5-4 Potential for injury and mortality of fauna as a result of the construction phase of the proposal

Activity with potential to cause mortality	Native animals with potential to be affected	Nature and magnitude of the impact of the proposal
Removal of hollow-bearing trees, as well as dead standing trees	• Hollow-dependent bats • Hollow-nesting and canopy-nesting birds • Arboreal mammals • Arboreal reptiles • Arboreal frogs.	Vegetation removal will be completed in accordance with the mitigation measures detailed in Chapter 6. The *Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW, 2024), where considered appropriate, will be used to identify mitigation measures to minimise fauna injury and mortality during construction. However, these measures are unlikely to eliminate injury and mortality completely.
Removal of understorey, groundcover and topsoil	• Small woodland birds species which nest in understorey vegetation and breed locally • Ground-dwelling reptiles • Ground-dwelling mammals • Frogs.	Mortality of smaller species of native reptiles and frogs may occur. These smaller species are generally abundant, and the mortality caused by the proposal is unlikely to have a substantial long-term impact on populations of these species. The level of mortality and injury of both non-threatened and threatened species of birds, bats and mammals is likely to be low with the implementation of the mitigation measures mentioned above. The implementation of measures such as exclusion fencing, pre-clearance surveys and 'spotter-catchers' supervising vegetation clearance would reduce impacts associated with injury and mortality of fauna during the construction phase of the proposal.
Movement of machinery between locations within the study area	• Terrestrial reptiles, frogs and mammals • Birds.	Occasional mortality of native animals may occur during vehicle movements within the subject land. With the implementation of speed limits and briefing of staff, the level of construction-phase mortality of native wildlife is likely to be negligible.

5.1.7 Groundwater dependent ecosystems

Low potential terrestrial groundwater dependant ecosystem has been mapped at Mullards Creek within PCT 4020 and PCT 3998 (BOM 2024). These PCTs are likely to be terrestrial and/or riparian GDEs that depend on the surface or subsurface presence of groundwater (often accessed via the capillary fringe – subsurface water just above the water table) when an alternative source of water (i.e. rainfall) cannot be accessed to maintain ecological function (refer to Figure 3-6).

The proposal has potential to directly and indirectly interact with surface, subsurface and/or groundwater flows associated with the GDEs identified within the study area. These impacts would be largely associated with the construction activities within proximity of Mullards Creek and the stormwater channel underneath Mandalong Road at the Mandalong Road/ Gimberts Road/Gateway Boulevard roundabout.

Three groundwater boreholes registered for stock and domestic use have been identified within 500 m of the subject land (WaterNSW, 2024). Groundwater levels in these boreholes are recorded as ranging from between 5 m to 7 m below ground level. The proposal is likely to be constructed to a depth of around 1.8 m, the proposal is unlikely to have to require any dewatering and impacts to groundwater water quality impacts would be minimal. Therefore, impacts to the GDE's within the biodiversity study are likely to be minimal.

Mitigation measures designed to reduce any potential impacts on GDEs are provided in Chapter 6.

5.2 Indirect and operational impacts

5.2.1 Edge effects on adjacent native vegetation and habitat

Linear infrastructure developments are known to cause disturbances to adjacent native vegetation in terms of reducing habitat quality. This is largely linked to an increase in edge effects associated with the fragmentation of tracts of native vegetation, as well as the creation of, or further increase to, habitat barriers. Edge effects may be temporary or permanent, and can include:

- altered soil moisture conditions
- altered light conditions
- noise and vibration
- weed invasion.

The proposal occurs within a highly modified area, with subject land already experiencing varying degrees of edge effects associated with existing roads and infrastructure. The proposal has, where possible, been designed to avoid impacts to habitats that are of higher quality. However, the proposal is likely to introduce new edge effects and incrementally increase existing edge effects within the study area, primarily due to road widening along Mandalong Road. Given the current edge effects and highly modified nature of remaining patches of native vegetation the incremental increase on adjacent native vegetation and habitat is likely to be of low magnitude.

Mitigation measures to minimise impacts associated with edge effects are provided in Chapter 6.

5.2.2 Wildlife connectivity and habitat fragmentation

Ecological field assessments of the subject land and surrounding lands found that existing landscapes associated with the subject land are a combination of highly modified environments and relatively small remnants of native vegetation communities. The remnants of vegetation associated with the subject land are connected to much larger patches of native vegetation on the periphery of the Morisset township.

Discussions regarding the condition of vegetation patches associated with the subject land, its wider landscape, and how they relate to pre-existing fragmentations and connectivity associated with subject land are discussed in detail within Section 3.9.

The discussions in Section 3.9 found that the proposed works have the potential to impact current corridors for Squirrel Glider movements at one location, at the western end of Dora Street some 70 m east of the Freeman's Drive, Mandalong and Wyee Roads, and Dora Street Roundabout.

The proposal will remove some pre-existing vegetation on the northern side of the Dora Street and also most of the tall vegetation on the southern side of Dora Street where the existing best connectivity exists. The loss of vegetation at this location may represent a new barrier in vegetation currently representing movement corridor opportunities for arboreal mammals, including Squirrel Gliders.

Chapter 6 details the mitigation measures that may be employed by Transport to mitigate impacts relating to connectivity and habitat fragmentation.

Specifically, Table 6-1 provides an example for the presentation of safeguards and mitigation measures, including some standard measures. Safeguards and management measures proposed should match with the impacts identified in Chapter 5. Examples of best practice management measures can be found in the Transport's *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (TfNSW 2024).

Specific examples of mitigative measures which may be employed in relation to impacts relating to wildlife connectivity and habitat fragmentation are presented in ID B19 and B20 in Table 6-1.

Squirrel Glider connectivity impacts

It is considered likely that the proposed works will further decrease the potential for gliders to cross Dora Street.

There appears to be a high likelihood that most if not all of the Squirrel Glider poles recently installed on the Cedar Mill event site will require relocation and re-installation. Additional glider crossing infrastructure will also be installed to ensure connectivity continues to be viable for arboreal fauna across Dora Street.

Liaison with Lake Macquarie City Council would be required to determine ongoing plans for development or infrastructure associated with the lands surrounding the subject land, such that a crossing would offer a practical ongoing solution for Squirrel Glider connectivity in association.

5.2.3 Injury and mortality

There is a chance of fauna mortality during both the construction and operational phase of the proposal through vehicle collision (i.e. roadkill). Vehicle collision is a direct impact that reduces local fauna population numbers.

There is limited and no definitive data on current rates of roadkill or fauna population densities in the study area, therefore the consequences of vehicle strike on local populations of fauna is relatively unknown. BioNet records show an individual Spotted-tailed Quoll (*Dasyurus maculatus*) observed as 'roadkill' within the locality within the past decade, as well as a Wombat (*Vombatus ursinus*) and numerous Foxes (*Vulpes vulpes*) within the previous twenty years, however this may not accurately capture all injuries or mortalities.

With the proposed widening of roads, the risk of vehicle strike within the locality has potential to incrementally increase, particularly for less mobile mammal species or species with limited habitat connectivity. The main impacts associated with vehicle strike and mortality include:

- potential long-term decrease in the size of a local population via mortality from vehicle strike
- creation of a larger barrier combined with potential median infrastructure that may trap or increase the length of time an animal would need to spend on the road to cross, leading to an increase of potential collision with a vehicle.

The significance of such an impact cannot be predicted as there is no definitive data available, however implementation of mitigation measures will endeavour to minimise these impacts, including connectivity options detailed in Section 5.2.2.

A summary of wildlife injury and mortality impacts in respect to the operational phase of the project is provided in Table 5-5.

Table 5-5 Potential for injury and mortality of fauna as a result of the operational phase of the proposal

Native animals with potential to be affected	Nature and magnitude of the impact of the proposal
Terrestrial, semi-aquatic and arboreal reptiles and frogs Mammals Birds including forest owls, woodland birds, blossom nomads and raptors	All roads have potential to result in the mortality (roadkill) of native animals. The risk of roadkill is higher where roads and/or associated landscaped areas: • traverse areas of substantial animal habitat • are located near natural or artificial water bodies • contain food sources (e.g. mown grass verges, nectar-producing shrubs) which attract animals to the road edge • have high speed limits • provide poor visibility of wildlife (e.g. due to bends, crests and poor lighting) • contain multiple lanes in each direction. Threatened birds and bats likely to occur within the subject land are at a lower risk of roadkill, due to their flying locomotion. However, some species such as forest owls and predatory birds (raptors) may readily feed on roadkill and could be placed at higher risk of road-strike mortality. Threatened mammals, particularly the Squirrel Glider are known to occur within the biodiversity study area and may cross the widened road to access potential habitat in the broader landscape which makes them susceptible to vehicle collision. Squirrel Glider poles have been installed along the eastern edge of Wyee Road and a portion of the southern edge of Dora Street as part of the adjoining development. This allows movement of the Squirrel Glider habitat from the south along Wyee Road to the north to Dora Street It is recommended if practicable to provide a fauna rope bridge to connect to the vegetation to the north of Dora Street although exact measures are yet to be finalised. While it is not possible to eliminate the risk of roadkill occurring, it is possible to minimise roadkill through consideration of the above factors in the design of roads and associated landscaping and infrastructure. It is also possible to reduce roadkill risk by encouraging animals to cross roads more safely through provision of features such as: • fauna rope bridges • landscaping or either side of road which encourages mammals, birds and bats to fly higher over roads. As part of the proposal the implementation of mitigation measures such as the installation of landscape plantings/road design and aerial fauna crossings could substantially reduce potential impacts on fauna. Overall, with adequate consideration of factors associated with roadkill in preparation of the detailed design, the proposal is unlikely to result in significant levels of roadkill mortality of threatened species.

5.2.4 Invasion and spread of weeds

Proliferation of weed and pest species is an indirect impact (i.e. not a direct result of proposal activities). Proliferation of weeds is likely to occur during construction and operation, although impacts would be greatest during vegetation clearing associated with the construction phase of the proposal. The most likely causes of weed dispersal and importation associated with the proposal include earthworks, movement of soil, and attachment of seed (and other propagules) to vehicles and machinery during all phases. Issues such as exposure of weed seed in soil during the landscaping phase and the proliferation of weeds in the subject land during construction also have the potential to occur.

Mitigation measures designed to limit the spread and germination of weeds are provided in Chapter 6.

5.2.5 Invasion and spread of pests

From a biodiversity conservation perspective, pest animals include all species that have a negative impact on the functioning of natural ecosystems and/or the conservation of threatened biodiversity. Pests therefore include both exotic and native species. Exotic pests present or likely to occur within the subject land include the Black Rat, Cat, Common Myna, Common Starling, Dog, Fox, House Mouse and Rabbit.

These species have the potential to affect uncommon or threatened indigenous biodiversity through predation (e.g. Black Rat, Cat, Dog, Fox), grazing (e.g. Rabbit) and competition for breeding habitat (e.g. Common Myna and Common Starling).

Many highly invasive and destructive pest species which are found overseas or interstate have not yet become established or presently have restricted distributions in NSW. Several such species are the subject of Key Threatening Process listings (e.g. Cane Toad, Large Earth Bumblebee, Red Imported Fire Ant and Yellow Crazy Ant). The primary risk associated with these species is the importation of goods or materials from interstate or overseas locations where populations of these species are well established. If the importation of goods from overseas or interstate is required appropriate pest control mitigation measures would be applied.

The biodiversity study area provides habitat for a range of commonly occurring pest species. The proposals activities have the potential to disperse pest species out of the subject land across the surrounding landscape, but the magnitude of this impact is expected to be low and mitigation measures are not considered necessary.

5.2.6 Invasion and spread of pathogens and disease

Plant and animal pathogens can affect threatened biodiversity through direct mortality and modification to vegetation structure and composition. The following pathogens are considered to have potential to affect the biodiversity within the study area and are the subject of Key Threatening Process listings:

- Amphibian Chytrid Fungus (*Batrachochytrium dendrobatidis*)
- Exotic Rust Fungi (order Pucciniales, e.g. Myrtle rust fungus *Uredo rangelii*)
- Phytophthora Root Rot Fungus (*Phytophthora cinnamomi*).

These three pathogens have all been recorded in the North Coast bioregion and have potential to occur within the subject land at present or in the future.

The main way in which Exotic Rust Fungi and Phytophthora Root Rot Fungus may be spread is through the movement of infected plant material and/or soil. The construction and operation of the proposal may increase the risk of disturbing and spreading these pathogens. With the implementation of hygiene procedures for the use of vehicles and the importation of materials to the construction footprint, the risk of introducing these pathogens is considered to be low. Preferential use of plant materials sourced on-site (e.g. mulch, seeds) used for vegetation restoration will also help to minimise this risk.

Amphibian Chytrid Fungus can be spread through the movement of infected animals or water (including mud or moist soil) from infected areas. With the implementation of hygiene procedures for the use of vehicles and the importation of materials to the subject land, the risk of introducing this pathogen to uninfected areas is low.

5.2.7 Changes to hydrology

The existing hydrological conditions of the subject land are already affected by altered landform and altered stormwater runoff and velocity as a result of surrounding land uses, existing roads and constructed stormwater drainage channels. The proposal area is generally located above the 0.2 per cent AEP (1 in 500 year ARI) flood event level.

The extent of hydrological impacts associated with the proposal have not been quantitatively derived for this assessment due to the minor change in hydraulic performance due to the proposal. Potential impacts to surface water hydrology and flooding during construction include:

- reduced infiltration associated with vegetation clearance, soil compaction and paving to accommodate widening of the road corridor
- alteration or impedance of existing drainage paths caused by excavations, the presence of plant and equipment and stockpiling of excavated soil and materials, resulting in localised areas of flooding and scour.

These potential impacts are not likely to be significant to result in impacts to biodiversity.

Mitigation measures are detailed in Chapter 6 and will be implemented to minimise potential impacts.

5.2.8 Noise, light, dust and vibration

Noise and vibration levels are expected to increase during operation of the proposal. However, a significant increase in noise and vibration impacts to biodiversity is not expected. Most fauna species within the subject land are already habituated to periodic disturbances from surrounding land uses (i.e. road traffic, human activity, etc.), and therefore are unlikely to be significantly impacted by increased operational noise and vibration.

However, there is potential for impacts to locally common fauna from noise, dust and vibration during construction of the proposal. These impacts may result in fauna temporarily avoiding habitats adjacent to construction. The magnitude of this impact is considered to be low and specific mitigation measures are not deemed necessary.

5.3 Cumulative impacts

The potential cumulative biodiversity impact as a consequence of the construction and operation of the proposal are discussed here within the context of the existing environment. The proposal would not act alone in causing impacts to biodiversity. The incremental effects of multiple sources of impact (past, present and future) are referred to as cumulative impacts and provide an opportunity to consider the proposal within a strategic context.

In assessing the cumulative impact of a proposal, it is important to consider whether the additive effects of multiple proposals may cause such a critical threshold to be reached for any threatened biodiversity affected.

Several developments are underway or have been completed in the locality, that also impact on biodiversity values that are likely to be impacted by the current proposal. A summary of these is provided in Table 5-6.

Based on the below assessment the proposal is unlikely to cause any critical cumulative impact thresholds to be exceeded. The impacts of the proposal are minor in comparison to the other projects.

Table 5-6 Present and future project/proposals

Project/proposal	Similar biodiversity values impacted	Construction impacts	Operational impacts
Cedar Mill Cultural Events Site Morisset (Morisset Event Space), (Kleinfelder, 2022) Project construction has commenced.	• PCT 3583 Hunter Coast Lowland Scribbly Gum Forest (equivalent to PCT 1636) • *Angophora inopina* • Squirrel Glider • Southern Myotis • Important habitat mapping for Swift Parrot • Habitat for various threatened fauna species • Hollow-bearing Trees.	• 6.45 ha of native vegetation • 6.45 ha of PCT 1636 Scribbly Gum – Red Bloodwood – Angophora inopina heathy woodlands on lowlands of the Central coast (equivalent to PCT 3583) • 30 *Angophora inopina* individuals and 0.9 ha of habitat • 6.45 ha of Squirrel Glider habitat impacted. • 3.4 ha of Southern Myotis habitat • 0.03 ha of Important Habitat for the Swift Parrot • Removal of two hollow-bearing trees • Removal of waterway and constructed dams • Impacts to wildlife connectivity for threatened fauna species • Potential impact on hydrological processes.	• Increased potential for vehicle strike from increased vehicle movement within the development site • Indirect impacts on aquatic habitat including potential alterations to hydrology • Increase to existing edge effects and noise/ vibration. Mitigation measures proposed: • Revegetation of PCT 1636 is proposed along the western edge of the development site, along Wyee Road • Installation of glider poles and a fauna over pass on Dora Street • Installation of nest boxes.

Project/proposal	Similar biodiversity values impacted	Construction impacts	Operational impacts
Caravan Park – Long Term Living BDAR (Kleinfelder, 2021)	• PCT 3583 Hunter Coast Lowland Scribbly Gum Forest (equivalent to PCT 1636) • PCT 4020 Coastal Creekflat Layered Grass-Sedge Swamp Forest (equivalent to PCT 1718) • Swamp Sclerophyll Forest on Coastal Floodplains TEC • *Angophora inopina* • *Tetratheca juncea* • Squirrel Glider • Southern Myotis • Important habitat mapping for Swift Parrot • Habitat for various threatened fauna species • Hollow-bearing trees.	• 2.75 ha of native vegetation • 2.44 ha of PCT 1636 Scribbly Gum – Red Bloodwood – Angophora inopina heathy Woodland on lowlands of the Central Coast (equivalent to PCT 3585) • 0.32 ha of PCT 1718 Swamp Mahogany – Flax-leaved Paperbark Swamp forest on coastal lowlands of the Central Coast (equivalent to PCT 4020) • 0.32 ha of Swamp Sclerophyll Forest on Coastal Floodplains TEC • 0.37 ha of *Tetratheca juncea* habitat • 36 *Angophora inopina* individuals and 0.6 ha of habitat • 2.75 ha of Squirrel Glider habitat (species recorded on site) • 0.32 ha of Wallum Froglet habitat (recorded on site) • 1.67 ha of Southern Myotis habitat (recorded on site) • 2.76 ha of Important Habitat for the Swift Parrot • Removal of 3 hollow-bearing trees.	• Increase to existing edge effects and noise/ vibration • Indirect impacts on water quality including potential alterations to hydrology • Widening an existing barrier to wildlife movement • Increased potential for vehicle strike from increased vehicle movement within the development site.
136, 158 and 170 Gimberts Road Morrisett BDAR (Biosis, 2021)	• PCT 3583 Hunter Coast Lowland Scribbly Gum Forest (equivalent to PCT 1636) • PCT 4042 Lower North Riverflat Eucalypt Paperbark Forest (equivalent to PCT 1598) • Swamp Sclerophyll Forest on Coastal Floodplains TEC • *Tetratheca juncea* • Important habitat mapping for Swift Parrot.	• 1.03 ha of PCT 1598 Forest Red Gum grassy open forest on floodplains of the Lower Hunter (equivalent to PCT 4042) • 0.28 ha of PCT 1638 Smooth-barked Apple – Scribbly Gum Grass – shrub woodland (equivalent to PCT 3583) • 0.33 ha of PCT 1649 Smooth-barked apple – red mahogany – swamp mahogany – Melaleuca sieberi heathy swamp forest • 0.33 ha of Swamp Sclerophyll Forest on Coastal Floodplains TEC • 1.64 ha of Koala habitat (Scat Recorded on site) • 0.57 ha of Important Habitat for the Swift Parrot.	• Increased potential for vehicle strike from increased vehicle movement within the development site • Indirect impacts on aquatic habitat including potential alterations to hydrology • Increase to existing edge effects and noise/ vibration.

5.4 Assessments of significance

An assessment of significance has been conducted for threatened species, populations or ecological communities that have either been positively identified within the study area or that are considered to have a high or moderate likelihood of occurring in the subject land due to the presence of potential habitat which would be affected by the proposal.

The proposal would be assessed under Part 5, Division 5.1 of the EP&A Act. As such, assessments of significance have been undertaken in accordance with the following published guidelines and legislation:

BC Act listed TECs and species:

- Part 7 Division 1 Section 7.3 of the BC Act – outlines the 'test of significance' that is to be undertaken to assess the likelihood of significant impact upon threatened species or ecological communities listed under the BC Act
- Threatened Species Test of Significance Guidelines: The Assessment of Significance (Office of Environment & Heritage, 2018) – outlines a set of guidelines to help applicants/proponents of a development or activity with interpreting and applying the factors of assessment in the former 'seven-part test'.

MNES:

a. *Matters of National Environmental Significance: Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999* (Department of the Environment, 2013a): guideline to assist in deciding whether an action would have a significant impact on EPBC Act matters and subsequently whether an EPBC Act referral may be required.

Combined assessments of significance have been conducted for groups of species that have similar life history and habitat requirements; e.g. small woodland birds, terrestrial mammals.

The overall outcome of the tests of significance (refer to Appendix D and Appendix E) indicates that the impacts to threatened biodiversity are unlikely to be significant. Given the proposal is not considered likely to lead to a significant impact on threatened species, populations, ecological communities or their habitats, a Species Impact Statement (SIS) and BDAR is not required under the BC Act to support this proposal. In respect to MNES matters including threatened flora, fauna and communities, a referral of this proposal for consideration as a controlled action under the EPBC Act is not required.

The results of the significance assessments completed are summarised below in Table 5-7 for BC Act biodiversity values and Table 5-8 for MNES.

Table 5-7 Summary of BC Act significance assessments findings

Significance assessment question (per Section 7.2 of the BC Act and Threatened Species Test of Significance Guidelines (OEH, 2018))						
Threatened species, or communities	a	b	c	d	e	Likely significant impact?
Threatened Ecological Communities						
Swamp Sclerophyll Forest on Coastal floodplains	X	N	N	N	Y	Unlikely
River Flat Eucalypt Forest on Coastal Floodplains	X	N	N	N	Y	Unlikely
Flora						
Acacia bynoeana (Bynoe's Wattle)	N	X	N	N	Y	Unlikely
Angophora inopina (Charmhaven Apple)	N	X	N	N	Y	Unlikely
Caladenia tessellata (Thick-lipped Spider-orchid)	N	X	N	N	Y	Unlikely
Cryptostylis hunteriana (Leafless Tongue Orchid)	N	X	N	N	Y	Unlikely
Diuris praecox (Rough Doubletail)	N	X	N	N	Y	Unlikely

Significance assessment question (per Section 7.2 of the BC Act and Threatened Species Test of Significance Guidelines (OEH, 2018))						
Threatened species, or communities	a	b	c	d	e	Likely significant impact?
Genoplesium insigne (Variable Midge Orchid)	N	X	N	N	Y	Unlikely
Grevillea parviflora subsp. *Parviflora* (Small-flower Grevillea)	N	X	N	N	Y	Unlikely
Rutidosis heterogama (Heath Wrinklewort)	N	X	N	N	Y	Unlikely
Tetratheca juncea (Black-eyed Susan)	N	X	N	N	Y	Unlikely
Fauna						
Dusky Woodswallow (*Artamus cyanopterus cyanopterus*)	N	X	N	N	Y	Unlikely
Gang-gang Cockatoo (*Callocephalon fimbriatum*)	N	X	N	N	Y	Unlikely
South-eastern Glossy Black Cockatoo (*Calyptorhynchus lathami lathami*)	N	X	N	N	Y	Unlikely
Little Eagle (*Hieraaetus morphnoides*)	N	X	N	N	Y	Unlikely
Little Lorikeet (*Glossopsitta pusilla*)	N	X	N	N	Y	Unlikely
Varied Sitella (*Daphoenositta chrysoptera*)	N	X	N	N	Y	Unlikely
Masked Owl (*Tyto novaehollandiae*)	N	X	N	N	Y	Unlikely
Sooty Owl (*Tyto tenebricosa)*	N	X	N	N	Y	Unlikely
Powerful Owl (*Ninox strenua*)	N	X	N	N	Y	Unlikely
Swift Parrot (*Lathamus discolor*)	N	X	N	N	Y	Unlikely
Regent Honeyeater (*Anthochaera phrygia*)	N	X	N	N	Y	Unlikely
Mammals						
Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*)	N	X	N	N	Y	Unlikely
Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)	N	X	N	N	Y	Unlikely
Little Bent-winged Bat (*Miniopterus australia*)	N	X	N	N	Y	Unlikely
Large Bent-winged Bat (*Miniopterus Orianae oceanensis*)	N	X	N	N	Y	Unlikely
Southern Myotis (*Myotis macropus*)	N	X	N	N	Y	Unlikely
Greater Broad-nosed Bat (*Scoteanax rueppellii*)	N	X	N	N	Y	Unlikely
Eastern Cave Bat (*Vespadelus troughtoni*)	N	X	N	N	Y	Unlikely
Koala (*Phascolarctos cinereus*)	N	X	N	N	Y	Unlikely
Grey-headed Flying Fox (*Pteropus poliocephalus*)	N	X	N	N	Y	Unlikely
Squirrel Glider (*Petaurus norfolcensis*)	N	X	N	N	Y	Unlikely
Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)	N	X	N	N	Y	Unlikely

Y = Yes (negative impact), **N** = No (no or positive impact), **X** = Yes/No answer not applicable, **?** = unknown impact.

Table 5-8 Summary of EPBC Act significance assessments findings

Threatened species, or communities	Assessment of significance questions (EPBC Act)									Important population (per Significant Impact Guidelines 1.1 (DoE, 2013a))	Likely significant impact?
	A	B	C	D	E	F	G	H	I		
Threatened ecological community											
Coastal Swamp Sclerophyll Forest of NSW and South East Queensland	Y	N	N	Y	N	N	N	X	X	N/A	Unlikely
Vulnerable species											
Angophora inopina Charmhaven Apple)	N	N	N	N	N	N	N	N	N	N	Unlikely
Caladenia tessellata (Thick-lipped Spider-orchid)	N	N	N	N	N	N	N	N	N	N	Unlikely
Cryptostylis hunteriana (Leafless Tongue Orchid)	N	N	N	N	N	N	N	N	N	N	Unlikely
Diuris praecox (Rough Doubletail)	N	N	N	N	N	N	N	N	N	N	Unlikely
Grevillea parviflora subsp. *Parviflora* (Small-flower Grevillea)	N	N	N	N	N	N	N	N	N	N	Unlikely
Rutidosis heterogama (Heath Wrinklewort)	N	N	N	N	N	N	N	N	N	N	Unlikely
Tetratheca juncea (Black-eyed Susan)	N	N	N	N	N	N	N	N	N	N	Unlikely
South-eastern Glossy Black Cockatoo (*Calyptorhynchus lathami lathami*)	N	N	N	N	N	N	N	N	N	N	Unlikely
Large-Pied Eared Bat (*Chalinolobus dwyeri*)	N	N	N	N	N	N	N	N	N	N	Unlikely
Grey-headed Flying-fox (*Pteropus poliocephalus*)	N	N	N	N	N	N	N	N	N	N	Unlikely
Endangered and critically endangered species											
Genoplesium insigne (Variable Midge Orchid)	N	N	N	N	N	N	N	N	N	N/A	Unlikely
Gang-gang Cockatoo (*Callocephalon fimbriatum*)	N	N	N	N	N	N	N	N	N	N/A	Unlikely
Regent Honeyeater (*Anthochaera phrygia*)	N	N	N	N	N	N	N	N	N	N/A	Unlikely

Threatened species, or communities	Assessment of significance questions (EPBC Act)									Important population (per Significant Impact Guidelines 1.1 (DoE, 2013a))	Likely significant impact?
	A	B	C	D	E	F	G	H	I		
Swift Parrot (*Lathamus discolor*)	N	N	N	N	N	N	N	N	N	N/A	Unlikely
Koala (*Phascolarctos cinereus*)	N	N	N	N	N	N	N	N	N	N/A	Unlikely

Y = Yes (negative impact), **N** = No (no or positive impact), **X** = Yes/No answer not applicable, **?** = unknown impact.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it would:

a lead to a long-term decrease in the size of an important population of a species
b reduce the area of occupancy of an important population
c fragment an existing important population into two or more populations
d adversely affect habitat critical to the survival of a species
e disrupt the breeding cycle of an important population
f modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
g result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
h introduce disease that may cause the species to decline, or
i interfere substantially with the recovery of the species.

A 'population of a species' as determined by the EPBC Act is an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited either a geographically distinct regional population, or a collection of location populations OR a population, or collection of local populations, that occurs within a particular bioregion. An important population as determined by the EPBC Act is a population of species that is likely to be key source populations either for breeding or dispersal, is likely to be necessary for maintaining genetic diversity, or is at or near the limit of the species range.

6. Mitigation

Once all practicable steps to avoid or minimise impacts have been implemented at the detailed design phase, mitigation measures would be implemented to lessen the potential ecological impacts of the proposal. Mitigation measures are to be undertaken during the construction and operational phases.

The Transport for NSW biodiversity guidelines and procedures identify a range of mitigation techniques to be applied, including managing the vegetation clearing process, re-establishment of native vegetation at the end of a proposal, weed management, provision of supplementary fauna habitat (such as nest boxes for appropriate species), and installation of erosion and sediment controls as appropriate. Mitigation measures as outlined in the '*Biodiversity Guidelines: Protecting and managing biodiversity on Transport for NSW projects'* (Transport for NSW, 2024) and '*Wildlife Connectivity Guidelines for Road Projects'* (NSW Roads and Maritime Services, 2012) are recommended for implementation. Further, impacts on aquatic habitat should be mitigated in accordance with the '*Policy and Guidelines for fish habitat conservation and management (Update 2013)'* (Department of Primary Industries, 2013).

Additional species-specific and site-specific mitigation measures are also provided in Table 6-1.

Table 6-1 Mitigation measures

Ref	Impact	Environmental safeguards	Responsibility	Timing	Likely efficacy of mitigation	Residual impacts anticipated?
B1	Removal of native vegetation	Biodiversity impacts will be minimised through detailed design and construction, where practical and demonstrated within the Detail Design Report and Post-Clearing Report.	Contractor	Detailed design and Construction	Effective	Predicted residual impact of 0.98 ha of native vegetation. Edge effects – none as the proposed control measures are known to be effective.
B2	Removal of native vegetation	In accordance with the Transport Tree and Hollow Replacement Guidelines (EMF-BD-GD-0129), trees and hollows that require replacement will be identified and: • a Tree and Hollow Replacement Plan will be prepared to address the impacts prior to the commencement of works (refer to EMF-BD-GD-0219-TT1); or • payment will be made to the Transport Conservation Fund prior to the commencement of works	Contractor	Detailed design	Effective	Predicted residual impact of 0.98 ha of native vegetation. Edge effects – none as the proposed control measures are known to be effective.
B3	Fauna and Flora impacts	Develop a Fauna and Flora Management Plan inclusive of wildlife connectivity in accordance with the Biodiversity Management Guideline (Transport, March 2024).	Contractor	Construction	Effective	Minor impact to highly disturbed aquatic habitat. Minor impacts to the disturbed aquatic habitat is not expected to be significant.
B4	Fragmentation of identified habitat corridors	A Wildlife Connectivity Strategy is to be developed through detailed design in accordance with the draft Wildlife Connectivity Guidelines (Roads and Maritime Services, 2011) or equivalent updated Transport Guidelines.	Contractor	Detailed design	Effective	The mitigation measures should be effective in ensuring wildlife connectivity remains and is potentially enhanced following construction.
B5	Removal of native vegetation	Pre-clearing surveys and final pre-clearing checks will be undertaken in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW, 2024).	Contractor	Construction	Effective	Predicted residual impact of 0.98 ha of native vegetation. Edge effects – none as the proposed control measures are known to be effective.

Ref	Impact	Environmental safeguards	Responsibility	Timing	Likely efficacy of mitigation	Residual impacts anticipated?
B6	Fragmentation of identified habitat corridors	The Wildlife Connectivity Strategy is to focus on maintaining fauna connectivity, particularly for Squirrel Glider, through the proposal and is to detail the following: (a) a review of the need and effectiveness of connectivity structures for the proposal (b) consideration of fauna connectivity structures where the project results in canopy gaps greater than 50 metres. (c) Identification of opportunities for supplementary habitat (d) Measures to minimise physical disturbance within the existing fauna corridor. (e) Measure to maximise the effectiveness of fauna connectivity measures, including but not limited to retention of mature vegetation around connectivity structures and landscaping (f) A program identifying the construction footprint and staging requirements, including the provision of connectivity structures (and associated features) as soon as practicable	Contractor	Construction	Effective	The mitigation measures should be effective in ensuring wildlife connectivity remains and is potentially enhanced following construction.
B7	Direct impacts to threatened species	Habitat removal will be undertaken by staged clearing in accordance with *Guide 4: Clearing of vegetation and removal of bushrock* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW, 2024).	Contractor	Construction	Effective	Predicted residual impact of 0.98 ha of native vegetation that provided habitat for threatened fauna species.
B8	Direct impacts to threatened species and TECs	If threatened fauna or flora species are discovered unexpectedly, stop works immediately and follow the Transport Unexpected Threatened Species Find Procedure contained in the Transport Biodiversity Guidelines – Guide 1 (Pre-clearing process (EMF-BD-GD-0032).	Contractor	Construction	Effective	Predicted residual impact of 0.98 ha of native vegetation. Edge effects – none as the proposed control measures are known to be effective.

Ref	Impact	Environmental safeguards	Responsibility	Timing	Likely efficacy of mitigation	Residual impacts anticipated?
B9	Aquatic impacts	Aquatic habitat (inclusive of Mullards Creek) will be protected in accordance with *Guide 10: Aquatic habitats and riparian zones* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW, 2024b) and Section 3.3.2 of the Standard precautions and mitigation measures of the *Policy and guidelines for fish habitat conservation and management Update 2013* (NSW DPI (Fisheries) 2013).	Contractor	Construction	Effective	Minor impact to highly disturbed aquatic habitat. Minor impacts to the disturbed aquatic habitat is not expected to be significant.
B10	Edge effects on adjacent native vegetation and habitat	Exclusion zones will be set up at the limit of clearing in accordance with *Guide 2: Exclusion zones* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW, 2024b).	Contractor	Construction	Effective	The mitigation measures should be effective in avoiding impacts to adjacent vegetation.
B11	Injury and mortality of fauna	Fauna encountered on-site during construction will be managed in accordance with *Guide 9: Fauna handling* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW, 2024b).	Contractor	Construction	Effective	Predicted residual impact of 0.98 ha of native vegetation that provided habitat for threatened fauna species.
B12	Invasion and spread of weeds	Weed species will be managed in accordance with *Guide 6: Weed management* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW, 2024b).	Contractor	Construction	Effective	None as the proposed control measures are known to be effective.
B13	Invasion and spread of pathogens and disease	Pathogens will be managed in accordance with *Guide 7: Pathogen management* of the *Biodiversity Management Guideline: Protecting and managing biodiversity on Transport for NSW projects* (Transport for NSW, 2024b).	Contractor	Construction	Effective	Minor, localised, modification to already highly disturbed habitat.

7. Offsets and other measures

The need for biodiversity offsets is founded in the theory of 'avoid, minimise and mitigate' the impacts of proposals. The accepted approach to environmental assessment requires that, in the first instance, environmental impacts are avoided or minimised as far as possible and subsequently reduced to acceptable levels through appropriate mitigation techniques. Where measures to avoid and mitigate impacts are not feasible or cost effective, then offset strategies can be used to compensate the residual impacts of the development on biodiversity.

Although efforts have been made to avoid, minimise and mitigate ecological impacts associated with the proposal, some residual impacts would occur. This biodiversity assessment identified that the proposal is not likely to have a significant impact on any threatened biodiversity listed under the BC Act or EPBC Act (refer to Section 5.4, Appendix D and Appendix E. In this instance, and due to the Strategic Assessment, the EPBC Act environmental offsets policy does not apply to the proposal. Further, the proposal does not have a statutory obligation to offset under the NSW Biodiversity Offset Scheme.

Transport would however provide biodiversity offsets, compensative measures and/or tree and hollow replacement in accordance the *No Net Loss Guidelines* (Transport for NSW, 2022c) and *Tree and Hollow Replacement Guidelines* (Transport for NSW, 2022d). This chapter provides an overview of the biodiversity offsets, compensative measures and/or tree and hollow replacement requirements in accordance with Transport's guidelines.

7.1 Thresholds

A comparison of the proposal's residual impacts against the predetermined offset thresholds in Table 3.1 of Transport's *No Net Loss Guideline* (Transport for NSW, 2022c) is provided in Table 7-1 and Table 7-2.

The assessment indicates that tree offsets would be required for this proposal.

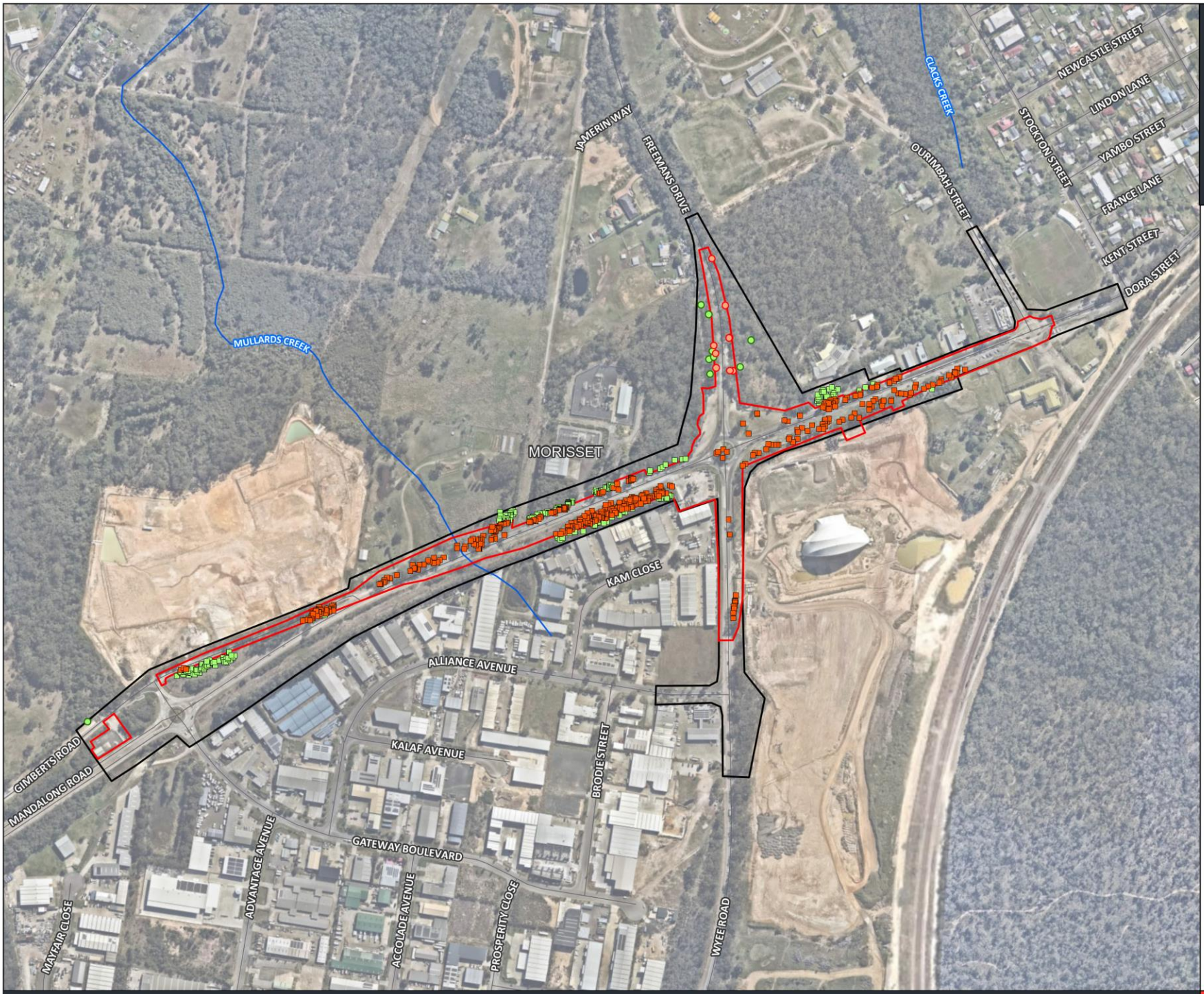
Table 7-1 Offset thresholds (No Net Loss Guidelines (Transport for NSW, 2022c))

Impact	Threshold	Does the proposal trigger an offset
Works involving clearing of a CEEC	Where there is any clearing of an CEEC in 'moderate to good' condition	No – no CEEC recorded within the study area.
Works involving clearing of an EEC	Where clearing of a EEC ≥ 2 ha in 'moderate to good' condition	No - the proposal will impact upon a total of 0.35 ha of EEC in moderate to good condition.
Works involving clearing of VEC	Where clearing of VEC ≥ 5 ha in 'moderate to good' condition	No - No VECs occur within subject land.
Works involving clearing of any habitat for a known species credit fauna species or clearing of breeding habitat (as defined by the TBDC) for dual-credit fauna species (excluding exotic and planted vegetation that cannot be assigned to a plant community type)	Where clearing ≥ 1 ha in 'moderate to good' condition	No - the proposal will impact on a maximum of 0.98 ha native habitat for threatened fauna, including all conditions (such as Regrowth and Planted Native Vegetation).
Works involving removal of known threatened flora species and their habitat	Where loss of individuals is ≥10 or where clearing of habitat is ≥ 1 ha	No - the proposal will impact upon 0.19 ha (around 3 individuals) for *Angophora inopina,* and 0.15 ha of *Tetratheca juncea.* The total of all clearing of native vegetation does not exceed 1 ha.
Type 1 or Type 2 key fish habitats	Where there is a net loss of habitat	No – no key fish habitats occur within the biodiversity study area.
Any residual biodiversity impact that doesn't require offsets in accordance with the No Net Loss Guideline is to be assessed against the requirements of the Tree and Hollow Replacement Guideline.	Any clearing of hollows and/or trees ≥5 cm DBH	Yes 9 hollow-bearing trees and 773 trees ≥5 cm DBH will be removed outside of the area that is subject to biodiversity offsetting (which is zero). This is the only offset required for the proposal. Refer to Appendix F for tree survey details.

Table 7-2 Assessment of vegetation impacts against thresholds

Veg. zone	Plant community type (PCT)	Condition	TEC	Impact area (ha)	Threshold triggered?
Zone 1	PCT 3583: Hunter Coast Lowland Scribbly Gum Forest	Good	Not a TEC	0.36	Tree replacement
Zone 2	PCT 3583: Hunter Coast Lowland Scribbly Gum Forest	Regrowth	Not a TEC	0.02	Tree replacement
Zone 3	PCT 3998 Lower North Creekflat Mahogany Swamp Forest	Good	Endangered BC Act and EPBC Act	0.01	Tree replacement
Zone 4	PCT 3998 Lower North Creekflat Mahogany Swamp Forest	Moderate	Endangered BC Act	0.23	Tree replacement
Zone 5	PCT 3998 Lower North Creekflat Mahogany Swamp Forest	Planted Native Vegetation	Not a TEC	0.25	Tree replacement
Zone 6	PCT 4042 Lower North Riverflat Eucalypt Paperbark Forest	Moderate	Endangered BC Act	0.08	Tree replacement
Zone 7	PCT 4020 Coastal Creekflat Layered Grass Sedge Forest	Good	Endangered BC Act and EPBC Act	0.03	Tree replacement
N/A	Planted Native Trees	–	Not a TEC	0.14	Tree replacement
N/A	Planted exotic trees	–	Not a TEC	0.12	Tree replacement

Figure 7-1 shows the locations of the recorded trees requiring offsets under the *Tree and Hollow Replacement Guidelines* (Transport for NSW, 2022d).

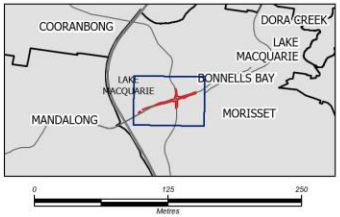


Mandalong Road Upgrade

Figure 7.1
Tree locations and proposal impacts

Legend

- Subject Land (Proposal area)
- Biodiversity study area
- Road
- Watercourse
- Trees likely to require removal
- Trees likely to be retained
- Hollow bearing trees to be retained
- Hollow bearing trees to be removed



Coordinate system: GDA2020 MGA Zone 56
Scale ratio correct when printed at A3

1:5,000 Date: 26/11/2024

GDA 2020

Data sources: Geoscience Australia, Nearmap, NSWSS

7.2 Preliminary offset calculations

Biodiversity offsets are no required for TECs or threatened species or native vegetation impacts.

No offsets are required for impacts to Key Fish Habitat.

The following section outlines the requirements under the *Tree and Hollow Replacement Guidelines* (Transport for NSW, 2022d).

7.3 Biodiversity offset strategy/tree and hollow replacement plan

A Tree and Hollow Replacement Plan or payment to the Transport Conservation Fund will be required.

As no other offsets are triggered the removal of all mapped native and amenity trees are subject to the Transport Tree and Hollow Replacement Guidelines (EMF-BD-GD-0129).

The subject land (and immediate surrounds) contains a total of 764 trees which is comprised of 603 native trees and 161 amenity trees. Of these 493 trees will be impacted trees by the proposal, as indicated in Table 7-3.

In relation to the tree and hollow replacement guidelines, this proposal will require tree planting to replace those trees being removed. If replacement is not feasible, or the entire replacement cannot be accommodated locally or can only be partially met, any remaining requirement can be met by transferring funds into the Transport Conservation Fund as per rates outlined in the Transport Tree and Hollow Replacement Guidelines (EMF-BD-GD-0129). A summary of tree and hollow impacts and tree replacement requirements is provided in Table 7-4.

Table 7-3 Summary of trees impacted by the proposal

Tree size category	Small tree (DBH 5–19 cm)	Medium tree (DBH 20–49 cm)	Large tree (DBH 50–100 cm)	Totals
Amenity trees	77	65	7	149
Native trees	178	145	21	344
Totals	**255**	**210**	**28**	**493**

Table 7-4 Summary of tree and hollow impacts and replacement requirements

Tree size category	Tree replacement guidelines	Total number of trees/ hollows impacted upon	Tree/hollow replacement requirement
Large tree (DBH 50–100 cm)	Plant Minimum of eight trees	28	224
Medium tree (DBH 20–49 cm)	Plant Minimum of four trees	210	840
Small tree (DBH 5–19 cm)	Plant Minimum of two trees	255	510
Total tree replacement		**493**	**1574**
Hollow replacement[1]	Provide three artificial hollows for every occupied hollow removed	22	13

(1) Assumed 20% occupancy rate

8. Conclusion

Four PCTs have been identified within the biodiversity study area through field verification of the NSW State Vegetation Type Map, including:

- PCT 3583: Hunter Coast Lowland Scribbly Gum Forest
- PCT 3998: Lower North Creekflat Mahogany Swamp Forest
- PCT 4020: Coastal Creekflat Layered Grass-Sedge Swamp Forest
- PCT 4042: Lower North Riverflat Eucalypt Paperbark Forest.

Four miscellaneous ecosystems were also identified within the biodiversity study area; Planted Native Trees, Planted Exotic Trees, Exotic Grassland and Regrowth Native Shrubs.

Native vegetation within the biodiversity study area is considered to meet the final determination of two endangered ecological communities listed under the *Biodiversity Conservation Act 2016* (BC Act) including:

- Swamp Sclerophyll Forest on Coastal floodplains 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.

One endangered ecological community meets the criteria for listing on the EPBC Act, being:

- Coastal Swamp Sclerophyll Forest of NSW and South East Queensland.

Two threatened flora species were recorded within the biodiversity study area during field surveys being:

- *Angophora inopina* (Charmhaven Apple) listed as vulnerable under the BC Act and EPBC Act
- *Tetratheca juncea* (Black-eyed Susan), listed as vulnerable under the BC Act and EPBC Act.

Eleven threatened fauna species were recorded within the biodiversity study area as follows:

- Little Lorikeet (*Glossopsitta pusilla*)
- Powerful Owl (*Ninox strenua*)
- Varied Sitella (*Daphoenositta chrysoptera*)
- Little Eagle (*Hieraaetus morphnoides*)
- Little Bent-winged Bat (*Miniopterus australis*)
- Large Bent-winged Bat (*Miniopterus orianae oceanensis*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*)
- Southern Myotis (*Myotis macropus*)
- Eastern Cave Bat (*Vespadelus troughtoni*)
- Grey-headed Flying Fox (*Pteropus poliocephalus*).

Of these species, all are listed as threatened under the BC Act, with the Grey-headed Flying Fox also being listed as threatened under the EPBC Act.

Mapped Important Habitat occurs within the subject land for Swift Parrot.

The key impact on biodiversity associated with the proposal would involve the direct removal of up to 0.98 ha of native vegetation and associated habitats. Of this, 0.27 ha consists of regrowth or planted native vegetation. Most of the moderate to good condition vegetation present has been modified to some degree due to past and current land uses.

Assessments of impact significance were conducted for all threatened species and ecological communities considered likely to be affected by the proposal. These impact assessments determined that the proposal is unlikely to lead to a significant impact on threatened species, populations, ecological communities or their habitats. Given the proposal is not considered likely to lead to a significant impact on threatened species, populations, ecological communities or their habitats, a Species Impact Statement or Biodiversity Development Assessment Report is not required under the BC Act to support this proposal. In respect to Matters of National Environmental Significance including threatened flora, fauna and communities, a referral of this proposal for consideration as a controlled action under the EPBC Act is not required.

As part of the detailed design phase Transport will consider further avoidance and minimisation options to minimise impacts on biodiversity. These options would include the incorporation of wildlife connectivity measures to minimise impacts on wildlife in accordance with the best practise guidelines outlined in the *Draft Wildlife Connectivity Guidelines for Road Projects* (NSW Roads and Maritime Services, 2012) or equivalent updated NSW Guidelines. With the implementation of the recommended mitigation measures proposed it is unlikely that residual impact of the proposal would result in a significant impact to biodiversity within the locality. This includes special consideration of Squirrel Glider connectivity across Dora Street from the Cedar Mill event site.

Given the residual impacts associated with the proposal Transport would be required to provide the following values:

- Biodiversity offsets and/or conservation measures: for impacts on terrestrial biodiversity values that exceed the offset thresholds, Transport would be required to provide offsets in accordance with their *No Net Loss Guidelines* (Transport for NSW, 2022c). No offsets are required under this policy and a Biodiversity Offset Strategy is not required.
- Tree and hollow replacement: All trees within the subject land are required to be offset under the *Tree and Hollow Replacement Guidelines* (Transport for NSW, 2022d). A Tree and Hollow Replacement Plan is required to determine the proposal's tree and hollow replacement requirements or an equivalent payment to the Transport Conservation Fund.

9. Glossary

Term	Definition
Accredited person or assessor	Means as person accredited under section 6.10 (of the BC Act) to prepare reports in accordance with the BAM.
Biodiversity Assessment Method	The Biodiversity Assessment Method is established under section 6.7 of the BC Act. The BAM is established for the purpose of assessing certain impacts on threatened species and threatened ecological communities (TECs), and their habitats, and the impact on biodiversity values.
Biodiversity Assessment Method Calculator	Biodiversity Assessment Method Calculator (BAM-C) – the online computer program that provides decision support to assessors and proponents by applying the BAM and referred to as the BAM-C. The BAM-C contains biodiversity data from the BioNet Vegetation Classification and the Threatened Biodiversity Data Collection that the assessor is required to use in a BAM assessment. The BAM-C applies the equations used in the BAM, including those to determine the number and class of biodiversity credits required to offset the impacts of a development, or created at a biodiversity stewardship site. It is published by the Department (DPIE 2020a).
Biodiversity credit report	The report produced by the BAM-C that sets out the number and class of biodiversity credits required to offset the remaining adverse impacts on biodiversity values at a development site, or on land to be biodiversity certified, or that sets out the number and class of biodiversity credits that are created at a biodiversity stewardship site (DPIE 2020a).
Biodiversity offsets	The gain in biodiversity values achieved from the implementation of management actions on areas of land, to compensate for losses to biodiversity values from the impacts of development (DPIE, 2020a).
Biodiversity Offsets and Agreement Management System	The online system used to administer the Biodiversity Offsets Scheme. The BOAMS is used by accredited assessors (to carry out specific BAM-related tasks involving access to the BAM-C to perform assessments, submit data, generate credits and calculate a credit price), by landholders (to apply for a Biodiversity Stewardship Agreement and manage ongoing reporting obligations for their agreement) and by proponents of developments (to view their credit obligation or the payment required to the Biodiversity Conservation Fund).
Biodiversity risk weighting	A factor of the formulas used by the BAM to calculate credits. The biodiversity risk weighting (BRW) is a score given to each vegetation zone and species based on the 'sensitivity to loss' versus the 'sensitivity to gain'. The value is set for threatened species and listed in the TBDC. The BRW for vegetation is calculated for each vegetation zone by the BAM-C using a factor of the 'sensitivity to loss' of the PCT or TEC (located in the BioNet vegetation classification) and the 'sensitivity to gain' of the ecosystem credit species (in the TBDC) that are predicted to occur.
Biodiversity Stewardship site	Refers to land which is the subject to a Biodiversity Stewardship Agreement under the BC Act.
BioNet Atlas	The DPIE database of flora and fauna records (formerly known as the NSW Wildlife Atlas). The Atlas contains records of plants, mammals, birds, reptiles, amphibians, some fungi, some invertebrates (such as insects and snails listed under the BC Act) and some fish (DPIE, 2020a).
BioNet Vegetation classification	Refers to the vegetation community-level classification for use in vegetation mapping programs and regulatory biodiversity impact assessment frameworks in NSW. Refer About BioNet Vegetation Classification | NSW Environment and Heritage (DPE, 2020a).
Construction footprint	The area to be directly impacted by the proposal during construction activities. See also definition for subject land.
Cumulative impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Refer to Clause 228(2) of the EP&A Regulation 2000 for cumulative impact assessment requirements.

Term	Definition
Direct impact	Direct impacts on biodiversity values include those related to clearing native vegetation and threatened species habitat and impacts on biodiversity values prescribed by the Biodiversity Conservation Regulation 2017 (the BC Regulation) (DPIE, 2020a).
Ecosystem credit species	Threatened species or components of species habitat that are identified in the Threatened Species Data Collection as requiring assessment for ecosystem credits. This is analogous with the definition of 'predicted species'.
Ecosystem credits	A measurement of the value of threatened ecological communities, threatened species habitat for species that can be reliably predicted to occur with a PCT, and PCTs generally. Ecosystem credits measure the loss in biodiversity values at a development, activity, clearing or biodiversity certification site and the gain in biodiversity values at a biodiversity stewardship site (DPIE, 2020a).
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic component (DPIE, 2020a).
Indirect impact	Impacts that occur when the proposal affects native vegetation and threatened species habitat beyond the development footprint or within retained areas (e.g. transporting weeds or pathogens, dumping rubbish). This includes impacts from activities related to the construction or operational phase of the proposal and prescribed impacts (DPIE, 2020a).
Landscape assessment area	The area which includes the subject land and a 1500 m buffer surrounding the outside edge of the boundary of the subject land or 500 m along each side of the centre line of a linear-shaped proposal
Local population	The population that occurs in the study area. The assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the study area, according to the following definitions: • The local population of a threatened plant species comprises those individuals occurring in the study area or the cluster of individuals that extend into habitat adjoining and contiguous with the study area that could reasonably be expected to be cross-pollinating with those in the study area. • The local population of resident fauna species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area. • The local population of migratory or nomadic fauna species comprises those individuals that are likely to occur in the study area from time to time or return year to year (OEH 2018).
Matter of national environmental significance	A matter of national environmental significance (MNES) is any of the nine defined components protected by a provision of Part 3 of the EPBC Act (Commonwealth).
Mitigation	Action to reduce the severity of an impact.
Native vegetation	Has the same meaning as in section 1.6 of the BC Act and section 60B of the LLS Act. In summary • trees (including any sapling or shrub or any scrub) • understorey plants • groundcover (being any type of herbaceous vegetation) • plants occurring in a wetland. A plant is native to New South Wales if it was established in New South Wales before European settlement (BC Act). Native vegetation does not extend to marine vegetation (being mangroves, seagrasses or any other species of plant that at any time in its life cycle must inhabit water other than fresh water). Marine vegetation is covered by the provisions of the FM Act.
NSW (Mitchell) landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000 (DPIE, 2020a).

Term	Definition
Operational footprint	The area that will be subject to ongoing operational impacts from the proposal. This includes the road, surrounding safety verges and infrastructure, fauna connectivity structures and maintenance access tracks and compounds.
Patch size	An area of native vegetation that: • occurs on the development site or biodiversity stewardship site • includes native vegetation that has a gap of less than 100 m from the next area of native vegetation (or ≤30 m for non-woody ecosystems). Patch size may extend onto adjoining land that is not part of the development site or biodiversity stewardship site (DPIE, 2020a).
PlantNET	An online database of the flora of New South Wales which contains currently accepted taxonomy for plants found in the State, both native and exotic.
Population	A group of organisms, all of the same species, occupying a particular area (DPIE, 2020a).
Spatial datasets	Spatial databases required to prepare a BAR • BioNet NSW (Mitchell) Landscapes – Version 3.1 • NSW Interim Biogeographic Regions of Australia (IBRA region and sub-regions) – Version 7 • NSW soil profiles • hydrogeological landscapes • acid sulfate soils risk • digital cadastral database • Vegetation Information Systems maps • Geological sites of NSW.
Species credit species	Threatened species or components of species habitat that are identified in the Threatened Species Data Collection as requiring assessment for species credits (DPIE, 2020a). This is analogous with the definition of 'candidate species'.
Species credits	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection (DPIE, 2020a).
Species polygon	An area of land identified in Chapter 5 (of the BAM) that contains habitat or is occupied by a threatened species (DPIE, 2020a).
Study area	The area directly affected by the proposal (subject land or construction footprint) and any additional areas likely to be affected by the proposal, either directly or indirectly.
Subject land	Land subject to a development, activity, clearing, biodiversity certification or a biodiversity stewardship proposal. It excludes the landscape assessment area which surrounds the subject land (i.e., the area of land in the 1500 m buffer zone around the subject land or 500 m buffer zone for linear proposals). In the case of a biodiversity certification proposal, subject land includes the biodiversity certification assessment area (DPIE, 2020a). See also definition for construction footprint. The proposal area is the equivalent term used in the REF and associated documents.
Threatened Biodiversity Data Collection	A publicly assessable online database (registration required) which contains information for listed threatened species, populations and ecological communities (DPIE, 2020a). Part of the BioNet database, published by the EHG and accessible from the BioNet website at www.bionet.nsw.gov.au.
Vegetation integrity (VI score)	The condition of native vegetation assessed for each vegetation zone against the benchmark for the PCT. The vegetation integrity score is the quantitative measure of vegetation condition calculated by the BAM-C (DPIE, 2020a).
Vegetation zone	A relatively homogeneous area of native vegetation on a development site, clearing site, land to be biodiversity certified or biodiversity stewardship site that is the same PCT and has the same broad condition state (DPIE, 2020a).

10. Limitations

No sampling technique can eliminate the possibility that a species is present within the subject land. For example, some species of plant may be present in the soil seed bank and some fauna species use habitats on a sporadic or seasonal basis and may not be present during surveys. The conclusions in this report are based upon data acquired for the proposal and the environmental field surveys, therefore, they are merely indicative of the environmental condition of the land at the time of preparing the report, including the presence or otherwise of species. It should be recognised that conditions, including the presence of threatened species, can change with time.

Targeted surveys have been conducted to detect target sedentary animal species and threatened flora species that are considered likely to occur within the subject land based on habitat characteristics and previous records. As the actual distribution and the range of habitat utilised by some species is not fully understood, there is always a small possibility that other species could occur despite being considered to have a low likelihood of occurrence based on their known range and known habitats.

Tests of significance have been completed based on the subject land. However, the outcomes of these tests of significance are subject to change following confirmation of the final design footprint extent.

Other limitations relating to the conclusions contained in this report are detailed in the following sections.

10.1 Reliance on externally supplied information

In preparing this study, WSP has relied upon data, surveys, analyses, designs, plans and other information provided by the client and other individuals and organisations. Except as otherwise stated in the study, WSP has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this study (conclusions) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. WSP will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WSP.

10.2 Study for benefit of client

This document has been prepared for the exclusive benefit of the client and no other party. WSP assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with in this study, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in this study (including without limitation matters arising from any negligent act or omission of WSP or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in this study). Other parties should not rely upon the study or the accuracy or completeness of any conclusions and should make their own inquiries and obtain independent advice in relation to such matters.

10.3 Changing circumstances

To the best of our knowledge, the proposal presented, and the facts and matters described in this study reasonably represent the client's intentions at the time of preparation of the study. However, the passage of time, the manifestation of latent conditions or the impact of future events (including a change in applicable law) may have resulted in a variation of the Proposal and of its possible environmental impact.

WSP will not be liable to update or revise this assessment to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the document.

11. Abbreviations

Term	Definition
AOBV	Area of Outstanding Biodiversity Value
BAM	Biodiversity Assessment Method
BAM-C	Biodiversity Assessment Method calculator
BC Act	Biodiversity Conservation Act 2016 (NSW)
BC Regulation	Biodiversity Conservation Regulation 2017 (NSW)
BDAR	Biodiversity Development Assessment Report
BOAMS	Biodiversity Offsets and Agreement Management System
BOS	Biodiversity Offset Scheme
BRW	Biodiversity risk weighting
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DIWA	Directory of Important Wetlands in Australia
DPE	Department of Planning and Environment
DPI	Department of Primary Industries
EEC	Endangered ecological community
EHG	NSW Environment and Heritage Group within the Department of Planning and Environment
EIS	Environmental Impact Statement
EP&A Act	*Environment Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
Fisheries NSW Policy and guidelines	Fisheries NSW Policy and guidelines for fish habitat conservation and management (Update 2013)
FM Act	Fisheries Management Act 1994 (NSW)
GDE	Groundwater dependent ecosystems
IBRA	Interim Biogeographically Regionalisation of Australia
MNES	Matters of national environmental significance
PCT	Plant community type
PMST	Protected Matters Search Tool
REF	Review of Environmental Factors
SAII	Serious and Irreversible Impacts
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSD	State Significant Development
SSI	State Significant Infrastructure
TBDC	Threatened Biodiversity Data Collection
TECs	Threatened ecological communities (VECs, EECs and CEECs)
TfNSW	Transport for NSW
VEC	Vulnerable Ecological Community

12. References

ATLAS OF LIVING AUSTRALIA. 2024. Atlas of Living Australia [Online]. Available: https://www.ala.org.au/ [Accessed 2024].

BUREAU OF METEOROLOGY. 2024a. Groundwater Dependent Ecosystems Atlas [Online]. Available: http://www.bom.gov.au/water/groundwater/gde/ [Accessed 2024].

BIOSIS (2021) 136, 158 and 170 Gimberts Road Morrisett BDAR.

COMMONWEALTH OF AUSTRALIA (2008) Approved Conservation Advice for *Angophora inopina.*

COMMONWEALTH OF AUSTRALIA (2011a), Survey Guidelines for Australia's threatened frogs (awe.gov.au).

COMMONWEALTH OF AUSTRALIA (2011b), Survey guidelines for Australia's threatened mammals (awe.gov.au).

COMMONWEALTH OF AUSTRALIA (2011c), Survey guidelines for Australia's threatened reptiles (awe.gov.au).

COMMONWEALTH OF AUSTRALIA (2011d), Survey guidelines for Australia's threatened fish (awe.gov.au).

COMMONWEALTH OF AUSTRALIA (2013), Draft survey guidelines for Australia's threatened orchids (awe.gov.au).

CROPPER, S. C. 1993. Management of Endangered Plants, Melbourne, CSIRO Australia.

DEBUS, S. J. S. 1995. Surveys of large forest owls in Northern New South Wales: methodology, calling behaviour and owls responses. Corella, 19, 38-50.

DEPARTMENT OF AGRICULTURE WATER AND THE ENVIRONMENT 2021. Conservation Advice for Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland. Canberra.

DEPARTMENT OF CLIMATE CHANGE ENERGY THE ENVIRONMENT AND WATER. 2024a. National Flying-fox monitoring viewer [Online]. Available: https://www.environment.gov.au/webgis-framework/apps/ffc-wide/ffc-wide.jsf.

DEPARTMENT OF CLIMATE CHANGE ENERGY THE ENVIRONMENT AND WATER. 2024b. Directory of Important Wetlands in Australia [Online]. Available: https://www.dcceew.gov.au/water/wetlands/australian-wetlands-database/directory-important-wetlands [Accessed 2024].

DEPARTMENT OF CLIMATE CHANGE ENERGY THE ENVIRONMENT AND WATER. 2024c. Protected Matters Search Tool [Online]. Available: https://pmst.awe.gov.au/#/map?lng=131.52832031250003&lat=-28.671310915880834&zoom=5&baseLayers=Imagery,ImageryLabels [Accessed 2024].

DEPARTMENT OF CLIMATE CHANGE ENERGY THE ENVIRONMENT AND WATER. 2024d. Species Profile and Threats Database [Online]. Available: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl [Accessed 2024].

DEPARTMENT OF ENVIRONMENT AND CONSERVATION 2004. Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft). Hurstville: Department of Environment and Conservation.

DEPARTMENT OF ENVIRONMENT AND CLIMATE CHANGE 2008. Managing Urban Stormwater: soils and construction, Vol 2D: main road construction. South Sydney: Department of Environment and Climate Change NSW.

Department of Environment and Climate Change (2009), Threatened species survey and assessment guidelines: field survey methods for fauna. Amphibians. (nsw.gov.au).

DEPARTMENT OF ENVIRONMENT AND CLIMATE CHANGE. 2024. NSW State Vegetation Type Map (SVTM).

DEPARTMENT OF ENVIRONMENT AND PLANNING 2024. Biodiversity Assessment Method Calculator (BAM-C). BAM data last updated: 22/06/2023 (Version: 61).

DEPARTMENT OF LAND AND WATER CONSERVATION 2002. The NSW State Groundwater Dependent Ecosystem Policy. Sydney: Department of Land and Water Conservation.

DEPARTMENT OF PLANNING AND ENVIRONMENT 2022a. Koala (Phascolarctos cinereus) Biodiversity Assessment Method Survey Guide. Parramatta: Environment and Heritage Group.

DEPARTMENT OF PLANNING AND ENVIRONMENT 2022b. NSW State Vegetation Type Map. Edition C1.1.M1 ed.

DEPARTMENT OF PLANNING AND ENVIRONMENT. 2024a. Areas of Outstanding Biodiversity Value register [Online]. Available: https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/areas-of-outstanding-biodiversity-value/area-of-outstanding-biodiversity-value-register [Accessed 2024].

DEPARTMENT OF PLANNING AND ENVIRONMENT. 2024b. Biodiversity Values Map [Online]. Available: https://datasets.seed.nsw.gov.au/dataset/biodiversity-values-map [Accessed 2024].

DEPARTMENT OF PLANNING AND ENVIRONMENT. 2024c. BioNet Atlas of NSW Wildlife [Online]. [Accessed 2024].

DEPARTMENT OF PLANNING AND ENVIRONMENT. 2024d. BioNet Vegetation Classification Database [Online]. Available: https://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx [Accessed].

DEPARTMENT OF PLANNING INDUSTRY AND ENVIRONMENT 2020a. Biodiversity Assessment Method.

DEPARTMENT OF PLANNING INDUSTRY AND ENVIRONMENT 2020b. Surveying threatened plants and their habitat – NSW survey guide for the Biodiversity Assessment Method. Parramatta: Environment, Energy and Science.

DEPARTMENT OF PRIMARY INDUSTRIES (2012), Risk Assessment Guidelines for Groundwater Dependent Ecosystems. Available for download from researchgate.net.

DEPARTMENT OF PRIMARY INDUSTRIES 2013. Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update). Wollongbar: NSW Department of Primary Industries.

DEPARTMENT OF PRIMARY INDUSTRIES. 2024a. Fisheries Spatial Data Portal [Online]. Available: https://www.dpi.nsw.gov.au/fishing/fisheries-research/spatial-data-portal [Accessed 2023].

DEPARTMENT OF PRIMARY INDUSTRIES. 2024b. NSW WeedWise [Online]. Available: https://weeds.dpi.nsw.gov.au/ [Accessed 2023].

DEPARTMENT OF PRIMARY INDUSTRIES. 2024c. Register of critical habitat [Online]. Available: https://www.dpi.nsw.gov.au/fishing/species-protection/conservation/what/register [Accessed 2023].

DEPARTMENT OF SUSTAINABILITY ENVIRONMENT WATER POPULATION AND COMMUNITIES 2013. Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies – Significant impact guidelines 1.2 Environment Protection and Biodiversity Conservation Act 1999.

DEPARTMENT OF THE ENVIRONMENT 2013. Matters of National Environmental Significance – Significant impact guidelines 1.1 Environmental Protection and Biodiversity Conservation Act 1999.

DEPARTMENT OF THE ENVIRONMENT 2014. EPBC Act Referral Guidelines for the vulnerable Koala (combined populations of Queensland, New South Wales and Australian Capital Territory). Commonwealth of Australia, 2014.

DEPARTMENT OF THE ENVIRONMENT AND ENERGY 2016. An Interim Biogeographic Regionalisation of Australia (IBRA) – Version 7. Canberra: Department of the Environment and Energy.

EAMUS, D., FROEND, R., LOOMES, R., HOSE, G. & MURRAY, B. 2006. A functional methodology for determining the groundwater regime needed to maintain the health of groundwater-dependent vegetation. Australian Journal of Botany, 24, 97–114.

HATTON, T. & EVANS, R. 1998. Dependence of ecosystems on groundwater and its significance to Australia. Canberra: Land and Water Resources Research and Development Corporation.

KAVANAGH, R. & PEAKE, P. 1993. Survey procedures for nocturnal forest birds: an evaluation of the variability in census results due to temporal factors, weather and technique. In Olsen, P. (ed.), . Australian Raptor Studies. Melbourne: Australian Raptor Association, RAOU.

KLEINFELDER. 2021, Caravan Park – Long Term Living BDAR.

KLEINFELDER. 2022. Cedar Mill Cultural Events Site Morisset (Morisset Event Space).

LAKE MACQUARIE CITY COUNCIL, 2015, Squirrel Glider Planning and Management Guidelines.

LAKE MACQUARIE CITY COUNCIL, 2018, Summary Background Technical Report for Lake Mac 2050 – Biodiversity.

LAKE MACQUARIE CITY COUNCIL, 2019, Lake Macquarie Native Vegetation Extent and Corridors. Available: https://lmcc.maps.arcgis.com/apps/webappviewer/index.html?id=6d879fae76ed47858c993a74b88b8ba6.

LAKE MACQUARIE CITY COUNCIL, 2022, LMCC 2022 Native Vegetation & Corridors Map. Available: https://experience.arcgis.com/experience/e09ed8885ef3440a9ec7dc6286229a76/.

NSW GOVERNMENT. 2023. NSW Planning Portal Spatial Viewer [Online]. Available: https://www.lakemac.com.au https://www.planningportal.nsw.gov.au/spatialviewer/#/find-a-property/address [Accessed 2023].

NSW ROADS AND MARITIME SERVICES 2012. Wildlife Connectivity Guidelines – Managing wildlife connectivity on road projects. Sydney.

NSW SCIENTIFIC COMMITTEE. 2011a. River-flat Eucalypt Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions [Online]. Available: https://www.environment.nsw.gov.au/Topics/Animals-and-plants/Threatened-species/NSW-Threatened-Species-Scientific-Committee/Determinations/Final-determinations/2011-2012/River-Flat-Eucalypt-Forest-on-Coastal-floodplains-minor-amendment-Determination.

NSW SCIENTIFIC COMMITTEE. 2011b. Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions – endangered ecological listing [Online]. Available: http://www.environment.nsw.gov.au/determinations/SwampSchlerophyllEndSpListing.htm.

OFFICE FOR ENVIRONMENT & HERITAGE 2016. NSW Mitchell Landscapes Version 3.1.

OFFICE OF ENVIRONMENT & HERITAGE 2018. Threatened Species Test of Significance Guidelines. Sydney.

OFFICE OF ENVIRONMENT & HERITAGE (2018), 'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method.

OFFICE OF ENVIRONMENT & HERITAGE (2017), Guidance to assist a decision-maker to determine a serious and irreversible impact (nsw.gov.au).

PENNAY, M., LAW, B. & REINHOLD, L. 2004. Bat calls of NSW. Region based guide to the echolocation calls of microchiropteran bats. Sydney: New South Wales Department of Environment and Conservation and State Forests of New South Wales.

PHILLIPS, S. & CALLAGHAN, J. 2011. The Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas Phascolarctos cinereus. Australian Zoologist, 35, 774-780.

PHILLIPS, S., LANE, A. & WALLIS, K. 2017. Managing koala populations for the future: constituent populations of the Central ARKS Port Stephens sub-area. Uki, NSW: Report prepared for Port Stephens Council.

ROADS AND TRAFFIC AUTHORITY 2011. Biodiversity Guidelines – Protecting and managing biodiversity on RTA projects. Sydney: RTA.

ROYAL BOTANIC GARDENS. 2024. PlantNet – The Plant Information Network System of Botanic Gardens Trust Version 2.0 [Online]. Available: https://plantnet.rbgsyd.nsw.gov.au/ [Accessed].

SEROV, P., KUGINIS, L. & WILLIAMS, J. P. 2012. Risk Assessment Guidelines for groundwater dependent ecosystems, Volume 1 – The conceptual framework. NSW Department of Primary Industries, Office of Water, Sydney.

THACKWAY, R. & CRESSWELL, I. D. 1995. An Interim Biogeographic Regionalisation of Australia, Canberra, Australian Nature Conservation Agency.

TRANSPORT FOR NSW 2022a. Biodiversity assessment guidelines.

TRANSPORT FOR NSW 2022b. Biodiversity Policy.

TRANSPORT FOR NSW 2022c. No net loss guidelines: A guide for achieving biodiversity offsets and conservation measures.

TRANSPORT FOR NSW 2022e. Tree and hollow replacement guidelines.

TRANSPORT FOR NSW 2024. Biodiversity Management Guidelines: Protecting and managing biodiversity on Transport for NSW projects.

Appendix A – Species recorded

Table A-1 Recorded flora

Family	Scientific name	Common name	Status		Cover (%) in each plot*								
			BC Act	EPBC Act	1	2	3	4	5	6	7	8	9
Fabaceae	*Acacia falcata*		–	–			1						
Fabaceae	*Acacia maidenii*		–	–								0.2	
Fabaceae	*Acacia suaveolens*		–	–			2	1					0.4
Fabaceae	*Acacia ulicifolia*		–	–			0.1						
Pteridaceae	*Adiantum aethiopicum*		–	–								0.9	
Asteraceae	*Ageratina adenophora*	Crofton Weed	–	–						3			10
Casuarinaceae	*Allocasuarina littoralis*	Black She-oak	–	–	0.1	15				30			
Casuarinaceae	*Allocasuarina torulosa*		–	–				5					
Primulaceae	*Anagallis arvensis*		–	–									0.2
Poaceae	*Andropogon virginicus*		–	–				0.2					
Myrtaceae	*Angophora costata*	Smooth-barked Apple	–	–								6	
Myrtaceae	*Angophora inopina*	Charmhaven Apple	V	V		10							
Poaceae	*Aristida ramosa*		–	–				0.4					
Poaceae	*Avena fatua*		–	–							0.2		
Proteaceae	*Banksia oblongifolia*		–	–									1
Proteaceae	*Banksia serrata*		–	–		0.1	12	1					
Proteaceae	*Banksia spinulosa var. collina*		–	–					0.6				
Asteraceae	*Bidens pilosa*		–	–					0.1		0.5		

Family	Scientific name	Common name	Status		Cover (%) in each plot*								
			BC Act	EPBC Act	1	2	3	4	5	6	7	8	9
Asteraceae	*Bidens subalternans*		–	–					0.1				
Pittosporaceae	*Billardiera scandens*		–	–			0.1	0.1					
Fabaceae	*Bossiaea heterophylla*		–	–				0.1					
Fabaceae	*Bossiaea scolopendria*		–	–				0.2					
Phyllanthaceae	*Breynia oblongifolia*		–	–	0.2								
Poaceae	*Briza maxima*		–	–					0.2				
Poaceae	*Briza subaristata*		–	–						0.1	0.1		
Poaceae	*Bromus hordeaceus*		–	–							1		
Myrtaceae	*Callistemon citrinus*		–	–					1				
Poaceae	*Carex inversa*		–	–	1	0.4							
Lauraceae	*Cassytha glabella*		–	–			0.1	0.1				0.1	
Casuarinaceae	*Casuarina glauca*	Swamp She-oak	–	–					10				
Poaceae	*Cenchrus clandestinus*		–	–					50	40	15		
Apiaceae	*Centella asiatica*		–	–				0.4	0.1	0.3	0.5		
Pteridaceae	*Cheilanthes sieberi*		–	–									0.1
Lauraceae	*Cinnamomum camphora*	Camphor Laurel	–	–						15	30		
Asteraceae	*Cirsium vulgare*	Spear Thistle	–	–							0.2		
Ranunculaceae	*Clematis aristata*		–	–	0.5	0.4						0.1	
Ranunculaceae	*Clematis glycinoides*		–	–							0.2		
Polygalaceae	*Comesperma ericinum*		–	–			0.3						
Proteaceae	*Conospermum ericifolium*		–	–				0.1					
Asteraceae	*Conyza bonariensis*		–	–					0.1				0.3

Family	Scientific name	Common name	Status		Cover (%) in each plot*								
			BC Act	EPBC Act	1	2	3	4	5	6	7	8	9
Poaceae	*Cortaderia selloana*	Pampas Grass	–	–						3			
Myrtaceae	*Corymbia gummifera*	Red Bloodwood	–	–			2	3					
Orchidaceae	*Cryptostylis erecta*		–	–				0.1					
Orchidaceae	*Cryptostylis subulata*		–	–			0.1	0.1					
Sapindaceae	*Cupaniopsis anacardioides*	Tuckeroo	–	–					1	0.3	0.1		
Poaceae	*Cynodon dactylon*		–	–			1		5		10		
Cyperaceae	*Cyperus gracilis*		–	–									0.3
Goodeniaceae	*Dampiera stricta*		–	–			0.5						
Asphodelaceae	*Dianella caerulea var. producta*		–	–	10	30	0.4	1	0.5	3	1	3	0.3
Convulvulaceae	*Dichondra repens*	Kidney Weed	–	–	0.3			0.5				0.4	
Fabaceae	*Dillwynia retorta*		–	–			0.2						
Sapindaceae	*Dodonaea triquetra*		–	–	1							0.4	
Poaceae	*Ehrharta erecta*		–	–					0.2			0.2	
Poaceae	*Entolasia marginata*		–	–	2	15						0.6	
Poaceae	*Entolasia stricta*		–	–			3	15	0.3				
Poaceae	*Eragrostis curvula*		–	–							30		
Myrtaceae	*Eucalyptus amplifolia*	Cabbage Gum	–	–							3		
Myrtaceae	*Eucalyptus capitellata*	Brown Stringybark	–	–			10	40					
Myrtaceae	*Eucalyptus haemastoma*	Scribbly Gum	–	–			3	5					2
Myrtaceae	*Eucalyptus robusta*	Swamp Mahogany	–	–	0.1	10			8	30	1		0.1
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum	–	–							20		
Cyperaceae	*Gahnia clarkei*		–	–	50	3					5	3	

Family	Scientific name	Common name	Status		Cover (%) in each plot*								
			BC Act	EPBC Act	1	2	3	4	5	6	7	8	9
Asteraceae	*Gamochaeta purpurea*		–	–									0.1
Asphodelaceae	*Geitonoplesium cymosum*		–	–	0.2							0.3	
Phyllanthaceae	*Glochidion ferdinandi*	Cheese Tree	–	–	10	10		3	2	2		5	1
Fabaceae	*Glycine microphylla*		–	–	0.1							0.1	
Fabaceae	*Glycine tabacina*		–	–							0.1		
Fabaceae	*Gompholobium pinnatum*		–	–			0.2						
Goodeniaceae	*Goodenia bellidifolia*		–	–	0.1								
Proteaceae	*Hakea dactyloides*		–	–			4						
Dilleniaceae	*Hibbertia dentata*		–	–						0.4			
Araliaceae	*Hydrocotyle bonariensis*		–	–					5	0.1	5		
Poaceae	*Hyparrhenia hirta*		–	–					1				0.4
Asteraceae	*Hypochaeris radicata*		–	–			0.1						
Dennstaedtiaceae	*Hypolepis muelleri*		–	–	0.5								20
Poaceae	*Imperata cylindrica*		–	–			0.3	0.2	1	30	5	1	70
Poaceae	*Juncus usitatus*		–	–									0.2
Myrtaceae	*Kunzea ambigua*		–	–					5				
Proteaceae	*Lambertia formosa*	Mountain Devil	–	–			20						
Verbenaceae	*Lantana camara*	Lantana	–	–	0.5	0.2				1	1	5	
Poaceae	*Lepidosperma laterale*		–	–			0.1	10					
Myrtaceae	*Leptospermum polygalifolium*		–	–			10		4		1		
Myrtaceae	*Leptospermum trinervium*		–	–			5	2					
Oleaceae	*Ligustrum sinense*	Small-leaved Privet	–	–	0.1	0.2			0.1		0.1	1	2

Family	Scientific name	Common name	Status		Cover (%) in each plot*								
			BC Act	EPBC Act	1	2	3	4	5	6	7	8	9
Lindsaeaceae	*Lindsaea linearis*		–	–			0.1	0.9					
Lindsaeaceae	*Lindsaea microphylla*		–	–			0.1						
Arecaceae	*Livistona australis*	Cabbage Palm	–	–					0.1				
Asparagaceae	*Lomandra filiformis subsp. filiformis*		–	–				1					
Asparagaceae	*Lomandra longifolia*		–	–	5							0.5	2
Asparagaceae	*Lomandra obliqua*		–	–		0.1	0.3	3					
Apocynaceae	*Marsdenia rostrata*		–	–		0.1							
Myrtaceae	*Melaleuca nodosa*	Prickly-leaved Paperbark	–	–	60	10			3	20		60	
Myrtaceae	*Melaleuca sieberi*		–	–	10	11							
Poaceae	*Microlaena stipoides*		–	–						0.5			
Araceae	*Monstera deliciosa*		–	–					0.1				
Lomariopsiodaceae	*Nephrolepis cordifolia*		–	–								0.4	
Amaryllidaceae	*Nothoscordum gracile*		–	–				0.1					
Rubiaceae	*Opercularia diphylla*		–	–			0.1						
Poaceae	*Oplismenus aemulus*		–	–	5	10						3	
Poaceae	*Oplismenus imbecillis*		–	–						0.4			
Oxalidaceae	*Oxalis perennans*		–	–	0.1							0.1	
Bignoniaceae	*Pandorea pandorana*		–	–								0.1	
Apocynaceae	*Parsonsia straminea*		–	–	15	5		0.5	0.3	0.6		3	
Poaceae	*Paspalum dilatatum*		–	–						15	1		
Iridacieae	*Patersonia glabrata*		–	–				2					
Proteaceae	*Persoonia levis*		–	–			1	1					0.6

Family	Scientific name	Common name	Status		Cover (%) in each plot*								
			BC Act	EPBC Act	1	2	3	4	5	6	7	8	9
Proteaceae	*Petrophile pulchella*		–	–			0.4						0.4
Poaceae	*Phalaris paradoxa*		–	–									0.9
Thymelaceae	*Pimelea linifolia*		–	–			0.2						
Pinaceae	*Pinus spp.*		–	–							5		0.2
Pittosporaceae	*Pittosporum undulatum*		–	–	0.5				0.5		0.3	0.5	1
Plantaginaceae	*Plantago lanceolata*		–	–							0.2		
Apiaceae	*Platysace linearifolia*		–	–			10						
Convulvulaceae	*Polymeria calycina*		–	–	0.1								
Araliaceae	*Polyscias sambucifolia*		–	–	1	1	0.5	6				0.1	
Campanulaceae	*Pratia purpurascens*		–	–	0.1	0.5		0.8			0.1	0.3	0.2
Acanthaceae	*Pseuderanthemum variabile*		–	–						0.1			
Dennstaedtiaceae	*Pteridium esculentum*	Bracken Fern	–	–						0.6	0.1	0.3	
Rosaceae	*Rubus ulmifolius*	Blackberry	–	–	0.3	1		0.6	15	0.5	7	0.3	
Polygonaceae	*Rumex brownii*		–	–							0.5		
Poaceae	*Setaria parviflora*		–	–							5		
Malvaceae	*Sida rhombifolia*		–	–							0.3		
Solanaceae	*Solanum mauritianum*	Tobacco Bush	–	–		0.1				0.3	0.2		
Asteraceae	*Sonchus oleraceus*		–	–							0.1		
Poaceae	*Sporobolus creber*		–	–							15		
Elaeocarpaceae	*Tetratheca juncea*	Black-eyed Susan	V	V			0.5	0.5					
Orchidaceae	*Thelymitra ixioides var. ixioides*	Dotted Sun Orchid	–	–			0.1						
Poaceae	*Themeda triandra*	Kangaroo Grass	–	–								1	

Family	Scientific name	Common name	Status		Cover (%) in each plot*								
			BC Act	EPBC Act	1	2	3	4	5	6	7	8	9
Asphodelaceae	*Tricoryne elatior*		–	–			0.1						
Fabaceae	*Trifolium repens*		–	–							0.1		
Verbenaceae	*Verbena bonariensis*		–	–					0.1		0.5		
Fabaceae	*Vicia sativa*		–	–							0.1		
Ericaceae	*Woollsia pungens*		–	–			0.5						
Colchicaeae	*Wurmbea latifolia*		–	–			0.1						
Asphodelaceae	*Xanthorrhoea latifolia*		–	–			30	50					

Note: *Cover determined in accordance with the BAM.

Table A-2 Recorded fauna

Class	Scientific name	Common name	Status	
			BC Act	EPBC Act
Amphibia	*Crinia signifera*	Common Eastern Froglet	–	–
Amphibia	*Limnodynastes peronii*	Striped Marsh Frog	–	–
Amphibia	*Litoria fallax*	Eastern Dwarf Tree Frog	–	–
Amphibia	*Litoria tyleri*	Tyler's Tree Frog	–	–
Amphibia	*Uperoleia fusca*	Dusky Toadlet	–	–
Aves	*Acanthiza lineata*	Striated Thornbill	–	–
Aves	*Acanthiza nana*	Yellow Thornbill	–	–
Aves	*Acanthorhynchus tenuirostris*	Eastern Spinebill	–	–
Aves	*Acridotheres tristis*	Common Myna	–	–
Aves	*Anthochaera carunculata*	Red Wattlebird	–	–
Aves	*Anthochaera chrysoptera*	Little Wattlebird	–	–
Aves	*Artamus leucorynchus*	White-breasted Woodswallow	–	–
Aves	*Cacatua sanguinea*	Little Corella	–	–
Aves	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	–	Marine
Aves	*Caligavis chrysops*	Yellow-faced Honeyeater	–	–
Aves	*Calyptorhynchus funereus*	Yellow-tailed Black-Cockatoo	–	–
Aves	*Calyptorhynchus lathami*	Glossy Black-Cockatoo	Vulnerable	–
Aves	*Chenonetta jubata*	Australian Wood Duck	–	–
Aves	*Columba livia*	Rock Dove	–	–
Aves	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	–	Marine
Aves	*Corvus coronoides*	Australian Raven	–	–

Class	Scientific name	Common name	Status	
			BC Act	EPBC Act
Aves	*Cracticus tibicen*	Australian Magpie	–	–
Aves	*Cracticus torquatus*	Grey Butcherbird	–	–
Aves	*Daphoenositta chrysoptera*	Varied Sittella	Vulnerable	–
Aves	*Elanus caeruleus*	Black-shouldered Kite	–	–
Aves	*Eolophus roseicapilla*	Galah	–	–
Aves	*Falco cenchroides*	Nankeen Kestrel	–	–
Aves	*Gerygone olivacea*	White-throated Gerygone	–	–
Aves	*Glossopsitta pusilla*	Little Lorikeet	Vulnerable	–
Aves	*Grallina cyanoleuca*	Magpie-Lark	–	Marine
Aves	*Hieraaetus morphnoides*	Little Sea-Eagle	Vulnerable	–
Aves	*Hirundo neoxena*	Welcome Swallow	–	–
Aves	*Malurus cyaneus*	Superb Fairy-wren	–	–
Aves	*Malurus lamberti*	Variegated Fairy-wren	–	–
Aves	*Manorina melanocephala*	Noisy Miner	–	–
Aves	*Neochmia temporalis*	Red-browed Finch	–	–
Aves	*Ninox strenua*	Powerful Owl	Vulnerable	–
Aves	*Ocyphaps lophotes*	Crested Pigeon	–	–
Aves	*Oriolus sagittatus*	Olive-backed Oriole	–	–
Aves	*Pardalotus punctatus*	Spotted Pardalote	–	–
Aves	*Pardalotus striatus*	Striated Pardalote	–	–
Aves	*Phalacrocorax carbo*	Great Cormorant	–	–
Aves	*Phalacrocorax sulcirostris*	Little Black Cormorant	–	–

Class	Scientific name	Common name	Status	
			BC Act	EPBC Act
Aves	*Philemon corniculatus*	Noisy Friarbird	–	–
Aves	*Platalea regia*	Royal Spoonbill	–	–
Aves	*Platycercus eximius*	Eastern Rosella	–	–
Aves	*Ptilonorhynchus violaceus*	Satin Bowerbird	–	–
Aves	*Rhipidura albiscapa*	Grey Fantail	–	–
Aves	*Rhipidura leucophrys*	Willie Wagtail	–	–
Aves	*Scythrops novaehollandiae*	Channel-billed Cuckoo	–	Marine
Aves	*Sphecotheres vieilloti*	Australasian Figbird	–	–
Aves	*Strepera graculina*	Pied Currawong	–	–
Aves	*Sturnus vulgaris*	Common Starling	–	–
Aves	*Threskiornis Molucca*	Australian White Ibis	–	–
Aves	*Trichoglossus chlorolepidotus*	Scaly-breasted Lorikeet	–	–
Aves	*Trichoglossus moluccanus*	Rainbow Lorikeet	–	–
Aves	*Vanellus miles*	Masked Lapwing	–	–
Aves	*Zosterops lateralis*	Silvereye	–	Marine
Mammalia	*Austronomus australis*	White-striped Free-tailed Bat	–	–
Mammalia	*Chalinolobus gouldii*	Gould's Wattled Bat	–	–
Mammalia	*Chalinolobus morio*	Chocolate Wattled Bat	–	–
Mammalia	*Macropus giganteus*	Eastern Grey Kangaroo	–	–
Mammalia	*Micronomus norfolkensis*	Eastern Coastal Free-tailed Bat1	Vulnerable	–
Mammalia	*Miniopterus australis*	Little Bent-winged Bat	Vulnerable	–
Mammalia	*Miniopterus orianae oceanensis*	Large Bent-winged Bat	Vulnerable	–

Class	Scientific name	Common name	Status	
			BC Act	EPBC Act
Mammalia	*Ozimops ridei*	Eastern Free-tailed Bat	–	–
Mammalia	*Pseudocheirus peregrinus*	Common Ringtail Possum	–	–
Mammalia	*Pteropus poliocephalus*	Grey-headed Flying-fox	Vulnerable	Vulnerable
Mammalia	*Trichosurus vulpecula*	Common Brushtail Possum	–	–
Mammalia	*Vespadelus troughtoni*	Eastern Cave Bat	Vulnerable	–
Reptilia	*Intellagama lesueurii*	Eastern Water Dragon	–	–
Reptilia	*Lampropholis delicata*	Grass Skink	–	–
Reptilia	*Pseudechis porphyriacus*	Red-bellied Black Snake	–	–

Appendix B – Habitat suitability assessment

The criteria outlined in Table B-1 can be used to determine the likelihood that a threatened species could occur in the study area. The criteria are designed for use in a BAR only and is not applicable for use in a BDAR (i.e., where the BAM-C is being used). Only recorded sightings from BioNet are valid for these criteria.

Table B-1 Habitat suitability assessment criteria

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey or has been recorded within the past five years (known from a reputable source).
High	A species is considered highly likely to occur in the study area if: • There are previous credible records on BioNet within the study area from the last 10 years and suitable habitat is present. **OR** • The species is highly mobile, is dependent on identified suitable habitat within the study area (i.e., for breeding or important life cycle periods such as winter flowering resources) and has been recorded recently (within five years) on BioNet in the locality. This also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	A species is considered moderately likely to occur in the study area if: • Any suitable habitat (e.g., foraging) is present in the study area, the species is highly mobile and has been recorded in the locality in the last 10 years on BioNet. The species may be unlikely to maintain sedentary populations, however, may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (i.e., for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area. **OR** • The species is not highly mobile, is dependent on identified suitable habitat features (e.g., hollows, rocky outcrops) within the study area and has been recorded in the locality in the last 10 years on BioNet. **OR** • For flora species that are associated with PCTs in the study area (see TBDC) or have been recorded in the locality in the last 10 years on BioNet – the associated PCT/habitat present in the study area is not degraded and the species was not targeted by surveys in accordance with the BAM and relevant survey guidelines. In addition, for flora species known to occur in disturbed areas (e.g., orchids), records from any time within the locality may warrant inclusion in this category.

Likelihood	Criteria
Low	A species is considered to have a low likelihood of occurring in the study area if: • For highly mobile species, the species may be an occasional visitor, but habitat similar to the study area is widely distributed in the locality, meaning that the species is not dependent (i.e., for breeding or important life cycle periods such as winter flowering resources) on habitats in the study area and the species has not been recorded in the locality in the last 10 years on BioNet. **OR** • The species is not highly mobile, is dependent on identified suitable habitat features (e.g., hollows, rocky outcrops) within the study area and has not been recorded in the locality in the last 10 years on BioNet. **OR** • For flora species that are associated with PCTs in the study area (see TBDC) and the species was not identified following targeted surveys in accordance with the BAM and relevant survey guidelines. Flora species that have been recorded in the locality on BioNet at any time, associated suitable habitat (see the TBDC) is not present in the study area, though similar habitats of the same vegetation formation is present in the study area.
Unlikely	Suitable habitat for the species is absent from the study area.

Table B-2 Habitat suitability assessment table

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Plants							
Acacia bynoeana Bynoe's Wattle	E1	V	Species	n/a	Occurs south of Dora Creek-Morisset area to Berrima and the Illawarra region and west to the Blue Mountains. It grows mainly in heath and dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes disturbed sites such as trail margins and recently burnt areas. Typically occurs in association with *Corymbia gummifera, Eucalyptus haemastoma, E. gummifera, E. parramattensis, E. sclerophylla, Banksia serrata* and *Angophora bakeri*.	BioNet (26), PMST	Moderate – Several occurrence records within the locality, with potential habitat present in the biodiversity study area.
Angophora inopina Charmhaven Apple	V	V	Species	South of Wootton	Grows in open woodland on deep white sandy soils over sandstone. Species is known to occur as far north as Karuah and as far south as Charmhaven, with the main population occurring between Morisset and Charmhaven.	BioNet (359), PMST	**Recorded** – 23 individuals were recorded within the biodiversity study area during the field survey; three within the subject land, and 20 outside of the subject land.
Asperula asthenes Trailing Woodruff	V	V	Species	n/a	Trailing Woodruff is a low, trailing perennial herb with leaves in whorls of four around the stem. It has tiny fragrant white star-shaped flowers followed by tiny two-lobed fruit, only 1 mm long. This small herb occurs only in NSW. It is found in scattered locations from Bulahdelah north to near Kempsey, with several records from the Port Stephens/Wallis Lakes area. Occurs in damp sites, often along river banks.	BioNet (14)	Low – The biodiversity study area is outside of the distribution of this species.
Caladenia tessellata Thick-lipped Spider-orchid	V	V	Species	n/a	Occurs south of Swansea where it grows on clay loam or sandy soils. Prefers low open forest with a heathy or sometimes grassy understorey. Within NSW, currently known from two disjunct areas; one population near Braidwood on the Southern Tablelands and three populations in the Wyong area on the Central Coast. Previously known also from Sydney and South Coast areas.	PMST	Moderate – suitable habitat is present within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Corunastylis insignis Wyong Midge Orchid 1	CE	CE	Species	Restricted to the Wyong LGA	A terrestrial orchid that grows to 6-15cm tall and bears 5-12 dark purple to dark reddish-purple flowers with a dark reddish-purple labellum. Species is known to occur in four localities in the Wyong local government area	PMST	Low – this species only occurs in the Wyong LGA.
Corunastylis sp. Charmhaven (NSW896673) Wyong Midge Orchid 2	CE	CE	Species	n/a	*Corunastylis* sp. Charmhaven (NSW896673) is distributed from Morisset to Warnervale, and as far east as Chain Valley Bay. 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*).	BioNet (30)	Low – All known locations for this species are located south from Wyee Point.
Corybas dowlingii Red Helmet Orchid	E	–	Species	n/a	*Corybas dowlingii* is restricted to the central coast and Hunter regions of New South Wales where it is currently known from the Port Stephens, Bulahdelah, Lake Macquarie and Freemans Waterhole areas. Occurs in sheltered areas such as gullies and southerly slopes in tall open forest on well-drained gravelly soil at elevations of 10–200 m; though the species has been recorded from sandy soils in swamp forest areas (e.g., Medowie, Anna Bay, Wauchope and Port Macquarie).	BioNet (34)	Low – Habitat within the biodiversity study area is not considered suitable, i.e. does not contain gullies and southern slopes in tall open forest and only marginal habitat otherwise.
Cryptostylis hunteriana Leafless Tongue-orchid	V	V	Species	n/a	Occurs south from the Gibraltar Range, chiefly in coastal districts but also extends on to tablelands. Grows in swamp-heath and drier forest on sandy soils on granite & sandstone. Occurs in small, localised colonies most often on the flat plains close to the coast but also known from some mountainous areas growing in moist depressions and swampy habitats.	BioNet (6), PMST	**Assumed present** – Six occurrence records within the locality, with potential habitat present in the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Cynanchum elegans White-flowered Wax Plant	E	E	Species	n/a	Occurs from the Gloucester district to the Wollongong area and inland to Mt Dangar where it grows in rainforest gullies, scrub and scree slopes. This species typically occurs at the ecotone between dry subtropical forest/woodland communities.	PMST	Unlikely - Habitat within the biodiversity study area is not considered suitable.
Diuris praecox Rough Doubletail	V	V	Species	Within the Parish boundaries of Forster, Eurunderee, Fens, Tomaree, Stowell and Stockton	Occurs in coastal and near-coastal districts from Ourimbah to Nelson Bay where it grows in sclerophyll forest often on hilltops or slopes	PMST	Moderate – Suitable habitat is present within the biodiversity study area.
Eucalyptus camfieldii Camfield's Stringybark	V	V	Species	n/a	Occurs in scattered locations within a restricted distribution in a narrow band with the most northerly records in the Raymond Terrace area south to Waterfall. Grows in poor coastal country in shallow sandy soils overlying Hawkesbury sandstone, in coastal heath mostly on exposed sandy ridges. Occurs mostly in small, scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas.	PMST	Unlikely - Habitat within the biodiversity study area is not considered suitable.
Eucalyptus parramattensis subsp. *decadens*	V	V	Species	n/a	There are two separate meta-populations of *E. parramattensis* subsp. *decadens*. The Kurri Kurri meta-population is bordered by Cessnock—Kurri Kurri in the north and Mulbring—Abedare in the south. Large aggregations of the subspecies are located in the Tomalpin area. The Tomago Sandbeds meta-population is bounded by Salt Ash and Tanilba Bay in the north and Williamtown and Tomago in the south. Occurs on deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath understorey. It also occurs as an emergent in dry or wet heathland. Often where this species occurs, it is a community dominant.	PMST	Unlikely - Habitat within the biodiversity study area is not considered suitable. Species was not recorded during survey.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Eucalyptus parramattensis C. Hall. subsp. *parramattensis* in the Wyong and Lake Macquarie local government areas	E2	–	Species	Restricted to Lake Macquarie and Wyong LGAs	The species usually occurs from the Goulburn Valley on the Central West slopes to Hill Top on the Central Coast. The endangered population in the Lake Macquarie and Wyong local government areas is at the north-eastern limit of the species range and is quite separate from other known populations. The majority of the population occurs within Wyong in the Porter's Creek and the Wallarah Creek catchments. 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, E. tereticornis, Corymbia gummifera* as well as *Melaleuca* species.	BioNet (4)	Unlikely – Four occurrence records within the locality. However, habitat within the biodiversity study area is not considered suitable.
Euphrasia arguta	CE	CE	Species	n/a	A small annual herb which grows to 20–35 cm in open forest associated with mixed grass and shrub understorey. Once thought extinct, this species was rediscovered in the Nundle area in 2008 where the species had regenerated following disturbance. Historically, *Euphrasia arguta* has only been recorded from relatively few places within an area extending from Sydney to Bathurst and north to Walcha. The Royal Botanic Gardens Specimen Register records an additional location reported and vouchered in 2002 from near the Hastings River; and Euphrasia arguta was also recorded from the Barrington Tops in 2012.	PMST	Low – This species is associated with the tablelands from Bathurst north to near Walcha.
Genoplesium baueri Yellow Gnat-Orchid	E	E	Species	n/a	Grows in dry sclerophyll forest and moss gardens over sandstone. The species has been recorded from locations between Ulladulla and Port Stephens. About half the records were made before 1960 with most of the older records being from northern Sydney suburbs. The species has been recorded at locations now likely to be within the following conservation reserves: Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments.	PMST	Low - Habitat within the biodiversity study area is not considered suitable. Species was not recorded during survey.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Genoplesium insigne Variable Midge Orchid	CE	CE	Species	n/a	Occurs in southern Lake Macquarie and northern Central Coast LGAs. It's distribution is recorded as far as Cooranbong in the north, Warnervale in the south and Chain Valley in the east. Appears to be associated with Scribbly Gum (*Eucalyptus haemastoma*), Red Bloodwood (*Corymbia gummifera*) and *Angophora inopina* (not always present) in heathy woodland on lowlands of the Central Coast and variations containing *Angophora costata* (Smooth-barked Apple).	BioNet (299)	Moderate – Several occurrence records within the locality, with suitable habitat present in the biodiversity study area.
Grevillea parviflora subsp. parviflora Small-flower Grevillea	V	V	Species	n/a	Mainly known from the Prospect area (but now extinct there) and lower Georges River to Camden, Appin and Cordeaux Dam areas, with a disjunct population near Putty, Cessnock and Cooranbong. Grows in heath or shrubby woodland in sandy or light clay soils usually over thin shales.	BioNet (46)	Moderate – Several occurrence records within the locality, with potential habitat is present in the biodiversity study area.
Maundia triglochinoides	V	–	Species	Other (riparian areas/ drainage lines, water ponding, man-made dams and drainage channels up to 1 m deep) Semi-permanent/ ephemeral wet areas Swamps (shallow swamps up to 1 m deep) Waterbodies (shallow waterbodies up to 1 m deep)	Known from Sydney area north to southern Queensland in coastal swamps or shallow freshwater in heavy clay. Populations within Sydney are now believed to be extinct, leaving Wyong as the southern limit of the current distribution.	BioNet (7)	Low – Seven occurrence records within the locality. No suitable habitat is present within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Melaleuca biconvexa Biconvex Paperbark	V	V	Species	n/a	Occurs as disjunct populations in coastal New South Wales from Jervis Bay to Port Macquarie, with the main concentration of records is in the Gosford/Wyong area. Grows in damp places, often near streams, or low-lying areas on alluvial soils of low slopes or sheltered aspects.	BioNet (419)	Unlikely – no suitable habitat within the study area
Persicaria elatior Knotweed	*V*	V	Species	Semi-permanent/ ephemeral wet areas (or within 50 m) Swamps (or within 50 m) Waterbodies (including wetlands, or within 50 m)	Occurs infrequently in coastal regions where it grows in damp places especially beside streams and lakes. Also occasionally occurs in swamp forest or associated with disturbance.	BioNet (1)	Low – One occurrence record within the locality. No suitable habitat is present within the biodiversity study area.
Pterostylis gibbosa Illawarra Greenhood	E	E	Species	n/a	The Illawarra greenhood is known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra) of New South Wales. All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage.	PMST	Low – This species is associated with the Hunter region (Milbrodale), Illawarra region and Shoalhaven region.
Rhizanthella slateri Eastern Underground Orchid	V	E	Species	n/a	Flowers from September to November. Little is known about the preferred habitat of this species, but apparently prefers sclerophyll forest with a reasonably deep layer of organic litter. *Rhizanthella slateri* is restricted to New South Wales where it is currently known from 14 populations including Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. The *Rhizanthella slateri* population in the Great Lakes LGA occurs at the known northern limit of the species' range and is disjunct from other known populations of the species.	PMST	Unlikely – This species has not been recorded in the locality and habitat within the biodiversity study area is not considered suitable.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Rhodamnia rubescens Scrub Turpentine	CE	CE	Species	n/a	Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils. Occurs in coastal districts north from Batemans Bay in New South Wales, around 280 km south of Sydney, to areas inland of Bundaberg in Queensland. Populations of *R. rubescens* typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 m a.s.l. in areas with rainfall of 1,000–1,600 mm.	BioNet (32)	Low – Several occurrence records within the locality. However, habitat within the biodiversity study area is not considered suitable. Species was not recorded during survey.
Rhodomyrtus psidioides Native Guava	CE	CE	Species	n/a	Pioneer species found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest often near creeks and drainage lines. Occurs from Broken Bay, around 90 km north of Sydney, New South Wales, to Maryborough in Queensland. Populations are typically restricted to coastal and sub-coastal areas of low elevation however the species does occur up to c. 120 km inland in the Hunter and Clarence River catchments and along the Border Ranges in NSW.	BioNet (1)	Low – One occurrence record within the locality. However, habitat within the biodiversity study area is not considered suitable. Species was not recorded during survey.
Rutidosis heterogama Heath Wrinklewort	CE	CE	Species	n/a	Grows in heath on sandy soils and moist areas in open forest and has been recorded along disturbed roadsides.	BioNet (305)	Moderate – Several occurrence records within the locality, with suitable habitat present within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Syzygium paniculatum Magenta Lilly Pilly	E	V	Species	n/a	Occurs between Bulahdelah and St Georges Basin where it grows in subtropical and littoral rainforest on sandy soils or stabilized dunes near the sea. On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the Central Coast, Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	BioNet (1)	Low – One occurrence record within the locality. However, habitat within the biodiversity study area is not considered suitable. Species was not recorded during survey.
Tetratheca juncea Black-eyed Susan	V	V	Species	n/a	Occurs in coastal districts from Lake Macquarie to Bulahdelah where it grows in dry sclerophyll forest and occasionally swampy heath in sandy, low nutrient soils with a dense understorey of grasses. Specifically, it is known to occur within Coastal Plains Smooth-barked Apple Woodland and Coastal Plains Scribbly Gum Woodland.	BioNet (629)	**Recorded** –26 clumps were recorded within the biodiversity study area.
Thelymitra adorata Wyong Sun Orchid	CE	CE	Species	n/a	Currently known from the Central Coast and southern Lake Macquarie council regions where it has been recorded to grow in grassy woodland and derived grasslands on clay loam or shale derived soils. There seems to be a strong association with Spotted Gum – Ironbark Forest with a diverse grassy understorey and occasional scattered shrubs.	PMST	Unlikely – No suitable habitat within the biodiversity study area.
Thesium australe Austral Toadflax	V	V	Species	n/a	Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Grows in association with *Themeda triandra* and (less frequently) with *Poa* spp.	PMST	Low - Habitat within the biodiversity study area is not considered suitable. Species was not recorded during survey.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Birds							
Anthochaera phrygia Regent Honeyeater	CE	CE, M	Species/ Ecosystem	Other (important habitat map)	Occurs mostly in box-ironbark forests and woodland and prefers wet, fertile sites such as along creek flats, broad river valleys and foothills. Riparian forests with *Casuarina cunninghamiana* and *Amyema cambagei* are important for feeding and breeding. Spotted Gum and Swamp Mahogany forests are also important feeding areas in coastal areas. Important food trees include Eucalyptus sideroxylon (Mugga Ironbark), E. albens (White Box), E. melliodora (Yellow Box) and E. leucoxylon (Yellow Gum).	BioNet (43)	Moderate – Several occurrence records within the locality. Biodiversity study area contains winter foraging resources (Spotted Gum (*Corymbia maculata)* and Swamp Mahogany (*Eucalyptus robusta)*) for the Regent Honeyeater. Note no Important Habitat is mapped for this species under BAM, but this species is known to have been recorded in the locality.
Artamus cyanopterus cyanopterus Dusky Woodswallow	V	–	Ecosystem	n/a	Dusky woodswallows are widespread in eastern, southern and south western Australia. The species occurs throughout most of New South Wales, but is sparsely scattered in, or largely absent from, much of the upper western region. Most breeding activity occurs on the western slopes of the Great Dividing Range. Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris. It has also been recorded in shrublands, heathlands and very occasionally in moist forest or rainforest. Also found in farmland, usually at the edges of forest or woodland.	Bionet (4)	Moderate – Four occurrence records within the locality, with some suitable habitat present within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Botaurus poiciloptilus Australasian Bittern	E	E	Ecosystem	n/a	Occurs in shallow, vegetated freshwater or brackish swamps. Requires permanent wetlands with tall dense vegetation, particularly bulrushes and spikerushes. When breeding, pairs are found in areas with a mixture of tall and short sedges but will also feed in more open territory.	PMST	Unlikely – No suitable habitat identified within the biodiversity study area.
Calidris canutus Red Knot	–	E, M	Species/ Ecosystem	Other (important habitat map)	In Australasia the Red Knot mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. They are occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps. They rarely use inland lakes or swamps.	Bionet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.
Calidris ferruginea Curlew Sandpiper	E	CE, M	Species/ Ecosystem	Other (important habitat map)	Occurs in inter-tidal mudflats of estuaries, lagoons, mangrove channels and also around lakes, dams, floodwaters and flooded saltbush surrounding inland lakes	BioNet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Callocephalon fimbriatum Gang-gang Cockatoo	E	E	Species/ Ecosystem	Hollow bearing trees (Eucalypt trees with hollows at least 3 m above ground and hollow diameter of 7 cm or greater)	The Gang-gang Cockatoo is distributed from southern Victoria through south- and central-eastern New South Wales. In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. It occurs regularly in the Australian Capital Territory. It is rare at the extremities of its range, with isolated records known from as far north as Coffs Harbour and as far west as Mudgee. In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas. May also occur in sub-alpine Snow Gum (*Eucalyptus pauciflora*) woodland and occasionally in temperate rainforests. Favours old growth forest and woodland attributes for nesting and roosting. Nests are located in hollows that are 10 cm in diameter or larger and at least 9 m above the ground in eucalypts.	BioNet (1)	Moderate – Three occurrence records within the locality. Due to mobility and potential foraging resources within the biodiversity study area, this species cannot be discounted.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Calyptorhynchus lathami lathami South-eastern Glossy Black Cockatoo	V	V	Species/ Ecosystem	Hollow bearing trees (Living or dead tree with hollow greater than 15 cm diameter and greater than 8 m from the ground)	The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (*Allocasuarina littoralis*) and Forest Sheoak (*A. torulosa*) are important foods. Inland populations feed on a wide range of sheoaks, including Drooping Sheoak, *Allocasuaraina diminuta*, and A. gymnathera. Belah is also utilised and may be a critical food source for some populations. In the Riverina, birds are associated with hills and rocky rises supporting Drooping Sheoak, but also recorded in open woodlands dominated by Belah (*Casuarina cristata*). Feeds almost exclusively on the seeds of several species of she-oak (Casuarina and Allocasuarina species), shredding the cones with the massive bill. Dependent on large hollow-bearing eucalypts for nest sites.	BioNet (3)	Moderate – Three occurrence records within the locality. Due to mobility and potential foraging resources within the biodiversity study area, this species cannot be discounted.
Charadrius leschenaultii Greater Sand Plover	–	V, M	Species/ Ecosystem	Other (important habitat map)	Almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; begin foraging activity on wet ground at low tide, usually away from the edge of the water; individuals may forage and roost with other waders. Diet includes insects, crustaceans, polychaete worms and molluscs. Prey is detected visually by running a short distance, stopping to look, then running to collect the prey.	PMST	Unlikely – No suitable habitat identified within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Chthonicola sagittata Speckled Warbler	V	-	Ecosystem	n/a	The Speckled Warbler has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria, as far west as the Grampians. The species is most frequently reported from the hills and tablelands of the Great Dividing Range, and rarely from the coast. There has been a decline in population density throughout its range, with the decline exceeding 40% where no vegetation remnants larger than 100 ha survive. The Speckled Warbler 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.	Bionet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.
Climacteris picumnus victoriae Brown Treecreeper (eastern subspecies)	V	V	Ecosystem	n/a	The Brown Treecreeper is endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges. Often found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey.	BioNet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.
Daphoenositta chrysoptera Varied Sittella	V	–	Ecosystem	n/a	The Varied Sittella 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. The Varied Sittella feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees, and from small branches and twigs in the tree canopy. It builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.	BioNet (11)	**Recorded** – Several occurrence records within the locality, with some suitable habitat present within the biodiversity study area. Recorded once within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Diomedea antipodensis gibsoni Gibson's Albatross	V	V	n/a	n/a	In Australian territory, Gibson's Albatross has been recorded foraging between Coffs Harbour, NSW, and Wilson's Promontory, Victoria. Males and females appear to use different foraging areas, with females frequenting the Tasman Sea in the vicinity of 40° S, while males either disperse westwards at lower latitudes or north-east towards the mid-Pacific Ocean. Gibson's Albatross flies within 15 m of the sea surface, using the updraft from wave fronts for lift. It circles over breeding islands to heights of at least 1500 m.	PMST	Unlikely – No suitable habitat identified within the biodiversity study area.
Ephippiorhynchus asiaticus Black-necked Stork	E	–	Ecosystem	Swamps (shallow, open freshwater or saline wetlands or shallow edges of deeper wetlands within 300 m) Waterbodies (shallow lakes, lake margins and estuaries within 300 m)	Widespread in coastal and subcoastal northern and eastern Australia, as far south as central NSW (although vagrants may occur further south or inland, well away from breeding areas). In NSW, the species becomes increasingly uncommon south of the Clarence Valley, and rarely occurs south of Sydney. Since 1995, breeding has been recorded as far south as Bulahdelah. Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries. Usually forage in water 5-30cm deep for vertebrate and invertebrate prey. Eels regularly contribute the greatest biomass to their diet, but they feed on a wide variety of animals, including other fish, frogs and invertebrates (such as beetles, grasshoppers, crickets and crayfish).	BioNet (15)	Low – Several occurrence records within the locality. However, no suitable habitat identified within the biodiversity study area.
Epthianura albifrons White-fronted Chat	V	–	Ecosystem	n/a	The White-fronted Chat is found across the southern half of Australia, from southernmost Queensland to southern Tasmania, and across to Western Australia as far north as Carnarvon. Found mostly in temperate to arid climates and very rarely sub-tropical areas, it occupies foothills and lowlands up to 1000 m above sea level. In NSW, it occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas.	BioNet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Erythrotriorchis radiatus Red Goshawk	E	E	Species	n/a	The Red Goshawk is endemic to Australia. It is very sparsely dispersed across around 15% of coastal and sub-coastal Australia, from western Kimberley Division (north of 19°S) to northeastern NSW (north of 33°). There appears to have been a recent coastal contraction of the range in parts of eastern Australia, and a northward contraction of about 500 km in NSW where it is now virtually extinct. The Red Goshawk occurs in coastal and sub-coastal areas in wooded and forested lands of tropical and warm-temperate Australia. Riverine forests are also used frequently. Such habitats typically support high bird numbers and biodiversity, especially medium to large species which the goshawk requires for prey. The Red Goshawk nests in large trees, frequently the tallest and most massive in a tall stand, and nest trees are invariably within one km of permanent water.	PMST	Unlikely – No suitable habitat identified within the biodiversity study area.
Falco subniger Black Falcon	V	–	Ecosystem	n/a	The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referable to the Brown Falcon. In New South Wales there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling hundreds of km (Marchant & Higgins 1993). The Black Falcon occurs as solitary individuals, in pairs, or in family groups of parents and offspring.	Bionet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.
Falco hypoleucos Grey Falcon	–	V	Ecosystem	n/a	The Grey Falcon is sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. The breeding range has contracted since the 1950s with most breeding now confined to arid parts of the range. There are possibly less than 5000 individuals left. Population trends are unclear, though it is believed to be extinct in areas with more than 500 mm rainfall in NSW.	PMST	Unlikely – No suitable habitat identified within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Glossopsitta pusilla Little Lorikeet	V	–	Ecosystem	n/a	The Little Lorikeet is a small green lorikeet with black bill and red patch on forehead and throat. The underside is yellow-green. Immatures are duller with less red on face and brown bill. Found in forests, woodland, treed areas along watercourses and roads. Forages mainly on flowers, nectar and fruit. Found along coastal east Australia from Cape York in Queensland down east coast and round to South Australia. Uncommon in southern Victoria.	BioNet (25)	**Recorded** – Several occurrence records within the locality, with suitable foraging habitat present within the biodiversity study area.
Grantiella picta Painted Honeyeater	V	V	Ecosystem	Other (mistletoe present at a density of greater than 5 per hectare)	Lives in dry forests and woodlands. Primary food is the mistletoes in the genus *Amyema*, though it will take some nectar and insects. Its breeding distribution is dictated by presence of mistletoes which are largely restricted to older trees. Less likely to be found in in strips of remnant box-ironbark woodlands, such as occur along roadsides and in windbreaks, than in wider blocks.	PMST	Unlikely – No suitable habitat identified within the biodiversity study area.
Haliaeetus leucogaster White-bellied Sea-eagle	V	M	Species/ Ecosystem	Other (living or dead mature trees with suitable vegetation within 1 km of a river, lake, dame or creek)	Occurs in coastal areas including islands, estuaries, inlets, large rivers, inland lakes and reservoirs. Builds a huge nest of sticks in tall trees near water, on the ground on islands or on remote coastal cliffs.	BioNet (8)	Low – Several occurrence records within the locality. However, no suitable foraging or nesting habitat or large nests identified within the biodiversity study area.
Haematopus fuliginosus Sooty Oystercatcher	V	–	Species	Other (within 100 m of estuarine areas and ocean)	The Sooty Oystercatcher is found on rocky headlands, rock shelves, exposed reefs with rock pools, beaches and muddy estuaries. The species forages on exposed intertidal rocky shorelines at low tide. It breeds almost exclusively on offshore islands, and occasionally on isolated promontories during spring and summer. They nest on the ground in amongst rocks, seaweed, shells and pebbles.	BioNet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Hieraaetus morphnoides Little Eagle	V	–	Species/ Ecosystem	Other (nest tree – live or occasionally dead large old tree with vegetation)	The Little Eagle is distributed throughout the Australian mainland occupying habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring. Prey includes birds, reptiles and mammals, with the occasional large insect and carrion. Preys on birds, reptiles and mammals, occasionally adding large insects and carrion. Most of its former native mammalian prey species in inland NSW are extinct and rabbits now form a major part of the diet.	BioNet (2)	**Recorded** – One individual was recorded flying over exotic grassland to the west of Mullards Creek.
Hirundapus caudacutus White-throated Needletail	V	V, M	Ecosystem	n/a	Widespread in eastern and south-eastern Australia. In eastern Australia, it is recorded in all coastal regions of Queensland and NSW, extending inland to the western slopes of the Great Divide and occasionally onto the adjacent inland plains. It is almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. Because they are aerial, it has been stated that conventional habitat descriptions are inapplicable, but there are, nevertheless, certain preferences exhibited by the species. Although they occur over most types of habitat, they are probably recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland. They also commonly occur over heathland, but less often over treeless areas, such as grassland or swamps. When flying above farmland, they are more often recorded above partly cleared pasture, plantations or remnant vegetation at the edge of paddocks. In coastal areas, they are sometimes seen flying over sandy beaches or mudflats and often around coastal cliffs and other areas with prominent updraughts, such as ridges and sand-dunes.	BioNet (3)	Low – Species may utilise aerial habitats above the biodiversity study area on a seasonal basis but is unlikely to occur within terrestrial habitats in the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Ixobrychus flavicollis Black Bittern	V	–	Ecosystem	Other (land within 40 m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation)	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.	BioNet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.
Lathamus discolor Swift Parrot	E	CE, M	Species/ Ecosystem	Other (important habitat map)	Breeding occurs in Tasmania, majority migrates to mainland Australia in autumn, over-wintering, particularly in Victoria and central and eastern NSW, but also south-eastern Queensland as far north as Duaringa. Until recently it was believed that in New South Wales, swift parrots forage mostly in the western slopes region along the inland slopes of the Great Dividing Range but are patchily distributed along the north and south coasts including the Sydney region, but new evidence indicates that the forests on the coastal plains from southern to northern NSW are also extremely important. In mainland Australia it is semi-nomadic, foraging in flowering eucalypts in eucalypt associations, particularly box-ironbark forests and woodlands. Preference for sites with highly fertile soils where large trees have high nectar production, including along drainage lines and isolated rural or urban remnants, and for sites with flowering Acacia pycnantha, is indicated. Sites used vary from year to year. 	BioNet (26)	High – Several occurrence records within the locality. Biodiversity study area contains winter foraging resources (Spotted Gum (*Corymbia maculata)* and Swamp Mahogany (*Eucalyptus robusta)*) for the Swift Parrot. Note Important Habitat is mapped for this species under BAM (see adjoining mapped purple areas).

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Limosa lapponica Bar-tailed Godwit	–	V, M	Species/ Ecosystem	Other (important habitat map)	The Bar-tailed Godwit is a migratory wader which undertakes the largest non-stop flight of any bird. The trans-Pacific route from its breeding grounds in the Arctic to its non-breeding grounds in the southern hemisphere covers over 11,000 km. Birds arrive in New South Wales between August and October and then leave between February and April, with a small number of individuals overwintering. The subspecies is most frequently recorded along major coastal river estuaries and sheltered embayments, particularly the Tweed, Richmond, Clarence, Macleay, Hastings, Hunter and Shoalhaven River estuaries, Port Stephens and Botany Bay. It is a rare visitor to wetlands away from the coast with scattered records as far west as along the Darling River and the Riverina. It is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. Less frequently it occurs in salt lakes and brackish wetlands, sandy ocean beaches and rock platforms.	BioNet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.
Limosa lapponica baueri Nunivak Bar-tailed Godwit	–	E	Species/ Ecosystem	Other (important habitat map)	The Bar-tailed Godwit (both subspecies combined) has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria. The migratory Bar-tailed Godwit (western Alaskan) does not breed in Australia. Occurs mainly in coastal habitats in coastal habitats which include large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It also has been recorded in coastal sewage farms and saltworks, salt lakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms and coral reef-flats.	PMST	Unlikely – No suitable habitat identified within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Lophoictinia isura Square-tailed Kite	V	–	Species/ Ecosystem	Other (nest trees)	The Square-tailed Kite ranges along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by March. Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. In arid north-western NSW, has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland. Is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage.	BioNet (3)	Low – Three occurrence records within the locality. However, no suitable habitat identified within the biodiversity study area.
Melanodryas cucullata cucullate South-eastern Hooded Robin	E	E	Ecosystem	n/a	Hooded robins (south-eastern) occur in south-eastern Australia from far south-east Queensland to Yorke Peninsula, South Australia, intergrading with *M. c. picata* in the southern Murray Darling basin. They prefer dry eucalypt and acacia woodlands and shrublands with an open understorey, some grassy areas and a complex ground layer. They avoid woodlands with tall trees or dense tree cover but sometimes occur in tall, dense heaths with scattered open areas.	PMST	Unlikely – No suitable habitat identified within the biodiversity study area.
Neophema chrysostoma Blue-winged Parrot	V	V	Ecosystem	n/a	Blue-winged parrots breed on mainland Australia south of the Great Dividing Range in southern Victoria from Port Albert in Gippsland west to Nelson, and sometimes in the far south-east of South Australia, and the north-western, central and eastern parts of Tasmania. Blue-winged parrots inhabit a range of habitats from coastal, sub-coastal and inland areas, through to semi-arid zones. They tend to favour grasslands and grassy woodlands and are often found near wetlands both near the coast and in semi-arid zones.	PMST	Unlikely – No suitable habitat identified within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Neophema pulchella Turquoise Parrot	V	–	Ecosystem	n/a	The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	BioNet (3)	Low – Three occurrence records within the locality. However, no suitable habitat identified within the biodiversity study area.
Ninox strenua Powerful Owl	V	–	Species/ Ecosystem	Hollow bearing trees (living or dead with hollows greater than 20 cm diameter)	A sedentary species with a home range of around 1000 ha it occurs within open Eucalypt, Casuarina or Callitris pine forest and woodland. It often roosts in denser vegetation including rainforest of exotic pine plantations. Generally, feeds on medium-sized mammals such as possums and gliders but will also eat birds, flying-foxes, rats and insects. Prey are generally hollow dwelling and require a shrub layer and owls are more often found in areas with more old trees and hollows than average stands.	BioNet (20)	**Recorded** – Two Powerful Owl's were recorded on two separate occasions during field survey. Foraging habitat is present within the biodiversity study area. However, no suitable large hollows suitable for breeding habitat was identified within the biodiversity study area.
Numenius madagascariensis Eastern Curlew	–	CE, M	Species/ Ecosystem	Other (important habitat map)	Inhabits coastal estuaries, mangroves, mud flats and sand pits. It is a migratory shorebird which generally inhabits sea and lake shore mud flats, deltas and similar areas, where it forages for crabs and other crustaceans, clam worms and other annelids, molluscs, insects and other invertebrates. Its migration route ranges from its wintering grounds in Australia to its breeding grounds in northern China, Korea and Russia	BioNet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Oxyura australis Blue-billed Duck	V	–	Ecosystem	n/a	The Blue-billed Duck is endemic to south-eastern and south-western Australia. It is widespread in NSW, but most common in the southern Murray-Darling Basin area. Birds disperse during the breeding season to deep swamps up to 300 km away. It is generally only during summer or in drier years that they are seen in coastal areas. The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed but prefers to dive if approached.	BioNet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.
Pandion cristatus Eastern Osprey	V	–	Species/ Ecosystem	Other (stick-nest in living and dead trees (>15 m) or artificial structures within 100 m of a floodplain for nesting)	Eastern Ospreys are found right around the Australian coastline, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. There are a handful of records from inland areas. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water.	BioNet (5)	Low – Five occurrence records within the locality. However, no suitable foraging habitat identified within the biodiversity study area.
Petroica boodang Scarlet Robin	V	–	Ecosystem	n/a	The Scarlet Robin is found from south east Queensland to south-east South Australia and also in Tasmania and south west Western Australia. In NSW, it occurs from the coast to the inland slopes. After breeding, some Scarlet Robins disperse to the lower valleys and plains of the tablelands and slopes. Some birds may appear as far west as the eastern edges of the inland plains in autumn and winter. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs.	BioNet (2)	Low – Two occurrence records within the locality. However, no suitable habitat identified within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Pomatostomus temporalis temporalis Grey-crowned Babbler (eastern subspecies)	V	–	Ecosystem	n/a	The eastern subspecies (*temporalis* occurs from Cape York south through Queensland, NSW and Victoria and formerly to the south east of South Australia. In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Balranald. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Woodlands on fertile soils in coastal regions.	BioNet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.
Ptilinopus regina Rose-crowned Fruit Dove	V	–	Ecosystem	n/a	Coast and ranges of eastern NSW and Queensland, from Newcastle to Cape York. Vagrants are occasionally found further south to Victoria. 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.	BioNet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.
Ptilinopus superbus Superb Fruit-Dove	V	–	Ecosystem	n/a	Occurs primarily from north-eastern Qld to north-eastern NSW. It is much less common further south. Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees.	BioNet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.
Rostratula australis Australian Painted Snipe	E	E	Ecosystem	n/a	Inhabits shallow, vegetated, temporary or infrequently filled wetlands, including where there are trees such as *Eucalyptus camaldulensis* (River Red Gum), *E. populnea* (Poplar Box) or shrubs such as *Muehlenbeckia florulenta* (Lignum) or *Sarcocornia quinqueflora* (Samphire). Feeds at the water's edge and on mudflats on seeds and invertebrates, including insects, worms, molluscs and crustaceans. Males incubate eggs in a shallow scrape nest.	PMST	Unlikely – No suitable habitat identified within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Stagonopleura guttata Diamond Firetail	V	V	Ecosystem	n/a	The Diamond Firetail is endemic to south-eastern Australia, extending from central Queensland to the Eyre Peninsula in South Australia. It is widely distributed in NSW, with a concentration of records from the Northern, Central and Southern Tablelands, the Northern, Central and South Western Slopes and the North West Plains and Riverina. Not commonly found in coastal districts, though there are records from near Sydney, the Hunter Valley and the Bega Valley. Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum *Eucalyptus pauciflora* Woodlands.	BioNet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.
Sternula nereis nereis Australian Fairy Tern	–	V	Species	n/a	Within Australia, the Fairy Tern occurs along the coasts of Victoria, Tasmania, South Australia and Western Australia, occurring as far north as the Dampier Archipelago near Karratha. The subspecies has been known from New South Wales in the past, but it is unknown if it persists there.	PMST	Unlikely – No suitable habitat identified within the biodiversity study area.
Stictonetta naevosa Freckled Duck	V	–	Ecosystem	n/a	In most years this species appears to be nomadic between ephemeral inland and coastal wetlands. In dry years they congregate on permanent wetlands while in wet years they breed prolifically and disperse widely, generally towards the coast. In inland eastern Australia, they generally occur in brackish to hyposaline wetlands that are densely vegetated with Lignum (*Muehlenbeckia cunninghamii*) within which they build their nests.	BioNet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.
Tyto novaehollandiae Masked Owl	V	–	Species/ Ecosystem	Hollow bearing trees with hollows greater than 20 cm diameter)	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within around 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution. 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 ha.	BioNet (5)	Moderate – Five occurrence records within the locality, with suitable habitat present within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Tyto tenebricosa Sooty Owl	V	–	Species / Ecosystem	Caves (caves or cliff lines/ ledges Hollow bearing trees (living or dead with hollows greater than 20 cm diameter)	Occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. Territories are occupied permanently. 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 (*Pseudocheirus peregrinus*) or Sugar Glider (*Petaurus breviceps*). Nests in very large tree-hollows.	BioNet (3)	Moderate – Three occurrence records within the locality. However, no suitable habitat identified within the biodiversity study area.
Turnix maculosus Red-backed Button-quail	V	–	Species	n/a	In Australia, the Red-backed Button-quail extends discontinuously from the Kimberley region of Western Australia, through the Top End of the Northern Territory and the southern Gulf of Carpentaria, to Cape York Peninsula and eastern Queensland and central-eastern and north-eastern NSW. It is mainly a species of coastal and subcoastal regions. Over their Australian range, Red-backed Button-quail inhabit grasslands, open and savannah woodlands with grassy ground layer, pastures and crops of warm temperate areas, typically only in regions subject to annual summer rainfall greater than 400 mm.	BioNet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.
Mammals							
Chalinolobus dwyeri Large-eared Pied Bat	E	E	Species	Cliffs (within 2 km of rocky areas containing caves, overhangs, escarpments et cetera)	Occurs in moderately wooded habitats, mainly in areas with extensive cliffs and caves and roosts in caves, mine tunnels and the abandoned, bottle-shaped mud nests of Fairy Martins. Breeding habitat (maternity roosts) is located in roof domes in sandstone caves. Thought to forage below the forest canopy for small flying insects.	BioNet (3)	Moderate – potential foraging habitat available within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Dasyurus maculatus Spotted-tailed Quoll	V	E	Ecosystem	n/a	Occurs from the Bundaberg area in south-east Queensland, south through NSW to western Victoria and Tasmania. In NSW, it occurs on both sides of the Great Dividing Range and north-east NSW represents a national stronghold. Occurs in wide range of forest types, although appears to prefer moist sclerophyll and rainforest forest types, and riparian habitat. Most common in large unfragmented patches of forest. It has also been recorded from dry sclerophyll forest, open woodland and coastal heathland, and despite its occurrence in riparian areas, it also ranges over dry ridges. Nests in rock caves and hollow logs or trees. Feeds on a variety of prey including birds, terrestrial and arboreal mammals, small macropods, reptiles and arthropods.	BioNet (6)	Low – Six occurrence records within the locality. However, no suitable habitat identified within the biodiversity study area. Unlikely to utilise exposed habitats in urbanised area next to busy roads.
Falsistrellus tasmaniensis Eastern False Pipistrelle	V	–	Ecosystem	n/a	The Eastern False Pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania. 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.	BioNet (5)	**Recorded via Anabat** – Foraging and breeding habitat present within the biodiversity study area.
Micronomus norfolkensis Eastern Coastal Free-tailed Bat	V	–	Ecosystem	n/a	The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW. Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures. Also known to roost and breed in the hollows of mangroves and travelling considerable distances to forage.	BioNet (42)	**Recorded via Anabat** – Foraging and breeding habitat present within the biodiversity study area.
Miniopterus australia Little Bent-winged Bat	V	–	Species/ Ecosystem	Caves (Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding)	Distributed along the east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Found in 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. Roosts 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.	BioNet (55)	**Recorded via Anabat** – Foraging and breeding habitat present within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Miniopterus Orianae oceanensis Large Bent-winged Bat	V	–	Species/ Ecosystem	Caves (Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding)	Large Bent-wing-bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Hunt in rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, Melaleuca forests and open grasslands.	BioNet (27)	**Recorded via Anabat** –Foraging habitat present. No breeding habitat recorded. All stormwater drains and culverts were inspected and no roosting bats were recorded.
Myotis macropus Southern myotis	V	–	Species	Waterbodies (with permanent pools/ stretches 3 m or wider)	Found in most habitat types in association with streams and permanent waterways usually at low elevations in flat or undulating landscapes from northern areas of Western Australia, and the Northern Territory, down the entire east coast and the southern coast of Australia to just west of the Victoria/South Australia border and inland along the Murray River. Roosts in caves, tree hollows, in clumps of dense vegetation (e.g. Pandanus), mines, tunnels, under bridges, road culverts and stormwater drains often in abandoned, intact Fairy Martin nests. Roost sites are strongly associated with bodies of water where this species commonly feeds on aquatic insects, shrimp and small fish at the water surface, however, aerial foraging for other insects is also known. Breeding habitat likely to coincide with roosting habitat.	BioNet (20)	**Recorded via Anabat** – Foraging habitat present. No breeding habitat recorded. All stormwater drains and culverts were inspected and no roosting bats were recorded. No Fairy Martin nests were recorded.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Petaurus australis Yellow-bellied Glider	V	V	Ecosystem	n/a	The Yellow-bellied Glider is found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. Extract sap by incising (or biting into) the trunks and branches of favoured food trees, often leaving a distinctive 'V'-shaped scar. Very mobile and occupy large home ranges between 20 to 85 ha to encompass dispersed and seasonally variable food resources.	BioNet (14)	Low – Several occurrence records within the locality. However, no suitable habitat identified within the biodiversity study area.
Petaurus norfolcensis Squirrel Glider	V	–	Species	n/a	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. 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. Require abundant tree hollows for refuge and nest sites. Diet varies seasonally and consists of Acacia gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein.	BioNet (120)	**Assumed Present** – this species has been recorded along Mandalong Road, with suitable foraging and roosting habitat present within the biodiversity study area.
Petauroides volans Greater Glider	–	E	Species	n/a	The Greater Glider has a restricted distribution in eastern Australia, from the Windsor Tableland in north Queensland to central Victoria, with an elevated range from sea level to 1200m above sea level. The species is largely restricted to eucalypt forests and woodlands, with a diet comprising of eucalypt leaves and occasional flowers. It is found in abundance in montane eucalypt forest with relatively old trees and an abundance of hollows. It also favours forests with a diversity of eucalypts to cater for seasonal variation in food abundance.	PMST	Low – Marginally suitable habitat identified within the biodiversity study area, however this species has not been recorded in the locality.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Pseudomys novaehollandiae New Holland Mouse	–	V	Ecosystem	n/a	The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Genetic evidence indicates that the New Holland Mouse once formed a single continuous population on mainland Australia and the distribution of recent subfossils further suggest that the species has undergone a large range contraction since European settlement. Total population size of mature individuals is now estimated to be less than 10,000 individuals although, given the number of sites from which the species is known to have disappeared between 1999 and 2009, it is likely that the species' distribution is actually smaller than current estimates. Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes	BioNet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.
Notamacropus parma Parma Wallaby	V	V	Species	n/a	The species once occurred in north-eastern NSW from the Queensland boarder to the Bega area in the southeast. Their range is now confined to the coast and ranges of central and northern NSW from the Gosford district to south of the Bruxner Highway between Tenterfield and Casino. Preferred habitat is moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest.	PMST	Unlikely – No suitable habitat identified within the biodiversity study area.
Petrogale penicillata Brush-tailed Rock Wallaby	E	V	Species	Other (land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles or clifflines)	Occurs in inland and sub-coastal south eastern Australia where it inhabits rock slopes. It prefers rocks which receive sunlight for a considerable part of the day. Windblown caves, rock cracks or tumbled boulders are used for shelter. Occur in small groups or "colonies" each usually separated by hundreds of metres.	BioNet (2)	Low – Two occurrence records within the locality. However, no suitable habitat identified within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Phascolarctos cinereus Koala	E	E	Species	Other (presence of koala use trees)	The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. Inhabits eucalypt woodlands and forests. Koalas Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. The preferred tree species vary widely on a regional and local basis. Some preferred species include Forest Red Gum *Eucalyptus tereticornis*, Grey Gum *E. punctata*. In coastal areas, Tallowwood *E. microcorys* and Swamp Mahogany *E. robusta* are important food species, while in inland areas White Box *E. albens*, Bimble Box *E. populnea* and River Red Gum *E. camaldulensis* are favoured. Hawks Nest and Tea Gardens Population and population in the Pittwater LGA listed as Endangered under the NSW BC Act.	BioNet (15)	Moderate – Several occurrence records within the locality, with suitable foraging (*E. robusta*) habitat present within the biodiversity study area.
Potorous tridactylus Long-nosed Potoroo	V	V	Species	Dense shrub layer or alternatively high canopy cover exceeding 70% (i.e. to capture populations inhabiting wet sclerophyll and rainforest)	The long-nosed potoroo is found on the south-eastern coast of Australia, from Queensland to eastern Victoria and Tasmania, including some of the Bass Strait islands. There are geographically isolated populations in western Victoria. In NSW it is generally restricted to coastal heaths and forests east of the Great Dividing Range, with an annual rainfall exceeding 760 mm. Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature. The fruit-bodies of hypogeous (underground-fruiting) fungi are a large component of the diet of the Long-nosed Potoroo. They also eat roots, tubers, insects and their larvae and other soft-bodied animals in the soil. Individuals are mainly solitary, non-territorial and have home range sizes ranging between 2–5 ha.	PMST	Low – Marginally suitable habitat identified within the biodiversity study area, however this species has not been recorded in the locality.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Pteropus poliocephalus Grey-headed flying Fox	V	V	Species/ Ecosystem	Other (breeding camps)	Occurs in the coastal belt from Rockhampton in central Queensland to Melbourne in Victoria. However, only a small proportion of this range is used at any one time, as the species selectively forages where food is available. As a result, patterns of occurrence and relative abundance within its distribution vary widely between seasons and between years. At a local scale, the species is generally present intermittently and irregularly. At a regional scale, broad trends in the distribution of plants with similar flowering and fruiting times support regular annual cycles of migration. Whilst Brisbane, Newcastle, Sydney and Melbourne are occupied continuously, elsewhere, during spring, Grey-headed Flying-foxes are uncommon south of Nowra and widespread in other areas of their range. The species is widespread throughout their range in summer, whilst in autumn it occupies coastal lowlands and is uncommon inland. In winter, the species congregates in coastal lowlands north of the Hunter Valley and is occasionally found on the south coast of NSW (associated with flowering Spotted Gum *Corymbia maculata*) and on the northwest slopes (generally associated with flowering White Box *Eucalyptus albens* or Mugga Ironbark *E. sideroxylon*). Occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines.	BioNet (49)	**Recorded** – Several occurrence records within the locality, with suitable foraging habitat present within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat	V	–	Ecosystem	n/a	This species is widespread through tropical Australia and migrates to southern Australia in summer. Occurs in eucalypt forest where it feeds above the canopy and in mallee or open country where it feeds closer to the ground. Generally, a solitary species but sometimes found in colonies of up to 10. It roosts and breeds in tree hollows but has also been recorded roosting under exfoliating bark, in burrows of terrestrial mammals, in soil cracks and under slabs of rock and in the nests of bird and sugar gliders.	BioNet (6)	Moderate – Six occurrence records within the locality. However, due to mobility and potential foraging and roosting habitat, this species cannot be discounted.
Scoteanax rueppellii Greater Broad-nosed Bat	V	–	Ecosystem	n/a	The preferred hunting areas of this species include tree-lined creeks and the ecotone of woodlands and cleared paddocks, but it may also forage in rainforest. Typically, it forages at a height of 3–6 m but may fly as low as one metre above the surface of a creek. It feeds on beetles, other large, slow-flying insects and small vertebrates. It generally roosts in tree hollows but has also been found in the roof spaces of old buildings.	BioNet (28)	**Recorded** - Suitable foraging habitat recorded. No breeding habitat recorded within the biodiversity study area.
Eastern Cave Bat (*Vespadelus troughtoni*	V	–	Species	Within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within 2 km of old mines, tunnels, old buildings or sheds.	The Eastern Cave Bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals. Occasionally found along cliff-lines in wet eucalypt forest and rainforest.	Bionet (2)	**Recorded** - Suitable foraging habitat recorded. No breeding habitat recorded within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Amphibians							
Heleioporus australiacus Giant Burrowing Frog	V	V	Species	n/a	Exists as two distinct populations: a northern population on the sandstone geology of the Sydney Basin, from Wollemi National Park in the north, south to Jervis Bay; and a southern population in disjunct pockets from about Narooma south into eastern Victoria. In the northern population there is a marked preference for sandstone ridgetop habitat and broader upland valleys where the frog is associated with small headwater and slow flowing to intermittent creeklines. The vegetation is typically woodland, open woodland and heath and may be associated with 'hanging swamp' seepage lines and where small pools form from collected water. Also observed occupying artificial ponded structures such as fire dams, gravel 'borrows', detention basins and box drains that have naturalised and are surrounded by undisturbed habitat. In the southern population, records appear to be associated with Devonian igneous and sedimentary formations and Ordovician metamorphics and are generally from more heavily timbered areas. It is absent from areas that have been cleared for agriculture or for urban development. Breed in summer and autumn in burrows in the banks of small creeks.	PMST	Unlikely – No suitable habitat identified within the biodiversity study area.
Crinia tinnula Wallum Froglet	V	–	Species	n/a	Wallum Froglets are found along the coastal margin from Litabella National Park in south-east Queensland to Kurnell in Sydney. Wallum Froglets are found in a wide range of habitats, usually associated with acidic swamps on coastal sand plains. They typically occur in sedgelands and wet heathlands. They can also be found along drainage lines within other vegetation communities and disturbed areas, and occasionally in swamp sclerophyll forests.	BioNet (14)	Unlikely – No suitable habitat identified within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Pseudophryne australis Red-crowned Toadlet	V	–	Species	n/a	The Red-crowned Toadlet is confined to the Sydney Basin, from Pokolbin in the north, the Nowra area to the south, and west to Mt Victoria in the Blue Mountains. 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.	BioNet (1)	Unlikely – No suitable habitat identified within the biodiversity study area.
Litoria aurea Green and Golden Bell Frog	E	V	Species	Semi-permanent/ ephemeral wet areas (within 1 km of wet areas) Swamps (within 1 km of swamp) Waterbodies (within 1 km of waterbody)	This species occurs in fragment patches near coastal locations from Vic to south of the NSW-QLD border. For breeding it utilises a wide range of waterbodies, including both natural and man-made structures, such as marshes, dams and stream sides, and ephemeral wetlands. It is found in small pockets of habitat in otherwise developed areas and can occur in disturbed sites. There is a clear preference for sites with a complexity of vegetation structure and terrestrial habitat attributes which include extensive grassy areas and an abundance of shelter sites such as rocks, logs, tussock forming vegetation and other cover used for foraging and shelter. Over-wintering shelter sites may be adjacent to or some distance away from breeding sites, but the full range of possible habitat used is not yet well understood	BioNet (180)	Unlikely – No suitable habitat identified within the biodiversity study area.
Litoria brevipalmata Green-thighed Frog	V	–	Species	Semi-permanent/ephemeral wet areas Swamps Waterbodies	Isolated localities along the coast and ranges from just north of Wollongong to south-east Queensland. It occurs 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.	BioNet (5)	Unlikely – No suitable habitat identified within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Litoria littlejohni Northern Heath Frog	E	E	Species	n/a	Littlejohn's Tree Frog is confined to eastern New South Wales and north-east Victoria. The Frog occurs in scattered locations between the Watagan Mountains, New South Wales, to Buchan in Victoria. Despite its very large distribution there are very few records of Littlejohn's Tree Frog, and it is probably the least known and least frequently encountered frog in New South Wales. Littlejohn's Tree Frog is known to inhabit forest, coastal woodland and heath from 100 to 950 m above sea level, but the species is not associated with any specific vegetation types.	PMST	Unlikely – No suitable habitat identified within the biodiversity study area.
Mixophyes balbus Stuttering Frog	E	V	Species	n/a	Occurs along the east coast of Australia from southern Queensland to north-eastern Victoria. Considered to have disappeared from Victoria and to have undergone considerable range contraction in NSW, particularly in south-east NSW. It is the only Mixophyes species that occurs in south-east NSW and in recent surveys it has only been recorded at three locations south of Sydney. The Dorrigo region, in north-east NSW, appears to be a stronghold for this species. 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.	PMST	Unlikely – No suitable habitat identified within the biodiversity study area.
Mixophyes iteratus Giant Barred Frog	V	V	Species	Other (land within 50 m of semi permanent and permanent drainages)	Terrestrial species which occurs in rainforests, Antarctic beech or wet sclerophyll forests. Feeds on insects and smaller frogs. The species is associated with permanent flowing drainages, from shallow rocky rainforest streams to slow-moving rivers in lowland open forest. It is not known to utilise still water areas. More prevalent at lower altitudes and in larger streams than its congeners, although has been recorded up to 1000 m asl.	BioNet (21)	Unlikely – No suitable habitat identified within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Uperoleia mahonyi Mahony's Toadlet	E	E	Species	n/a	Found between Kangy Angy and Seal Rocks on leached white sands. Vegetation types typically associated with this species include wallum heath, swamp mahogany-paperbark swamp forest, heath shrubland and Sydney red gum woodland. Breeding occurs in permanent or semi-permanent swamps or ponds of moderate size, and individuals are terrestrial outside of the breeding period.	PMST	Unlikely – No suitable habitat identified within the biodiversity study area.
Reptiles							
Hoplocephalus bungaroides Broad-headed Snake	E	E	Species/Ecosystem	Including escarpments, outcrops and pogodas within the Sydney Sandstone geologies	Largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within around 250 km of Sydney.	PMST	Unlikely – No suitable habitat identified within the biodiversity study area.
Fish							
Epinephelus daemelii Black Rockcod	V	V	n/a	n/a	The Black Rockcod is found in warm temperate and subtropical parts of the south-western Pacific. Adult Black Rockcod can grow to 2 m in length and at least 80 kg in weight, but it is more common to see smaller fish (up to 1 m/30 kg).	PMST	Unlikely – No suitable habitat identified within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Migratory species							
Actitis hypoleucos Common Sandpiper	–	M	n/a	n/a	The Common Sandpiper frequents a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity. It is mostly encountered along muddy margins or rocky shores and rarely on mudflats. It has been recorded in estuaries and deltas of streams, banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. The muddy margins utilised by the species are often narrow and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags. Roost sites are typically on rocks or in roots or branches of vegetation, especially mangroves. The species is known to perch on posts, jetties, moored boats and other artificial structures, and to sometimes rest on mud or 'loaf' on rocks.	BioNet (1)	Unlikely – No suitable habitat identified within the biodiversity study area.
Apus pacificus Fork-tailed Swift	–	M	n/a	n/a	In NSW, the species is recorded in all regions. Many records occur east of the Great Divide. The Fork-tailed Swift is almost exclusively aerial with them foraging and roosting aerially.	BioNet (3)	Low – May occur in aerial habitats over the biodiversity study area on a seasonal basis, but unlikely to use terrestrial habitats associated with the biodiversity study area.
Calidris acuminata Sharp-tailed Sandpiper	–	M	n/a	n/a	Occurs in a variety of habitats: tidal mudflat, mangrove swamps, saltmarshes, shallow fresh, brackish, salt inland swamps and lakes; flooded and irrigated paddocks, sewage farms and commercial saltfields.	Bionet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Calidris ruficollis Red-necked Stint	–	M	n/a	n/a	Mostly found in coastal areas, including sheltered inlets, bays lagoons and estuaries. They also occur in shallow wetlands near the coast or inland, including lakes, waterholes and dams. They forage in mudflats, shallow water, sandy open beaches, flooded paddocks and in samphire feeding along the edges. The species roosts on sheltered beaches, spits, banks or islets, of sand, mud, coral or shingle. Occasionally they roost on exposed reefs or shoals and amongst seaweed, mud and cowpats. During high tides they may also use sand dunes and claypans.	Bionet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.
Cuculus optatus Oriental Cuckoo	–	M	n/a	n/a	A non-breeding migrant to Australia, it often inhabits rainforest, vine thickets, wet sclerophyll forest and open woodland and sometimes occurs in mangroves, wooded swamps and as vagrants in gardens. The population trend appears to be stable.	BioNet (2)	Low – a very rare vagrant to the wider locality, that is unlikely to be dependent on habitat identified within the biodiversity study area.
Gallinago hardwickii Latham's Snipe	–	M	n/a	n/a	Occurs in freshwater or brackish wetlands generally near protective vegetation cover. This species feeds on small invertebrates, seeds and vegetation. It migrates to the northern hemisphere to breed.	BioNet (6)	Low – Several occurrence records within the locality. However, no suitable habitat identified within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Numenius phaeopus Whimbrel	–	M	n/a	n/a	The Whimbrel is a regular migrant to Australia and New Zealand, with a primarily coastal distribution. There are also scattered inland records of Whimbrels in all regions. It is found in all states but is more common in the north. It is found along almost the entire coast of Queensland and NSW. 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.	BioNet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.
Pluvialis fulva Pacific Golden Plover	–	M	n/a	n/a	Prefers sandy, muddy or rocky shores, estuaries and lagoons, reefs, saltmarsh, and or short grass in paddocks and crops. The species is usually coastal, including offshore islands; rarely far inland. Often observed on beaches and mudflats, sandflats and occasionally rock shelves, or where these substrates intermingle; harbours, estuaries and lagoons.	BioNet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.
Pluvialis squatarola Grey Plover	–	M	n/a	n/a	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. They also occur around terrestrial wetlands such as near-coastal lakes and swamps, or salt-lakes. The species is also very occasionally recorded further inland, where they occur around wetlands or salt-lakes. They usually forage on large areas of exposed mudflats and beaches and occasionally in pasture and on muddy margins of inland wetlands. They usually roost in sandy areas, such as on unvegetated sandbanks or sand-spits on sheltered beaches or other sheltered environments.	BioNet (2)	Low – Two occurrence records within the locality. However, no suitable habitat identified within the biodiversity study area.

Scientific name	Status		BAM credit type	Habitat constraints and/or geographic limitations	Distribution and habitat	Number of records (source)	Likelihood of occurrence
	BC Act	EPBC Act					
Tringa brevipes Grey-tailed Tattler	–	M	n/a	n/a	Often found on sheltered coasts with reefs, rock platforms or with intertidal mudflats. It is also found at intertidal rocky, coral or stony reefs, platforms and islets that are exposed at low tide. It has also been found in embayments, estuaries and coastal lagoons, especially fringed with mangroves. It is rarely seen on open beaches and occasionally found around near-coastal wetlands, such as lagoons, lakes and ponds in sewage farms and saltworks. Inland records for the species are rare. The species forages in shallow water, hard intertidal substrates, rock pools, intertidal mudflats, mangroves, banks of seaweed and among rocks and coral rubble, over which water may surge. The species roosts in mangroves, dense stands of shrubs, snags, rocks, beaches, reefs, artificial structures (sea walls, oyster racks), occasionally in near-coastal saltworks and sewage ponds and rarely on sandy beaches or sand banks.	BioNet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.
Tringa nebularia Common greenshank	–	M	n/a	n/a	Occurs in a range of inland and coastal environments. Inland, it occurs in both permanent and temporary wetlands, billabongs, swamps, lakes floodplains, sewage farms, saltworks ponds, flooded irrigated crops. On the coast, it occurs in sheltered estuaries and bays with extensive mudflats, mangrove swamps, muddy shallows of harbours and lagoons, occasionally rocky tidal ledges. It generally prefers wet and flooded mud and clay rather than sand.	BioNet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.
Tringa stagnatilis March Sandpiper	–	M	n/a	n/a	Occurs in coastal and inland wetlands (salt or fresh water), estuarine and mangrove mudflats, beaches, shallow or swamps, lakes, billabongs, temporary floodwaters, sewage farms and saltworks ponds.	BioNet (1)	Low – One occurrence record within the locality. However, no suitable habitat identified within the biodiversity study area.

Appendix C – Plot-based field data sheets

Date	2/10/2024		Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	High Threat
Plot Name	BAM 1		# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT	4020	Good	28	25	3	6	5	5	1	5	3	2
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			173.8	172.9	10.2	72.7	63	10.6	0.5	15.9	0.9	0.6
Eucalyptus robusta	0.1	1	TG		0.1							
Allocasuarina littoralis	0.1	30	TG		0.1							
Glochidion ferdinandi var. ferdinandi	10	20	TG		10							
Melaleuca nodosa	60	100	SG			60						
Melaleuca sieberi	10	20	SG			10						
Polyscias sambucifolia	1	15	SG			1						
Breynia oblongifolia	0.2	2	SG			0.2						
Dodonaea triquetra	1	5	SG			1						
Lantana camara	0.5	4	HT									0.5
Pittosporum undulatum	0.5	3	SG			0.5						
Rubus ulmifolius	0.3	3	EX								0.3	
Entolasia marginata	2	100	GG				2					
Gahnia clarkei	50	100	GG				50					
Dianella caerulea var. producta	10	100	FG					10				
Parsonsia straminea	15	50	OG							15		
Pratia purpurascens	0.1	100	FG					0.1				
Oxalis perennans	0.1	20	FG					0.1				
Goodenia bellidifolia	0.1	5	FG					0.1				
Clematis aristata	0.5	20	OG							0.5		
Geitonoplesium cymosum	0.2	10	OG							0.2		
Oplismenus aemulus	5	100	GG				5					
Lomandra longifolia	5	50	GG				5					
Ligustrum sinense	0.1	1	HT									0.1
Glycine microphylla	0.1	1	OG							0.1		
Polymeria calycina	0.1	2	OG							0.1		
Dichondra repens	0.3	100	FG					0.3				
Carex inversa	1	20	GG				1					
Hypolepis muelleri	0.5	3	EG						0.5			

Easting	357791
Northing	6335096
Orientation	270
Plot size	20X50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	3
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	0
Length logs (m)	6

BAM Attributes 1x1 plot (%)	
Litter (%)	67

Date	2/10/2024		Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot Name	BAM 2		# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT	3998	Good	24	20	5	4	5	2	0	4	4	2
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			133.1	131.6	45.1	22	28.5	30.5	0	5.5	1.5	0.4
Melaleuca nodosa	10	20	SG			10						
Melaleuca sieberi	10	10	SG			10						
Eucalyptus robusta	10	20	TG		10							
Allocasuarina littoralis	15	50	TG		15							
Angophora inopina	10	15	TG		10							
Glochidion ferdinandi var. ferdinandi	10	5	TG		10							
Melaleuca sieberi	1	5	SG			1						
Polyscias sambucifolia	1	3	SG			1						
Ligustrum sinense	0.2	5	HT									0.2
Banksia serrata	0.1	1	TG		0.1							
Lantana camara	0.2	5	HT									0.2
Dianella caerulea var. producta	30	100	FG					30				
Gahnia clarkei	3	10	GG				3					
Parsonsia straminea	5	20	OG							5		
Solanum mauritianum	0.1	1	EX								0.1	
Carex inversa	0.4	10	GG				0.4					
Clematis aristata	0.2	2	OG							0.2		
Entolasia marginata	15	300	GG				15					
Rubus ulmifolius	1	5	EX								1	
Pratia purpurascens	0.5	30	FG					0.5				
Lomandra obliqua	0.1	3	GG				0.1					
Clematis aristata	0.2	10	OG							0.2		
Oplismenus aemulus	10	100	GG				10					
Marsdenia rostrata	0.1	1	OG							0.1		

Easting	357852
Northing	6335128
Orientation	267
Plot size	20X50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	1
30-49	10
20-29	yes
10-19	yes
5-9	yes
<5	yes
Hollows	0
Length logs (m)	38

BAM Attributes 1x1 plot (%)	
Litter (%)	22

Date	2/10/2024		Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot Name	BAM 3		# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT	3583	Good	41	40	5	17	6	7	2	3	1	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			119.6	119.5	27	55.9	4.8	1.4	0.2	30.2	0.1	0
Eucalyptus capitellata	10	5	TG		10							
Eucalyptus haemastoma	3	2	TG		3							
Corymbia gummifera	2	3	TG		2							
Banksia serrata	10	15	TG		10							
Hakea dactyloides	4	30	SG			4						
Persoonia levis	1	10	SG			1						
Banksia serrata	2	15	TG		2							
Lambertia formosa	20	100	SG			20						
Acacia suaveolens	2	20	SG			2						
Acacia falcata	1	15	SG			1						
Polyscias sambucifolia	0.5	2	SG			0.5						
Dillwynia retorta	0.2	3	SG			0.2						
Platysace linearifolia	10	50	SG			10						
Acacia ulicifolia	0.1	3	SG			0.1						
Petrophile pulchella	0.4	3	SG			0.4						
Leptospermum trinervium	5	15	SG			5						
Leptospermum polygalifolium	10	20	SG			10						
Gompholobium pinnatum	0.2	50	SG			0.2						
Woollsia pungens	0.5	50	SG			0.5						
Lindsaea linearis	0.1	20	EG						0.1			
Billardiera scandens	0.1	20	OG							0.1		
Entolasia stricta	3	100	GG				3					
Lomandra obliqua	0.3	50	GG				0.3					
Lindsaea microphylla	0.1	2	EG						0.1			
Xanthorrhoea latifolia	30	100	OG							30		
Hypochaeris radicata	0.1	2	EX								0.1	
Thelymitra ixioides var. ixioides	0.1	1	FG					0.1				
Dianella caerulea var. producta	0.4	3	FG					0.4				
Opercularia diphylla	0.1	3	FG					0.1				
Cynodon dactylon	1	50	GG				1					
Tricoryne elatior	0.1	2	FG					0.1				
Dampiera stricta	0.5	20	FG					0.5				
Pimelea linifolia	0.2	10	SG			0.2						
Imperata cylindrica	0.3	15	GG				0.3					
Tetratheca juncea	0.5	3	SG			0.5						
Comesperma ericinum	0.3	15	SG			0.3						
Cryptostylis subulata	0.1	2	FG					0.1				
Lepidosperma laterale	0.1	3	GG				0.1					
Wurmbea latifolia	0.1	2	FG					0.1				
Lepidosperma spp.	0.1	2	GG				0.1					
Cassytha glabella	0.1	10	OG							0.1		

Easting	357890
Northing	6335144
Orientation	335
Plot size	20X50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	1
30-49	7
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	1
Length logs (m)	14

BAM Attributes 1x1 plot (%)	
Litter (%)	42

Date	2/10/2024		Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot Name	BAM 4		# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT	3583	Good	36	33	6	8	7	7	1	4	3	1
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			255.3	254.4	57	10.9	130	4.9	0.9	50.7	0.9	0.2
Eucalyptus haemastoma	5	7	TG		5							
Eucalyptus capitellata	40	11	TG		40							
Corymbia gummifera	3	4	TG		3							
Allocasuarina torulosa	5	4	TG		5							
Persoonia levis	1	3	SG			1						
Glochidion ferdinandi	3	6	TG		3							
Polyscias sambucifolia	6	25	SG			6						
Leptospermum trinervium	2	5	SG			2						
Acacia suaveolens	1	10	SG			1						
Banksia serrata	1	1	TG		1							
Bossiaea scolopendria	0.2	5	SG			0.2						
Conospermum ericifolium	0.1	3	SG			0.1						
Entolasia stricta	15	100	GG				15					
Xanthorrhoea latifolia	50	200	OG							50		
Imperata cylindrica	0.2	10	GG				0.2					
Lomandra obliqua	3	100	GG				3					
Dianella caerulea var. producta	1	30	FG					1				
Cassytha glabella	0.1	4	OG							0.1		
Lindsaea linearis	0.9	100	EG						0.9			
Parsonsia straminea	0.5	10	OG							0.5		
Dichondra repens	0.5	100	FG					0.5				
Rubus ulmifolius	0.6	5	EX								0.6	
Centella asiatica	0.4	100	FG					0.4				
Andropogon virginicus	0.2	3	HT									0.2
Lepidosperma laterale	110	10	GG				110					
Pratia purpurascens	0.8	100	FG					0.8				
Cryptostylis subulata	0.1	2	FG					0.1				
Nothoscordum gracile	0.1	2	EX								0.1	
Patersonia glabrata	2	10	FG					2				
Lomandra filiformis subsp. filiformis	1	5	GG				1					
Aristida ramosa	0.4	10	GG				0.4					
Bossiaea heterophylla	0.1	3	SG			0.1						
Cryptostylis erecta	0.1	16	FG					0.1				
Tetratheca juncea	0.5	3	SG			0.5						
Lepidosperma spp.	0.4	3	GG				0.4					
Billardiera scandens	0.1	5	OG							0.1		

Easting	357890
Northing	6335177
Orientation	0
Plot size	20X50
BAM Attributes 20x50m plot	
Stem classes	
80+	2
50-79	4
30-49	7
20-29	yes
10-19	yes
5-9	yes
<5	yes
Hollows	0
Length logs (m)	2

BAM Attributes 1x1 plot (%)	
Litter (%)	58

Date	3/10/2024	Planted	Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot Name	BAM 5	Native	# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT	3998	vegetation	29	17	4	6	3	2	0	2	12	3
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			114.4	42.4	21	14.1	6.3	0.6	0	0.4	72	1.3
Casuarina glauca	10	10	TG		10							
Eucalyptus robusta	8	9	TG		8							
Glochidion ferdinandi	2	3	TG		2							
Kunzea ambigua	5	4	SG			5						
Leptospermum polygalifolium	4	6	SG			4						
Cupaniopsis anacardioides	1	5	TG		1							
Pittosporum undulatum	0.5	1	SG			0.5						
Banksia spinulosa var. collina	0.6	2	SG			0.6						
Melaleuca nodosa	3	10	SG			3						
Ligustrum sinense	0.1	3	HT									0.1
Rubus ulmifolius	15	100	EX								15	
Callistemon citrinus	1	2	SG			1						
Hydrocotyle bonariensis	5	60	EX								5	
Cenchrus clandestinus	50	1000	EX								50	
Verbena bonariensis	0.1	5	EX								0.1	
Parsonsia straminea	0.3	50	OG							0.3		
Cynodon dactylon	5	200	GG				5					
Dianella caerulea var. producta	0.5	3	FG					0.5				
Imperata cylindrica	1	40	GG				1					
Briza maxima	0.2	2	EX								0.2	
Hyparrhenia hirta	1	100	HT									1
Conyza bonariensis	0.1	5	EX								0.1	
Bidens pilosa	0.1	10	EX								0.1	
Centella asiatica	0.1	50	FG					0.1				
Ehrharta erecta	0.2	50	HT									0.2
Entolasia stricta	0.3	20	GG				0.3					
Bidens subalternans	0.1	3	EX								0.1	
Monstera deliciosa	0.1	1	EX								0.1	
Livistona australis	0.1	1	OG							0.1		

Easting	357903
Northing	6335095
Orientation	255
Plot size	20X50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	9
20-29	yes
10-19	yes
5-9	yes
<5	yes
Hollows	0
Length logs (m)	34

BAM Attributes 1x1 plot (%)	
Litter (%)	47

Date	3/10/2024		Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot Name	BAM 6		# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT	3998	Moderate	24	14	4	1	3	3	1	2	10	5
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			196.2	118.2	62.3	20	30.9	3.4	0.6	1	78	37
Eucalyptus robusta	30	7	TG		30							
Allocasuarina littoralis	30	25	TG		30							
Cinnamomum camphora	15	4	HT									15
Solanum mauritianum	0.3	1	EX								0.3	
Cupaniopsis anacardioides	0.3	5	TG		0.3							
Melaleuca nodosa	20	15	SG			20						
Glochidion ferdinandi	2	5	TG		2							
Lantana camara	1	6	HT									1
Paspalum dilatatum	15	50	HT									15
Hydrocotyle bonariensis	0.1	3	EX								0.1	
Imperata cylindrica	30	100	GG				30					
Cortaderia selloana	3	1	HT									3
Briza subaristata	0.1	5	EX								0.1	
Ageratina adenophora	3	30	HT									3
Pseuderanthemum variabile	0.1	3	FG					0.1				
Dianella caerulea var. producta	3	50	FG					3				
Rubus ulmifolius	0.5	2	EX								0.5	
Centella asiatica	0.3	30	FG					0.3				
Parsonsia straminea	0.6	3	OG							0.6		
Cenchrus clandestinus	40	1000	EX								40	
Hibbertia dentata	0.4	1	OG							0.4		
Pteridium esculentum	0.6	4	EG						0.6			
Microlaena stipoides	0.5	60	GG				0.5					
Oplismenus imbecillis	0.4	60	GG				0.4					

Easting	357702
Northing	6335064
Orientation	33
Plot size	20X50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	1
20-29	yes
10-19	yes
5-9	yes
<5	yes
Hollows	0
Length logs (m)	7

BAM Attributes 1x1 plot (%)	
Litter (%)	27

Date	3/10/2024		Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot Name	BAM 7		# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT	4042	Moderate	39	17	4	2	4	4	1	2	21	5
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			165.5	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Eucalyptus tereticornis	20	6	TG		20							
Pinus spp.	5	1	#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Eucalyptus amplifolia	3	1	TG		3							
Eucalyptus robusta	1	1	TG		1							
Cinnamomum camphora	30	9	HT									30
Solanum mauritianum	0.2	1	EX								0.2	
Lantana camara	1	3	HT									1
Pittosporum undulatum	0.3	2	SG			0.3						
Cupaniopsis anacardioides	0.1	1	TG		0.1							
Leptospermum polygalifolium	1	3	SG			1						
Sida rhombifolia	0.3	5	EX								0.3	
Bidens pilosa	0.5	20	EX								0.5	
Ligustrum sinense	0.1	6	HT									0.1
Rubus ulmifolius	7	15	EX								7	
Imperata cylindrica	5	100	GG				5					
Pteridium esculentum	0.1	5	EG						0.1			
Hydrocotyle bonariensis	5	5	EX								5	
Cirsium vulgare	0.2	3	EX								0.2	
Centella asiatica	0.5	500	FG					0.5				
Plantago lanceolata	0.2	5	EX								0.2	
Cenchrus clandestinus	15	100	EX								15	
Briza subaristata	0.1	10	EX								0.1	
Avena fatua	0.2	20	EX								0.2	
Paspalum dilatatum	1	100	HT									1
Glycine tabacina	0.1	5	OG							0.1		
Clematis glycinoides	0.2	1	OG							0.2		
Cynodon dactylon	10	200	GG				10					
Dianella caerulea var. producta	1	10	FG					1				
Pratia purpurascens	0.1	10	FG					0.1				
Gahnia clarkei	5	15	GG				5					
Setaria parviflora	5	100	EX								5	
Eragrostis curvula	30	100	HT									30
Sporobolus creber	15	50	GG				15					
Trifolium repens	0.1	4	EX								0.1	
Vicia sativa	0.1	5	EX								0.1	
Verbena bonariensis	0.5	2	EX								0.5	
Bromus hordeaceus	1	5	EX								1	
Sonchus oleraceus	0.1	1	EX								0.1	
Rumex brownii	0.5	4	FG					0.5				

Easting	357619
Northing	6335026
Orientation	232
Plot size	20X50
BAM Attributes 20x50m plot	
Stem classes	
80+	1
50-79	6
30-49	4
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	0
Length logs (m)	16
BAM Attributes 1x1 plot (%)	
Litter (%)	30

Date	11/10/2024		Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot Name	BAM 8		# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT	4020	Good	31	27	4	4	6	4	3	6	4	3
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			96.9	90.4	11.2	61	9.1	3.8	1.6	3.7	6.5	6.2
Angophora costata	3	2	TG		3							
Melaleuca nodosa	60	68	SG			60						
Angophora costata	3	2	TG		3							
Glochidion ferdinandi	5	30	TG		5							
Lantana camara	5	20	HT									5
Pittosporum undulatum	0.5	5	SG			0.5						
Ligustrum sinense	1	5	HT									1
Pteridium esculentum	0.3	3	EG						0.3			
Dodonaea triquetra	0.4	3	SG			0.4						
Polyscias sambucifolia	0.1	3	SG			0.1						
Acacia maidenii	0.2	2	TG		0.2							
Lomandra longifolia	0.5	2	GG				0.5					
Dianella caerulea var. producta	3	20	FG					3				
Oplismenus aemulus	3	500	GG				3					
Imperata cylindrica	1	100	GG				1					
Entolasia marginata	0.6	100	GG				0.6					
Parsonsia straminea	3	50	OG							3		
Adiantum aethiopicum	0.9	60	EG						0.9			
Pandorea pandorana	0.1	3	OG							0.1		
Pratia purpurascens	0.3	5	FG					0.3				
Geitonoplesium cymosum	0.3	2	OG							0.3		
Cassytha glabella	0.1	2	OG							0.1		
Themeda triandra	1	5	GG				1					
Rubus ulmifolius	0.3	20	EX								0.3	
Dichondra repens	0.4	500	FG					0.4				
Gahnia clarkei	3	10	GG				3					
Glycine microphylla	0.1	10	OG							0.1		
Oxalis perennans	0.1	20	FG					0.1				
Clematis aristata	0.1	3	OG							0.1		
Ehrharta erecta	0.2	50	HT									0.2
Nephrolepis cordifolia	0.4	100	EG						0.4			

Easting	357320
Northing	6333817
Orientation	230
Plot size	20X50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	2
20-29	Yes
10-19	No
5-9	No
<5	yes
Hollows	0
Length logs (m)	14

BAM Attributes 1x1 plot (%)	
Litter (%)	71

Date	11/10/2024		Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Plot Name	BAM 9		# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT	3583 Regrowth		25	17	4	5	4	2	2	0	7	3
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			113.7	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Eucalyptus haemastoma	1	1	TG		1							
Ligustrum sinense	2	11	HT									2
Glochidion ferdinandi	1	1	TG		1							
Pittosporum undulatum	1	1	SG			1						
Banksia oblongifolia	1	5	SG			1						
Acacia suaveolens	0.4	4	SG			0.4						
Eucalyptus haemastoma	1	10	TG		1							
Eucalyptus robusta	0.1	2	TG		0.1							
Persoonia levis	0.6	1	SG			0.6						
Petrophile pulchella	0.4	2	SG			0.4						
Pinus spp.	0.2	2	#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Hypolepis muelleri	20	100	EG						20			
Imperata cylindrica	70	1000	GG				70					
Lomandra longifolia	2	10	GG				2					
Ageratina adenophora	10	100	HT									10
Cyperus gracilis	0.3	100	GG				0.3					
Juncus usitatus	0.2	100	GG				0.2					
Cheilanthes sieberi	0.1	20	EG						0.1			
Dianella caerulea var. producta	0.3	5	FG					0.3				
Conyza bonariensis	0.3	10	EX								0.3	
Anagallis arvensis	0.2	5	EX								0.2	
Pratia purpurascens	0.2	100	FG					0.2				
Gamochaeta purpurea	0.1	2	EX								0.1	
Hyparrhenia hirta	0.4	5	HT									0.4
Phalaris paradoxa	0.9	100	EX								0.9	

Easting	358064
Northing	6335274
Orientation	150
Plot size	20X50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	0
20-29	no
10-19	yes
5-9	no
<5	yes
Hollows	0
Length logs (m)	0

BAM Attributes 1x1 plot (%)	
Litter (%)	0.4

Appendix D – Tests of Significance (BC Act)

The proposal will be assessed under Part 5 Division 5.1 of the EP&A Act. Under this assessment, Section 7.3 of the BC Act requires that a test of significance is completed to assess the likelihood of significant impact upon threatened species, populations or ecological communities listed under the BC Act.

Assessments of significance have been completed for the following TEC as listed under the BC Act:

- Swamp Sclerophyll Forest on Coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.
- River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Assessments of significance have been completed for threatened species listed under the BC Act outlined in Table D-1.

Table D-1 BC Act listed threatened species for which assessments of significance have been completed

Scientific name	Common name	BC Act status	Potential occurrence (Moderate, High, Recorded)
Flora			
Acacia bynoeana	Bynoe's Wattle	E	Moderate
Angophora inopina	**Charmhaven Apple**	**V**	**Recorded**
Caladenia tessellata	Thick Lip Spider Orchid	V	Moderate
Corunastylis sp. Charmhaven (NSW896673)	Charmhaven Midge Orchid	CE	Moderate
Cryptostylis hunteriana	Leafless Tongue Orchid	V	Moderate
Diuris praecox	Rough Double Tail	V	Moderate
Genoplesium insigne	Variable Midge Orchid	CE	Moderate
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	Moderate
Rutidosis heterogama	Heath Wrinklewort	V	Moderate
Tetratheca juncea	**Black-eyed Susan**	**V**	**Recorded**
Fauna			
Anthochaera Phrygia	Regent Honeyeater	CE	Moderate
Artamus cyanopterus cyanopteru	Dusky Woodswallow	V	Moderate
Callocephalon fimbriatum	Gang-Gang Cockatoo	E	Moderate
Calyptorhynchus lathami lathami	South-eastern Glossy Black Cockatoo	V	Moderate
Daphoenositta chrysoptera	**Varied Sittella**	**V**	**Recorded**
Glossopsitta pusilla	**Little Lorikeet**	**V**	**Recorded**
Hieraaetus morphnoides	**Little Eagle**	**V**	**Recorded**
Lathamus discolor	Swift Parrot	E	Moderate
Ninox strenua	**Powerful Owl**	**V**	**Recorded**

Scientific name	Common name	BC Act status	Potential occurrence (Moderate, High, Recorded)
Tyto novaehollandiae	Masked Owl	V	Moderate
Tyto tenebricosa	Sooty Owl	V	Moderate
Micronomus norfolkensis	**Eastern Coastal Freetail-bat**	**V**	**Recorded**
Falsistrellus tasmaniensis	**Eastern False Pipistrelle**	**V**	**Recorded**
Miniopterus australis	**Little Bent-winged Bat**	**V**	**Recorded**
Miniopterus orianae oceanensis	**Large Bent-winged Bat**	**V**	**Recorded**
Myotis macropus	**Southern Myotis**	**V**	**Recorded**
Petaurus norfolcensis	Squirrel Glider	V	High
Phascolarctos cinereus	Koala	E	Moderate
Pteropus poliocephalus	**Grey-headed Flying-fox**	**V**	**Recorded**
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	Moderate
Scoteanax rueppellii	**Greater Broad-nosed Bat**	**V**	**Recorded**
Vespadelus troughtoni	**Eastern Cave Bat**	**V**	**Recorded**

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

(a) in the case of a threatened species, whether the proposed development or activity 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

Not applicable.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity—

(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.

The extent of River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions has not been mapped across its entire range. However, a study during the 1990s estimated that the extent within the lower Hunter and central coast district to be around 10,000 ha (NSW Scientific Committee, 2011a). Removal of around 0.08 ha less than 0.001% of the estimated extent within the lower and central Hunter region. Therefore, impacts associated with the proposal are not expected to place the local occurrence of this TEC at risk of extinction.

The proposal is considered unlikely to modify the composition of the TEC substantially and adversely such that the local occurrence is placed at risk of extinction. The local occurrence of the TEC has already been substantially and adversely modified by past and present land-use practices. No midstory layer is present and the ground layer is dominated by pasture weeds. The disturbance from the proposal is not considered likely to further modify the composition of the TEC such that the local occurrence of it is placed at risk of extinction. The current composition of the TEC within the locality is predicted to remain as is after the work is complete.

(c) in relation to the habitat of a threatened species or ecological community—

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, 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 development or activity, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

The proposal is predicted to involve the removal or modification of around 0.08 ha of River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.

The extent of this TEC within the subject land are directly adjacent to the existing Mandalong Road. Due to the current disturbed and fragmented nature of the landscape, the proposal is unlikely to result in any new barriers or additional and incremental increases to existing fragmentation impacts on habitats within the landscape.

Due to the current modified state and fragmented state of the habitat, and the relatively small extent of remnant habitat to be removed, the importance of the habitat to be removed, modified, fragmented or isolated is considered unlikely to significantly impact the long-term survival of this TEC in the locality.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

No areas of declared area of outstanding biodiversity value are present within the biodiversity study area.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process

A key threatening process is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. There are currently 39 key threatening processes listed under Schedule 4 of the BC Act, of which seven are applicable to TECs (refer to Table D-2). However, hygiene and weed control measures to be implemented will reduce or avoid the impact of most key threatening processes. Clearing of native vegetation is unavoidable, however the small area to be cleared is negligible.

Table D-2 Key threatening processes and relevance to proposal

Key threatening process	Relevance to the proposal
Clearing of native vegetation	Yes. The proposal would result in clearing of native vegetation.
Infection of native plants by *Phytophthora cinnamomi*	Yes. The proposal may result in the introduction or spread of *Phytophthora cinnamomi*. However, hygiene measures would be followed to prevent the introduction or spread of *Phytophthora cinnamomi*.
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae.	Yes. The proposal may result in the introduction or spread of Exotic Rust Fungi. However, hygiene measures would be followed to prevent the introduction and spread of Exotic Rust Fungi.
Invasion and establishment of exotic vines and scramblers.	Yes. The proposal may result in the invasion and establishment of exotic vines and scramblers. However, weed control measures would be followed to prevent invasion and establishment of exotic vines and scramblers.
Invasion of native plant communities by African Olive *Olea europaea* L. subsp. *cuspidata*	Yes. The proposal may result in the invasion and establishment of African Olive *Olea europaea* L. subsp. *cuspidata*. However, weed control measures would be followed to prevent invasion and establishment of African Olive *Olea europaea* L. subsp. *cuspidata.*
Invasion, establishment and spread of *Lantana camara*	Yes. The proposal may result in the invasion and establishment of *Lantana camara*. However, weed control measures would be followed to prevent invasion and establishment of *Lantana camara.*
Invasion of native plant communities by exotic perennial grasses	Yes. The proposal may result in the invasion and establishment of exotic perennial grasses. However, weed control measures would be followed to prevent invasion and establishment of exotic perennial grasses.

Conclusion

The proposal is considered unlikely to have an adverse effect on the extent of River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions, such that the local occurrence of the TEC is likely to be placed at further risk of extinction. The extent of impacts is negligible (0.08 ha) in a local and regional context, and the proposal is unlikely to modify the composition of the TEC substantially and adversely. The proposal will contribute to a key threatening process of vegetation clearing, however this is negligible (less than 0.001%) within the Lower Hunter region. Therefore, the proposal is unlikely to result in a significant impact on River-flat Eucalypt Forest on Coastal Floodplains of the NSW 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

(a) in the case of a threatened species, whether the proposed development or activity 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

Not applicable.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity—

(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.

The extent of Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions has not been mapped across its entire range. However, a study during the 1990s estimated that the extent within the Lower Hunter and central coast district to be around 7000 ha (NSW Scientific Committee, 2011b). Removal of around 0.27 ha around 0.004% of the estimated extent within the lower and central Hunter region. Therefore, impacts associated with the proposal are not expected to place the local occurrence of this TEC at risk of extinction.

The proposal is considered unlikely to modify the composition of the TEC substantially and adversely such that the local occurrence is placed at risk of extinction. The local occurrence of the TEC has already been substantially and adversely modified by past land-use practices. The ground layer in most areas to be impacted is largely disturbed and impacted by weeds. The disturbance from the proposal is not considered likely to further modify the composition of the TEC such that the local occurrence of it is placed at risk of extinction. The current composition of the TEC within the locality is predicted to remain as is after the work is complete.

(c) in relation to the habitat of a threatened species or ecological community—

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, 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 development or activity, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

The proposal is predicted to involve the removal or modification of around 0.27 ha of Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.

The patches of TEC located within the subject area are directly adjacent to the existing Mandalong Road. Due to the current disturbed and fragmented nature of the landscape, the proposal is not expected to result in any new barriers or additional and incremental increases to existing fragmentation impacts on habitats within the landscape.

Due to the current modified state and fragmented state of the habitat, and the relatively small extent of remnant habitat to be removed, the importance of the habitat to be removed, modified, fragmented or isolated is considered unlikely to significantly impact the long-term survival of this TEC in the locality.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

No areas of declared area of outstanding biodiversity value are present within the biodiversity study area.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process

A key threatening process is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. There are currently 39 key threatening processes listed under Schedule 4 of the BC Act, of which seven are applicable to TECs (refer to Table D-3). However, hygiene and weed control measures to be implemented will reduce or avoid the impact of most key threatening processes, with the exception of clearing of native vegetation.

Table D-3 Key threatening processes and relevance to proposal

Key threatening process	Relevance to the proposal
Clearing of native vegetation	Yes. The proposal would result in clearing of native vegetation.
Infection of native plants by *Phytophthora cinnamomi*	Yes. The proposal may result in the introduction or spread of *Phytophthora cinnamomi*. However, hygiene measures would be followed to prevent the introduction or spread of *Phytophthora cinnamomi*.
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae.	Yes. The proposal may result in the introduction or spread of Exotic Rust Fungi. However, hygiene measures would be followed to prevent the introduction and spread of Exotic Rust Fungi.
Invasion and establishment of exotic vines and scramblers.	Yes. The proposal may result in the invasion and establishment of exotic vines and scramblers. However, weed control measures would be followed to prevent invasion and establishment of exotic vines and scramblers.
Invasion of native plant communities by African Olive *Olea europaea* L. subsp. *cuspidata*	Yes. The proposal may result in the invasion and establishment of African Olive *Olea europaea* L. subsp. *cuspidata*. However, weed control measures would be followed to prevent invasion and establishment of African Olive *Olea europaea* L. subsp. *cuspidata.*
Invasion, establishment and spread of *Lantana camara*	Yes. The proposal may result in the invasion and establishment of *Lantana camara*. However, weed control measures would be followed to prevent invasion and establishment of *Lantana camara.*
Invasion of native plant communities by exotic perennial grasses	Yes. The proposal may result in the invasion and establishment of exotic perennial grasses. However, weed control measures would be followed to prevent invasion and establishment of exotic perennial grasses.

Conclusion

The proposal is considered unlikely to have an adverse effect on the extent of Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions, such that the local occurrence of the TEC is likely to be placed at further risk of extinction. The extent of impacts is considered negligible (0.27ha), and the proposal is considered unlikely to modify the composition of the TEC substantially and adversely. The proposal is unlikely to contribute to a key threatening process. Therefore, the proposal is unlikely to result in a significant impact on Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.

Threatened orchids

This assessment of significance has been completed for the following threatened Orchid species listed under the BC Act:

- *Caladenia tessellata*
- *Cryptostylis hunteriana*
- *Diuris praecox*
- *Genoplesium insigne*

Corunastylis sp. Charmhaven (NSW896673) and *Genoplesium insigne* are both listed as critically endangered under the BC Act. *Caladenia tessellata, Cryptostylis hunteriana* and *Diuris praecox* are all listed as vulnerable under the BC Act. These species have been assessed together as all these orchids have habitat in PCT 3583 Hunter Coast Lowland Scribbly Gum Forest present within the subject land. A description of each of the threatened orchids is as follows:

- *Caladenia tesselata* is a very rare terrestrial orchid species previously recorded in scattered coastal localities on the Central Coast that flowers from September to October.
- *Cryptostylis hunteriana* is a rare leafless orchid that is known to occur on the Central Coast primarily in forests dominated by *Angophora costata*, *Corymbia gummifera*, and *Eucalyptus haemastoma* (of which is similar to the dry sclerophyll forest habitat types found within the study area), often in areas where congeners *Cryptostylis subulata* and *Cryptostylis erecta* are found. *Cryptostylis hunteriana* flowers from November to December. *Cryptostylis subulata* and *Cryptostylis erecta* were recorded within PCT 3583 Hunter Coast Lowland Scribbly Gum Forest which provides habitat for these species
- *Diuris praecox* is a small terrestrial ground orchid that is restricted to coastal areas from Nelson Bay south to Ourimbah and flowers in August.
- *Genoplesium insigne* occurs in southern Lake Macquarie and northern Central Coast LGAs, and flowers from September to November. Known locations/populations of this species have exhibited dormancy for greater than four years (i.e. likely to persist underground for greater than four years). Therefore, absence in a given year may be a 'false absence' and the species can re-emerge once conditions are favourable (e.g. rainfall in winter and appropriate disturbance).

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats

(a) in the case of a threatened species, whether the proposed development or activity 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

No threatened orchids were recorded within the biodiversity study area during the targeted surveys completed in August, October and November.

The proposal involves clearing at the edges of the existing roads within the subject land, resulting in increased distance between the habitats. However, the distance between habitat patches either side of the road will not exceed the flight distances of insect pollinators. Insect pollinators will cross the road and genetic exchange is still likely to occur between any plants either side of the existing Mandalong Road and Freemans Drive if the species are present. Pollination and seed dispersal occurs by insects will still occur, and population viability is unlikely to be impacted to the extent that a local population of these species will become extinct either in the short-term or long-term.

Although the proposal may represent the loss of some vegetated areas, the loss of these patches is restricted to roadside vegetation within the biodiversity study area and is only a very marginal component of larger locally occurring areas of vegetation that would be suitable habitat to these species. The proposal is not considered likely to have an adverse effect on the life cycle of these threatened orchid 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 ecological community or critically endangered ecological community, whether the proposed development or activity:

(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

Not applicable.

(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

Not applicable.

(c) 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 proposed development or activity, 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 development or activity, 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.

The proposal is expected to impact 0.37 ha of suitable habitat for these threatened orchids.

The extent of habitat within the subject land is already subjected to disturbance and fragmentation associated with the existing infrastructure in the surrounding landscape. Due to the existing isolation, the proposal is not expected to result in any new barriers to habitats within the landscape. However, the proposal will contribute to a minor incremental increase to existing fragmentation impacts already in the immediate area.

Given the context of the habitat to be removed (i.e. habitat restricted to habitat within the road corridor) which is subject to existing edge effects and fragmentation and barriers, the importance of the habitat to be removed, modified, fragmented or isolated is considered unlikely to significantly affect the long-term survival of the local population in the locality.

(d) Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

No areas of declared area of outstanding biodiversity value are present within the biodiversity study area.

(e) Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

A key threatening process is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. There are currently 39 key threatening processes listed under Schedule 4 of the BC Act, of which seven are applicable to this assessment (refer to Table D-4). However, hygiene and weed control measures to be implemented will reduce or avoid the impact of most key threatening processes, with the exception of clearing of native vegetation.

Table D-4 Key threatening processes and relevance to proposal

Key threatening process	Relevance to the proposal
Clearing of native vegetation	Yes. The proposal would result in clearing of native vegetation.
Infection of native plants by *Phytophthora cinnamomi*	Yes. The proposal may result in the introduction or spread of *Phytophthora cinnamomi*. However, hygiene measures would be followed to prevent the introduction or spread of *Phytophthora cinnamomi*.
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae.	Yes. The proposal may result in the introduction or spread of Exotic Rust Fungi. However, hygiene measures would be followed to prevent the introduction and spread of Exotic Rust Fungi.
Invasion and establishment of exotic vines and scramblers.	Yes. The proposal may result in the invasion and establishment of exotic vines and scramblers. However, weed control measures would be followed to prevent invasion and establishment of exotic vines and scramblers.

Key threatening process	Relevance to the proposal
Invasion of native plant communities by African Olive *Olea europaea* L. subsp. *cuspidata*	Yes. The proposal may result in the invasion and establishment of African Olive *Olea europaea* L. subsp. *cuspidata*. However, weed control measures would be followed to prevent invasion and establishment of African Olive *Olea europaea* L. subsp. *cuspidata.*
Invasion, establishment and spread of *Lantana camara*	Yes. The proposal may result in the invasion and establishment of *Lantana camara*. However, weed control measures would be followed to prevent invasion and establishment of *Lantana camara.*
Invasion of native plant communities by exotic perennial grasses	Yes. The proposal may result in the invasion and establishment of exotic perennial grasses. However, weed control measures would be followed to prevent invasion and establishment of exotic perennial grasses.

Conclusion

The proposal is expected to impact 0.37 ha of suitable habitat for these threatened orchids species. Given the extent of habitat within the subject land is already subjected to disturbance and fragmentation associated with the existing infrastructure in the surrounding landscape, the proposal is not considered likely to have a significant impact on these species that may lead to local extinction.

Angophora inopina

The *Angophora inopina* is listed as Vulnerable under the BC Act and listed as Vulnerable under the Commonwealth EPBC Act.

Angophora inopina has a limited distribution in coastal Central NSW, which is divided into two populations, a northerly occurrence of the species at Karuah to the north of Port Stephens and a southerly population occurring between Toronto on the north-western side of Lake Macquarie and Charmhaven in the Central Coast Council Area (Office of Environment & Heritage, 2021). The main population occurs between Morisset and Charmhaven (Office of Environment & Heritage, 2021).

Angophora inopina habitat within the biodiversity study area consists of PCT 3583 Hunter Coast Lowland Scribbly Gum Forest and PCT 3998 Lower North Creekflat Mahogany Swamp Forest.

(a) in the case of a threatened species, whether the proposed development or activity 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

Angophora inopina occurs at five locations within the biodiversity study area, two within PCT 3583 Hunter Coast Lowland Scribbly Gum Forest and three within PCT 3998 Lower North Creekflat Mahogany Swamp Forest (see figure 3.1 for locations). Twenty-three individuals occur with the biodiversity study area, of these 3 will be impacted by the proposal.

Although the proposal may represent the loss of some vegetated areas, the loss of these patches is restricted to roadside vegetation within the biodiversity study area and is only a very marginal component of larger locally occurring areas of vegetation that would be suitable habitat to this species. A minority of this species will be impacted, being 3 out of 23 specimens. The proposal is not considered likely to have an adverse effect on the life cycle of this 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 ecological community or critically endangered ecological community, whether the proposed development or activity:

(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

Not applicable.

(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

Not applicable.

(c) 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 proposed development or activity, 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 development or activity, 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.

Very small areas of habitat for Charmhaven Apple will be removed or modified as a result of the proposed works. 3 will be impacted and 20 will be retained.

The extent of habitat within the subject land is already subjected to disturbance and fragmentation associated with the existing infrastructure in the surrounding landscape. Due to the existing isolation, the proposal is not expected to result in any new barriers to habitats within the landscape. However, the proposal will contribute to a minor incremental increase to existing fragmentation impacts already in the immediate area.

Given the context of the habitat to be removed (i.e. habitat restricted to habitat within the road corridor) which is subject to existing edge effects and fragmentation and barriers, the importance of the habitat to be removed, modified, fragmented or isolated is considered unlikely to significantly affect the long-term survival of the local population in the locality. The majority of this species will be retained.

(d) Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

No areas of declared area of outstanding biodiversity value are present within the biodiversity study area.

(e) Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

A key threatening process is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. There are currently 39 key threatening processes listed under Schedule 4 of the BC Act, of which seven are applicable to this assessment (refer to Table D-5). However, hygiene and weed control measures to be implemented will reduce or avoid the impact of most key threatening processes, with the exception of clearing of native vegetation.

Table D-5 Key threatening processes and relevance to proposal

Key threatening process	Relevance to the proposal
Clearing of native vegetation	Yes. The proposal would result in clearing of native vegetation.
Infection of native plants by *Phytophthora cinnamomi*	Yes. The proposal may result in the introduction or spread of *Phytophthora cinnamomi*. However, hygiene measures would be followed to prevent the introduction or spread of *Phytophthora cinnamomi*.
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae.	Yes. The proposal may result in the introduction or spread of Exotic Rust Fungi. However, hygiene measures would be followed to prevent the introduction and spread of Exotic Rust Fungi.
Invasion and establishment of exotic vines and scramblers.	Yes. The proposal may result in the invasion and establishment of exotic vines and scramblers. However, weed control measures would be followed to prevent invasion and establishment of exotic vines and scramblers.
Invasion of native plant communities by African Olive *Olea europaea* L. subsp. *cuspidata*	Yes. The proposal may result in the invasion and establishment of African Olive *Olea europaea* L. subsp. *cuspidata*. However, weed control measures would be followed to prevent invasion and establishment of African Olive *Olea europaea* L. subsp. *cuspidata.*
Invasion, establishment and spread of *Lantana camara*	Yes. The proposal may result in the invasion and establishment of *Lantana camara*. However, weed control measures would be followed to prevent invasion and establishment of *Lantana camara.*

Key threatening process	Relevance to the proposal
Invasion of native plant communities by exotic perennial grasses	Yes. The proposal may result in the invasion and establishment of exotic perennial grasses. However, weed control measures would be followed to prevent invasion and establishment of exotic perennial grasses.

Conclusion

3 *Angophora inopina* trees will be directly impacted by the proposal within the subject land and twenty will be retained. Area of species polygon to be impacted is calculated as 0. 19ha and retention of 0.61 ha. Given the extent of habitat within the subject land is already subjected to disturbance and fragmentation associated with the existing infrastructure in the surrounding landscape, the proposal is not considered likely to have a significant impact on this species that may lead to local extinction.

Tetratheca juncea

Tetratheca juncea is listed as Vulnerable under the BC Act and listed as Vulnerable under the Commonwealth EPBC Act.

Confined to the northern portion of the Sydney Basin bioregion and the southern portion of the North Coast bioregion in the local government areas of Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Cessnock. It is 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 200 m elevation and annual rainfall between 1000–1200 mm. The preferred substrates are sandy skeletal soil on sandstone, sandy-loam soils, low nutrients; and clayey soil from conglomerates, pH neutral.

No *Tetratheca juncea* clumps will be directly impacted by the proposal within the subject land. Twenty six clumps will be retained. Area of species polygon to be impacted is calculated as 0.15 ha compared to retention of 0.89 ha.

(a) in the case of a threatened species, whether the proposed development or activity 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

No *Tetratheca juncea* clumps will be directly impacted by the proposal within the subject land. Twenty six clumps will be retained. Area of species polygon to be impacted is calculated as 0.15 ha compared to retention of 0.89 ha.

Although the proposal may represent the loss of some vegetated areas, the loss of these patches is restricted to roadside vegetation within the biodiversity study area and is only a very marginal component of larger locally occurring areas of vegetation that would be suitable habitat to this species. None of the recorded specimens will be impacted. The proposal is not considered likely to have an adverse effect on the life cycle of this 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 ecological community or critically endangered ecological community, whether the proposed development or activity:

(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

Not applicable.

(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

Not applicable.

(c) 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 proposed development or activity, 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 development or activity, 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.

No *Tetratheca juncea* clumps will be directly impacted by the proposal within the subject land. Twenty six clumps will be retained. Area of species polygon to be impacted is calculated as 0.15 ha compared to retention of 0.89 ha.

The extent of habitat within the subject land is already subjected to disturbance and fragmentation associated with the existing infrastructure in the surrounding landscape. Due to the existing isolation, the proposal is not expected to result in any new barriers to habitats within the landscape. However, the proposal will contribute to a minor incremental increase to existing fragmentation impacts already in the immediate area.

Given the context of the habitat to be removed (i.e. habitat restricted to habitat within the road corridor) which is subject to existing edge effects and fragmentation and barriers, the importance of the habitat to be removed, modified, fragmented or isolated is considered unlikely to significantly affect the long-term survival of the local population in the locality. All of the known individuals of this species will be retained.

(d) Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

No areas of declared area of outstanding biodiversity value are present within the biodiversity study area.

(e) Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

A key threatening process is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. There are currently 39 key threatening processes listed under Schedule 4 of the BC Act, of which seven are applicable to this assessment (refer to Table D-6). However, hygiene and weed control measures to be implemented will reduce or avoid the impact of most key threatening processes, with the exception of clearing of native vegetation.

Table D-6 Key threatening processes and relevance to proposal

Key threatening process	Relevance to the proposal
Clearing of native vegetation	Yes. The proposal would result in clearing of native vegetation.
Infection of native plants by *Phytophthora cinnamomi*	Yes. The proposal may result in the introduction or spread of *Phytophthora cinnamomi*. However, hygiene measures would be followed to prevent the introduction or spread of *Phytophthora cinnamomi*.
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae.	Yes. The proposal may result in the introduction or spread of Exotic Rust Fungi. However, hygiene measures would be followed to prevent the introduction and spread of Exotic Rust Fungi.
Invasion and establishment of exotic vines and scramblers.	Yes. The proposal may result in the invasion and establishment of exotic vines and scramblers. However, weed control measures would be followed to prevent invasion and establishment of exotic vines and scramblers.
Invasion of native plant communities by African Olive *Olea europaea* L. subsp. *cuspidata*	Yes. The proposal may result in the invasion and establishment of African Olive *Olea europaea* L. subsp. *cuspidata*. However, weed control measures would be followed to prevent invasion and establishment of African Olive *Olea europaea* L. subsp. *cuspidata.*
Invasion, establishment and spread of *Lantana camara*	Yes. The proposal may result in the invasion and establishment of *Lantana camara*. However, weed control measures would be followed to prevent invasion and establishment of *Lantana camara.*

Key threatening process	Relevance to the proposal
Invasion of native plant communities by exotic perennial grasses	Yes. The proposal may result in the invasion and establishment of exotic perennial grasses. However, weed control measures would be followed to prevent invasion and establishment of exotic perennial grasses.

Conclusion

No *Tetratheca juncea* clumps will be directly impacted by the proposal within the subject land. Twenty six clumps will be retained. Area of species polygon to be impacted is calculated as 0.15 ha compared to retention of 0.89 ha.

Given the extent of habitat within the subject land is already subjected to disturbance and fragmentation associated with the existing infrastructure in the surrounding landscape, the proposal is not considered likely to have a significant impact on this species that may lead to local extinction.

Other threatened flora

This assessment of significance has been completed for the following threatened flora species listed under the BC Act:

- *Acacia bynoeana*
- *Grevillea parviflora subsp. parviflora*
- *Rutidosis heterogama.*

Acacia bynoeana, Grevillea parviflora subsp. parviflora and *Rutidosis heterogama* are listed as vulnerable under the BC Act. *Acacia bynoeana* is listed as endangered under the BC Act. These species have been assessed together as all of these species have habitat in PCT 3583 Hunter Coast Lowland Scribbly Gum Forest present within the subject land.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats.

(a) in the case of a threatened species, whether the proposed development or activity 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

For threatened plants, effective pollination is important to maintain population viability. The separation of individual plants is a consideration when determining the local population and likelihood of cross-pollination. The size and connection of habitat affects the ability of individual plants to disperse seed and genetic material, and also determines what constitutes a population and future viability. These species are largely pollinated either by insects

The proposal involves clearing at the edges of the existing roads within the subject land, resulting in increased distance between the habitats. However, the distance between habitat patches either side of the road will not exceed the flight distances of insect pollinators. Insect pollinators will cross the road and genetic exchange is still likely to occur between any plants either side of the existing Mandalong Road and Freemans Drive if the species are present. Pollination and seed dispersal occurs by insects will still occur, and population viability is unlikely to be impacted to the extent that a local population of these species will become extinct either in the short-term or long-term. Despite targeted surveys in the correct season, these species were not recorded in the potential habitat. The proposal is unlikely to have an adverse effect on the life cycle of these specie such that they are likely to be placed at risk of extinction.

(b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(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

Not applicable.

(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

Not applicable.

(c) 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 proposed development or activity, 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 development or activity, 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.

The proposed works are expected to result in the removal of around 0.98 ha of native vegetation, and not all of this is suitable for these species due to various disturbance conditions. Despite targeted surveys in the correct season, these species were not recorded in the potential habitat.

The proposed action would result in the construction of a new dual lane carriageway. Despite the current fragmented nature of the landscape through which it would intersect, the proposed action would result in a new barrier that would likely lead to additional and incremental increases to existing fragmentation impacts on habitats within the landscape. Furthermore, the proposed action would also result in an increase in isolation of habitats as the current habitat patches would be made smaller thereby increasing the physical distance between some habitat fragments.

It is predicted that the fragmentation and isolation impacts caused by the proposed action would unlikely be enough to prevent the breeding and dispersal of plant pollinators or the dispersal of plant propagules (i.e. seed or other vegetative reproductive material) between habitat patches.

The areas of potential habitat to be impacted upon for these species are likely to be highly modified as a result of past and current land uses. They are already affected by varying degrees of fragmentation (including other road, water and transmission infrastructure) within a highly modified mosaic landscape.

Owing to the small amount of vegetation to be removed as a result of the proposed works and availability of suitable habitat surrounding the boundary of the proposed works, it is unlikely to be important to local populations.

(d) Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

The subject land did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

(e) Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

A KTP is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs. Of the 38 listed KTPs under the BC Act, seven are applicable to these species (see Table D-7)). However, hygiene and weed control measures to be implemented would reduce or avoid the impact of most KTPs with the exception of clearing of native vegetation. The proposal involves works that are part of a KTP and will exacerbate the KTP, however the contribution is minimal.

Table D-7 Key threatening processes and relevance to proposal

Key threatening process	Relevance to the proposal
Clearing of native vegetation	Yes. The proposal would result in clearing of native vegetation.
Infection of native plants by *Phytophthora cinnamomi*	Yes. The proposal may result in the introduction or spread of *Phytophthora cinnamomi*. However, hygiene measures would be followed to prevent the introduction or spread of *Phytophthora cinnamomi*.
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae.	Yes. The proposal may result in the introduction or spread of Exotic Rust Fungi. However, hygiene measures would be followed to prevent the introduction and spread of Exotic Rust Fungi.
Invasion and establishment of exotic vines and scramblers.	Yes. The proposal may result in the invasion and establishment of exotic vines and scramblers. However, weed control measures would be followed to prevent invasion and establishment of exotic vines and scramblers.

Key threatening process	Relevance to the proposal
Invasion of native plant communities by African Olive *Olea europaea* L. subsp. *cuspidata*	Yes. The proposal may result in the invasion and establishment of African Olive *Olea europaea* L. subsp. *cuspidata*. However, weed control measures would be followed to prevent invasion and establishment of African Olive *Olea europaea* L. subsp. *cuspidata.*
Invasion, establishment and spread of *Lantana camara*	Yes. The proposal may result in the invasion and establishment of *Lantana camara*. However, weed control measures would be followed to prevent invasion and establishment of *Lantana camara.*
Invasion of native plant communities by exotic perennial grasses	Yes. The proposal may result in the invasion and establishment of exotic perennial grasses. However, weed control measures would be followed to prevent invasion and establishment of exotic perennial grasses.

Conclusion

The extent of native vegetation clearing, and habitat removal associated with the proposal, is very small in terms of the available habitat for this species within the surrounding landscape. The loss of maximum 0.98 ha of potential habitat is not considered to be significant in regard to the maintenance of this species locally, and therefore the proposed works are not likely to have a significant impact upon these species. Despite targeted surveys in the correct season, these species were not recorded in the potential habitat.

Woodland birds

These following woodland bird species have been assessed together due to their similarity of preferred habitat and resources relevant to the boundaries of the subject land:

- Dusky Woodswallow (*Artamus cyanopterus cyanopterus*), listed as Vulnerable under the BC Act
- Varied Sittella (*Daphoenositta chrysoptera*), listed as Vulnerable under the BC Act
- Gang-gang Cockatoo (*Callocephalon fimbriatum*), listed as Vulnerable under the BC Act
- Glossy-Black Cockatoo (*Calyptorhynchus lathami lathami*), listed as Vulnerable under the BC Act.

Only one of these woodland species was recorded within the study area, being the Varied Sittella. All other remaining woodland birds are considered to have a moderate or higher likelihood of occurrence based on the habitats available.

The proposal has potential to impact around 0.98 ha of woodland habitat that may be used for foraging may provide potential foraging and marginal breeding habitat for the Dusky Woodswallow, Scarlet Robin and Varied Sittella.

No breeding habitat was identified during targeted surveys for either the Gang-gang Cockatoo or the Glossy-Black Cockatoo which are dual species credit species under BAM. Habitat for these species (14.47 ha and 18.94 ha respectively) is likely only to constitute potential foraging habitat for the species.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats —

(a) in the case of a threatened species, whether the proposed development or activity 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

A total of up to 0.98 ha of native vegetation, representing potential habitat for these threatened species may be potentially affected by the proposed works. Although the proposed works may represent the loss of potential foraging habitat and breeding habitat for some of these species, such resources within the subject land are relatively small and largely modified compared to the abundance of locally occurring resources that are accessible to these species. The ability of the subject land to support such species is not considered likely to be diminished to the extent that a significant adverse effect might be brought to bear upon local populations. Although the proposed action would cause a small incremental loss of foraging habitat for threatened woodland birds it is unlikely that the proposed action would significantly reduce the viability of populations occurring locally.

(b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(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

Not applicable.

(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

Not applicable.

(c) 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 proposed development or activity, 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 development or activity, 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.

The proposed action would remove up to 0.98 ha of potential habitat, including habitat suitable for foraging and breeding, although this area of vegetation is considered unlikely to be of significant importance for such species in relation to the abundance of similar and higher quality habits for these species in the greater locality.

Given the high mobility these species as well as the fact that similar and higher quality habitat is easily accessible to them in the locality, it is not considered likely that habitat would become significantly more isolated or fragmented beyond that currently existing in the subject and wider locality.

The extent of potential habitat to be removed represents a relatively small proportion of foraging habitat available within the surrounding landscape. Owing to the relatively small proportion of potential habitat removal and the mobility of these species, the proposed action is unlikely to significantly affect their long-term survival.

(d) Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

The subject land did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

(e) Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to both these woodland bird species, the proposal is consistent with three KTPs under the BC Act, being clearing of native vegetation, removal of hollow-bearing trees and removal of dead wood and dead trees. The extent of native vegetation clearing, and habitat removal associated with the proposed works, is considered relatively small in terms of the available habitat for these species within the surrounding landscape. The proposal involves works that are part of a KTP and will exacerbate these KTP, however the contribution is minimal. It is unlikely that the proposed action would significantly increase these key threatening processes to the point that local populations are significantly impacted.

Conclusion

Threatened woodland birds are considered to likely utilise habitats within the subject land. While potential habitat exists in the subject land, there is an abundance of similar and higher quality habitat in the wider locality. The impacts are no of a magnitude that would significantly diminish the integrity of habitat opportunities in the study area's vicinity. Therefore, the proposed action would represent an incremental loss of available local habitat, which is unlikely to have a significant impact upon these species.

Threatened nectarivorous birds

- Little Lorikeet (*Glossopsitta pusilla*)
- Swift Parrot (*Lathamus discolor*)
- Regent Honeyeater (*Anthochaera phrygia*)

Conservation Status

- Little Lorikeet is listed as a Vulnerable species under the BC Act.
- Swift Parrot is listed as Endangered under the BC Act
- Regent Honeyeater is listed as Critically Endangered under the BC Act

Distribution

For the purposes of this assessment, in central NSW, the ranges of Little Lorikeet, Swift Parrot and Regent Honeyeater largely overlap, extending from the coast to the western slopes of the Great Dividing Range, (Pizzey and Knight, 2007). While the distribution of records for the three species in central coastal NSW largely coincide, their seasonal movements and use of habitats in the locality of the study area are considerably different.

For the Little Lorikeet nomadic movements are common, and while influenced by seasonal variations of food availability like Swift Parrots and Regent Honeyeaters, they are largely resident in some regions for much of the year, due to the reliability of foraging resources (NSW Scientific Committee, 2009a).

Swift Parrots, only occur in mainland Australia during the cooler months of the year from around April to September, the migrating population returning to Tasmania for breeding during the warmer months of the year (Higgins, 1999).

Regent Honeyeaters, are a highly nomadic species and although a number of locations have been identified as being somewhat reliably visited by the species from time to time, their very low numbers, and relatively unobtrusive behaviours make them difficult to observe and predict (Roderick and Ingwersen, 2014).

In the study area locality and greater region, records for Little Lorikeets are relatively numerous (Office of Environment & Heritage, 2016a). Only 36 per cent of the Little Lorikeet's distribution overlays reserves held within the NSW National Parks and Wildlife Service estate (Office of Environment & Heritage, 2016d), although the portion of the reserve system that provides suitable habitat for this species is not known.

Both Swift Parrots and Regent Honeyeater are well known to visit the Morisset area and both species have been observed locally, if not sporadically over the years.

Habitat

The Little Lorikeet inhabits forests and woodlands, with most suitable vegetation associations occurring in dry, open eucalypt forest and woodlands (Higgins, 1999). They have a general preference for dry open forest and woodland dominated by Eucalyptus spp., but they are also known to use Melaleuca spp. and Angophora spp. forests as well as tall wet sclerophyll forest in some areas (Higgins, 1999).

Swift Parrots use a range of dry woodland habitats and are also known to use wet sclerophyll forests where they target lerps and psyllids, in many cases defended by resident Bell Miners (Higgins, 1999). Neither Little Lorikeets nor Swift Parrots are dependent upon strong linkages of continuous vegetation for movements through the landscape, both species being capable of travelling long distances across open country.

Regent Honeyeaters are well known to use box/gum woodland types, across the ranges and western slopes, but their strongly nomadic movements extend to the ranges and coastal areas (Roderick and Ingwersen, 2014). Unlike the two parrots discussed above, Regent Honeyeaters are more dependent on linkages in vegetation for movements through the landscape so large gaps in vegetation are more likely to be a barrier to their movements.

Breeding habitat for Little Lorikeets is in hollow branches or other holes in trees, usually live eucalypts with some preference for trees associated with water (Higgins, 1999). Breeding sites are usually selected in woodland but they have been recorded in Allocasuarina spp. and in partly cleared forest (Higgins, 1999).

Swift Parrots do not breed on mainland Australia and so breeding behaviours are not associated with the Morisset locality.

There are no records of Regent Honeyeater breeding in the Morisset locality, but there are records of the species displaying breeding behaviours in the greater Cessnock region of the Hunter Valley over the last couple of decades.

Ecology

Little Lorikeets are gregarious, foraging in small flocks and usually with other species of lorikeet, whereby they feed primarily on nectar and pollen in the tree canopy (NSW Scientific Committee, 2009a). On the Western slopes of NSW, White Box and Yellow Box are considered to be important food resources for pollen and nectar respectively (Courtney J., 2006). Most breeding records come from the western slopes of NSW (where there has been extensive loss of habitat from historic clearing), with the southern Australia breeding season extending from June-December and sometimes January (Higgins, 1999). Nest hollows are located at heights of 2 m to 15 m (Courtney J., 2006) in smooth-barked eucalypts including Blakely's Red Gum. Long term studies of this species on the north-west slopes of NSW (Courtney J., 2006) indicate that nest hollows are used traditionally, whereby the same hollow is known to be occupied for at least 29 years, although, not necessarily by the same individuals.

While this species is not considered to be migratory, it is generally recognised to be nomadic (Higgins, 1999), particularly concerning food availability, with irregular influxes occurring at any time when resources are available. Long-term investigation of the breeding population on the north-western slopes indicates that breeding birds are resident from April to December, and even during their non-resident period, they may return to the nest area for short periods if there is some tree-flowering in the vicinity (Courtney J., 2006).

Foraging preferences

Locally, Little Lorikeets are likely to use different foraging resources as they become available throughout the year, which would prevent site use continuity with different blossom occurring in different areas. In Morisset, amongst the wide variety of blossom producing trees they might use, they have been observed to move into the Watagan Mountains in autumn for Sydney Blue Gum blossom; Swamp Mahogany, and Forest Red Gum associated with drainage lines and lake margins through winter and spring; and then Blackbutt through spring and summer (Richardson, 2016a).

In the Morisset area the foraging preferences of Swift Parrots and Regent Honeyeaters overlap with the blossom preferences of Little Lorikeet. Local blossom resources associated with the subject land, include Swamp Mahogany (Eucalyptus robusta) and Forest Red Gum E. tereticornis. The flowering period of Swamp Mahogany is winter, and Forest Red Gum individuals flower during any season. Locally, Swamp Mahogany is the blossom favoured by Regent Honeyeaters and Little Lorikeets when available. Swift Parrots are more rarely encountered using this species locally but it has been observed to use Forest Red Gum around Morisset/Cooranbong/Eraring, while it has been seen to use Swamp Mahogany in other areas around Lake Macquarie such as Wyee Point and Chain Valley Bay (WSP ecologist, pers. obs.).

Threats

Threats to the Little Lorikeet detailed in the NSW Government Little Lorikeet profile (Office of Environment & Heritage, 2022) include:

- habitat loss, fragmentation and degradation
- loss of old hollow-bearing trees
- competition with the Honeybee
- habitat infestation by invasive weeds
- inappropriate fire regimes
- aggressive exclusion from wooded habitats by an overabundance of Noisy Miners
- climate change
- degradation of woodland habitat and vegetation structure from overgrazing
- lack of community knowledge regarding the species and its habitat requirements
- historical and ongoing habitat woodland loss, due to agricultural, mining, forestry and residential developments.

Threats to the Swift Parrot detailed in the NSW Government Little Lorikeet profile (Office of Environment & Heritage, 2000) include:

- habitat loss, fragmentation and degradation from a diversity of large -scale developments senescence and dieback
- habitat distribution changes due to climate change
- food reductions due to drought
- competition from introduced bees and large aggressive honeyeaters for food resources
- fatal collisions with human made structures
- Psittacine Beak and Feather Disease vulnerabilities
- habitat degradation and growth inhibition by weed infestations
- high frequency fire frequencies changing food availability
- aggressive exclusion from wooded habitats by an overabundance of Noisy Miners
- predation by cats
- illegal capture and trade of wild birds for aviculture.

Threats to the Little Lorikeet detailed in the NSW Government Little Lorikeet profile (Office of Environment & Heritage, 2024a) include:

- historical and ongoing habitat woodland loss, due to agricultural and residential developments, particularly Box-Gum woodlands on fertile soil
- continuing loss of key habitat tree species, from major developments (mining and agriculture) timber, and residential developments
- continued degrading and lack of recruitment of key forage species from loss of paddock trees and small remnants leading to increased fragmentation of existing habitat
- reduced natural regeneration of native canopy and shrub strata due to over-grazing particularly gallery forests
- aggressive competition from large honeyeaters, such as noisy miners, noisy friarbirds and red wattlebirds
- reduced population numbers increasing extinction vulnerability to stochastic processes, which affect key life cycle behaviours, genetic diversity, fecundity, community competition
- egg and nest predation by other birds and mammals
- habitat reducing forestry management practices focused on large trees. Firewood collection and harvesting in Box-ironbark woodlands
- recreational-user disturbance of nesting sites reducing fecundity
- foraging habitat losses to inappropriate fire regimes
- drought reductions of free-standing water required for nesting site integrity.

The proposal would incrementally reduce the amount of seasonal foraging resources available to threatened nectarivorous birds locally and would slightly increase the fragmentation and degradation of threatened nectarivorous bird habitat at the peripheries of the subject land. With respect to threatened nectarivorous birds, the proposal would represent one KTP, being clearing of native vegetation. This KTP is not likely to significantly affect these species in the locality.

Specific impacts

The subject land encompasses sections of the existing road carriageway of Mandalong Road, Freeman's Drive, Dora Street, and Wyee Road. Nevertheless, habitats most suited to communities which contain suitable foraging resources for threatened nectarivorous birds, which is limited to occurrences of preferred flowering eucalypt species, includes PCT's 3582, 3998, 4020 and 4042. The four combined PCTs (in all conditions) represent a maximum 0.98 ha of potentially suitable foraging habitat for threatened nectarivorous birds in the subject land. The area of habitat likely to be impacted, effectively occurs as the widening of small sections of existing road verges along Mandalong Road and Wyee Road.

(a) in the case of a threatened species, whether the proposed development or activity 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

Most of the subject land encompasses the existing road carriageways of Mandalong Road, Freeman's Drive, Dora Street, and Wyee Road. In these locations suitable habitat for threatened nectivorous birds is limited to PCT's 3582, 3998, 4020 and 4042 along Mandalong and Wyee Roads encompassing 0.98 ha.

Functionally, PCT 3583 may represent landscape connectivity and vegetative buffers for other PCT's targeted by threatened nectarivorous birds, but it does not provide favoured blossom resources or nesting opportunities for these species. However, it has been recorded to serve as a vegetative refuge for threatened nectarivorous birds from more dominant nectarivorous birds when swamp mahogany (E. robusta) is abundantly flowering locally.

Trees used by locally occurring threatened nectarivorous birds include Red Bloodwood (*Corymbia gummifera*) occurring in PCT 3582, Swamp Mahogany in PCTs 3998, 4020 and 4042 and both Swamp Mahogany and Forest Red Gum in PCT 4020. These three canopy tree species provide favoured seasonal foraging opportunities for Little Lorikeets, while locally Swift Parrots are limited Swamp Mahogany and Forest Red Gum, and Regent Honeyeater is limited to Swamp Mahogany. Local blossom resources are also important for many other nectarivorous bird species. The habitats for threatened nectarivorous birds in associated with the subject land are largely fragmented remnants of larger local tracts of contiguous vegetation and occur as strips of native vegetation along Mandalong Road and Wyee Road.

Threatened nectivorous birds are highly nomadic depending on the availability of seasonal flowering resources. Due to their mobility, potential habitat occurring in the subject land may be used as part of local foraging resources. The proposal would likely impact a combined total of 0.98 ha within PCTs 3583, 3998, 4020 and 4042, which contain suitable foraging resources for locally occurring threatened nectarivorous birds. These communities occur as small areas of habitat that are linear in nature and would constitute a small widening of an existing road easement, representing a small incremental loss of potential foraging habitat locally. Any identified population of threatened nectarivorous birds would not be restricted to habitat in the subject land, as an abundance of similar foraging habitat resources occurs widely in the locality. It is considered unlikely that the proposed combined removal of habitat within PCTs 3583, 3998, 4020 and 4042 would be of sufficient extent to adversely impact viable local populations of threatened nectarivorous birds.

While August survey did not detect Swift Parrot, Mapped Important Habitat occurs within the biodiversity study area and subject land and as a result this species is assumed to be present as a species credit species. This species is also listed as a Serious and Irreversible Impact species under the BAM. The proposal will impact upon 0.27 ha of potential foraging habitat compared to retention of 2.08 ha.

(b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(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

Not applicable.

(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

Not applicable.

(c) 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 proposed development or activity, 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 development or activity, 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.

It is estimated that around 0.98 ha of habitat containing foraging resources for threatened nectarivorous birds would be affected by the proposal. While August survey did not detect Swift Parrot, Mapped Important Habitat occurs within the biodiversity study area and subject land and as a result this species is assumed to be present as a species credit species. This species is also listed as a Serious and Irreversible Impact species under the BAM. The proposal will impact upon 0.27 ha of potential foraging habitat compared to retention of 2.08 ha. Any local population of threatened nectarivorous birds would not be restricted to habitat resources within the subject land and there is an abundance of similar habitat adjacent to the subject land and the wider locality. These species are not solely dependent on resources within the subject land and may only use onsite resources intermittently as part of movements in similar and more significant habitat resources within the locality.

Habitat connectivity is not likely to be significantly affected by the proposal, with most of the subject land encompassing existing road carriageways of Mandalong Road, Freeman's Drive, Dora Street, and Wyee Road with relatively small linear areas of native vegetation cleared. It is estimated that around 0.98 ha of habitat containing seasonal foraging resources for threatened nectarivorous birds would be affected by the proposal. Native vegetation to be removed would be limited to linear widenings of the existing road easements. As the subject land is largely confined to cleared areas, the proposal would not fragment or isolate any previously undisturbed patches of habitat. Indeed, native vegetation likely to be impacted by the proposal occurs as narrow strips of vegetation along Mandalong Road, Freeman's Drive, Dora Street, and Wyee Road.

Given the considerable mobility these species and the occurrence of similar and more significant habitat adjacent to and more widely in the locality, it is considered very unlikely that habitat would become further isolated or fragmented significantly beyond that currently existing in the study area.

The subject land is largely confined to the existing Mandalong Road, Freeman's Drive, Dora Street, and Wyee Road carriageways. In total, around 0.98 ha of native vegetation containing seasonal foraging resources, largely linear in shape, would likely be affected. The vegetation associated with the proposal occurs as relatively small strips along the edges of Mandalong Road, Freeman's Drive, Dora Street, and Wyee Road. An abundance of similar and more significant habitat areas for these species occurs adjacent to the subject land and in the wider locality.

Therefore, as the linear nature of the proposal would avoid excessive clearing and only a small area of potential habitat would be affected, the proposal is not considered likely to significantly remove, modify, fragment or isolate habitat such that it might adversely affect the long-term survival of these species.

(d) Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

The subject land did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

(e) Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

Threatening process means a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities. Key threatening processes are listed under the BC Act and at present there are 38 listed KTPs.

With respect to the Varied Sittella, the proposal is commensurate with one KTP, being clearing of native vegetation. The proposal would add incrementally to this KTP; however, it is not likely to affect this species in the proposal locality, due to the limited effects to connectivity for this species in the landscape and the very limited impacts to available habitat for this species locally and in the wider region.

Conclusion

The subject land predominately consists of existing road carriageways, with a very small areas of native vegetation which are linear in shape, likely to be affected. The combined PCTs contain resources that threatened nectarivorous birds may use, so impacts are largely limited to the removal of such habitats. Due to the proximity of potential habitats occurring within the subject land to more extensive habitats in the vicinity, onsite habitats may only be rarely used by threatened nectarivorous birds as part of their more extensive seasonal movements in the wider locality. An abundance of similar and more significant habitat occurs in the locality that is suitable for such species.

While the proposal would add incrementally to the loss of potential habitat for these species, it is generally restricted to existing road carriageways and disturbed areas. Vegetation removal represents only linear widening of an existing road easement, and as such, it is not likely to further fragment or isolate suitable habitat at levels which would significantly affect these very mobile species.

While August survey did not detect Swift Parrot, Mapped Important Habitat occurs within the biodiversity study area and subject land and as a result this species is assumed to be present as a species credit species. This species is also listed as a Serious and Irreversible Impact species under the BAM. The proposal will impact upon 0.27 ha of potential foraging habitat compared to retention of 2.08 ha.

Therefore, the proposal is unlikely to have a significant adverse effect on threatened nectivorous birds.

Large Forest Owls

Due to the lack of quality habitat for Sooty Owl (*Tyto tenebricosa*) and both habitat and locality records for Barking Owl (*Ninox connivens*) assessment is limited to Powerful Owl and Masked Owl, although assessments of these two species largely cover the habitat attributes discussed for other forest owl species.

Powerful Owl (*Ninox strenua*)

Conservation Status

The Powerful Owl is listed as Vulnerable under the New South Wales BC Act.

Distribution

The Powerful Owl is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria (Department of Environment and Conservation, 2005).

Habitat

The Powerful Owl primarily occupies tall moist eucalypt forest of the eastern tableland edges and wet and dry sclerophyll forests occurring closer to the coast (Department of Environment and Conservation, 2006). Casuarina or Callitris pine forest and woodlands are also used by this species with optimal habitat including a tall shrub layer and abundant hollows supporting high densities of arboreal mammals (Department of Environment and Conservation, 2006).

This species prefers large tracts of forest or woodland habitat but can also occur in fragmented landscapes. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation often in riparian contexts (Higgins, 1999).

Ecology

The Powerful Owl is a specialist predator of arboreal marsupials such as possums and gliders (particularly the slow-moving Greater Glider, as well as Common Ringtail Possum and Sugar Glider) (Kavanagh et al., 1995); however this predominantly mammalian diet is supplemented extensively with birds, Flying-foxes, large insects and rats (Department of Environment and Conservation, 2006). The breeding cycle occupies three months from egg laying to fledgling, with egg laying being strictly seasonal from mid-May to mid-July (Department of Environment and Conservation, 2006). Powerful Owls nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80–240 cm) that are at least 150 years old. (Kavanagh and Debus, 1994). During the breeding season, the male Powerful Owl roosts in a ‘grove’ of up to 20–30 trees, situated within 100–200 m of the nest tree where the female shelters (NSW National Parks and Wildlife Service, 1998). Pairs of Powerful Owls are believed to have high fidelity to a small number of hollow-bearing nest trees and would defend a large home range of 400–1450 ha (Debus, 1995).

Threats

Key threats include:

- historical loss and fragmentation of suitable forest and woodland habitat from land clearing for residential and agricultural development. Also affecting prey species such as the Greater Glider
- inappropriate forest harvesting practices that have changed forest structure and removed old-growth hollow-bearing trees. Hollow loss results in a reduction of nest sites for the owl and its prey species
- disturbances during the breeding period may affect breeding success
- high frequency hazard reduction burning may also reduce the longevity of individuals by affect in prey availability
- road kills
- secondary poisoning
- predation of fledglings by foxes, dogs and cats.

The proposal would incrementally reduce the amount of foraging habitat available locally and would minimally increase the fragmentation and degradation of Powerful Owl habitat in the study area. With respect to the Powerful Owl, the proposal is likely to be commensurate with one KTP, being clearing of native vegetation. This KTP is not likely to significantly affect this species in the locality.

Specific impacts

Around 0.98 ha of potentially suitable habitat was recorded in the subject land within four PCT's, represented by include PCT's 3582, 3583, 3998), 4020 and 4042. Areas of habitat likely to be impacted, effectively occur as the widening of small sections of the existing road verges along Mandalong Road, Dora Street, Wyee Road and Freemans Drive. Powerful Owls prefer to roost in large hollows, but no hollow-bearing trees were recorded in the subject land. The lack of large hollows for the Powerful Owl and the other large forest owls, reduces the utility of habitats associated with the biodiversity study area to limited potential for foraging behaviours.

Masked Owl (*Tyto novaehollandiae*)

Status

The Masked Owl is listed as Vulnerable under the BC Act.

Distribution

Masked Owls are distributed mainly throughout NSW from the coast where it is most abundant to the western plains (NSW Scientific Committee, 2004).

Habitat

Masked Owls inhabit a diverse range of wooded habitats, including eucalypt forests, woodlands and almost treeless inland plains. Optimal habitat includes an open understorey and a mosaic of sparse and dense ground cover, which suit the terrestrial mammals that make up the majority of its diet.

Ecology

Masked Owls typically prey on terrestrial mammals including rodents and marsupials but would also take other species opportunistically. Territories range 400 ha to 1000 ha and forages by hunting from perches at ecotones within forests and at forest edges (Kavanagh, 1996).

Large hollows in live or occasionally dead eucalypts are used for roosting (Department of Environment and Conservation, 2006) but are also known to roost and nest in dense foliage in gullies and caves (Garnett and Crowley, 2000).

Eggs are laid in nests in hollows of large, old eucalypts. Nest-hollow entrances are at least 3 m above the ground with a diameter greater than 40 cm and depth greater than 100 cm. Breeding mostly occurs during autumn and winter (NSW National Parks and Wildlife Service, 2003).

Threats

Threats to Masked Owl include:

- loss of mature hollow-bearing trees and changes to forest and woodland structure
- clearing of habitat for grazing, agriculture, forestry and other developments
- a combination of grazing and regular burning affects ground cover for mammal prey, particularly in open, grassy forests
- secondary poisoning from rodenticides
- being hit by vehicles.

Specific impacts

Around 0.98 ha of potentially suitable habitat was recorded in the subject land within four PCT's, represented by include PCT's 3582, 3583, 3998), 4020 and 4042. Areas of habitat likely to be impacted, effectively occur as the widening of small sections of the existing road verges along Mandalong Road, Dora Street, Wyee Road and Freemans Drive. Masked Owls prefer to roost in large hollows, but no hollow-bearing trees were recorded in the subject land. The lack of large hollows for the Masked Owl and the other large forest owls, reduces the utility of habitats associated with the biodiversity study area to limited potential for foraging behaviours.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats.

(a) in the case of a threatened species, whether the proposed development or activity 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

Around 0.98 ha of potentially suitable habitat was recorded in the subject land within four PCT's, represented by include PCT's 3582, 3583, 3998), 4020 and 4042. Areas of habitat likely to be impacted, effectively occur as the widening of small sections of the existing road verges along Mandalong Road, Dora Street, Wyee Road and Freemans Drive. Forest Owls prefer to roost in large hollows, but no hollow-bearing trees were recorded in the subject land. The lack of large hollows for large forest owls, reduces the utility of habitats associated with the biodiversity study area to limited potential for foraging behaviours. No suitable nest hollows will be impacted.

Impacts to native vegetation are linear in shape, and effectively adding incrementally to and minimally widening existing road corridors. As large forest owls occupy large home ranges in the order of 400 ha to 1,500 ha, it is considered likely that the subject land is used as part of the larger home range of local individuals, of the Powerful Owl, in particular, as an individual was observed within Ausgrid land. The relatively high density of Ringtail Possums observed here, suggesting that it may be of some importance to local Powerful Owls. However, the subject land lacked important habitat attributes, such as hollow-bearing trees, critical to enabling large forest owls and a wider diversity of arboreal prey than observed on site. Shrubby habitats, suited to a favoured prey species for Powerful Owl (Common Ringtail Possum) would not be significantly diminished by the proposal.

Although the Masked Owl may rarely occur locally within habitats of higher quality surrounding the subject land, the habitats within the subject land are considered unlikely to be frequented by this species, due to current traffic loads associated with the area and the Masked Owl's preference for hunting terrestrial prey species, which prefer more open understories.

Therefore, due to the small amount of potential foraging habitat likely to be impacted, its limited extent restricted to small widenings of the existing road corridors, and the abundance of more significant habitat in the proposal locality, it is considered unlikely that the proposal would have an adverse effect on the lifecycle of large forest owls such that they would be placed at risk of extinction in the location.

(b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(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

Not applicable.

(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

Not applicable.

(c) 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 proposed development or activity, 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 development or activity, 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.

It is estimated that around 0.98 ha of four local PCT's representing foraging habitat for large forest owls would be affected by the proposal, and importantly, no critical habitat resources, such as hollow-bearing trees would be affected therein. Local populations of large forest owls are not restricted to habitat resources in the subject land as the Powerful Owl and Masked Owl occupy large home ranges in the order of 400 ha to 1,500 ha. Although large forest owls may use habitat associated with the subject land, the loss of a very small amount of habitat which does not contain important habitat attributes, such as breeding hollows, is unlikely to reduce their ability to occur locally or significantly diminish resources they are currently reliant on.

Habitats within and immediately surrounding the subject land already occur in a fragmented landscape brought about by the existing roadways, considerable development to the south of Mandalong Road, the M1 Pacific Motorway to the west and cleared/developed areas over much of its boundaries. Key habitats associated with the site are the more extensive habitats that surround the biodiversity study area, and which will not be significantly impacted by the proposal. The proposal would not significantly inhibit access to higher quality habitats associated with the subject land or significantly increase isolation or fragmentation of habitats for large forest owls in the landscape where it occurs.

Habitats within and immediately surrounding the subject land currently exist as relatively small remnants of previously occurring habitats of native vegetation. Currently, those habitats are largely only accessible to flying fauna and resilient species which can persist in a fragmented landscape. Those criteria which compromise the connectivity of native habitats were already significantly present within the subject land and the landscape in which it occurred during site visitations. Therefore, the small amounts of habitat that the proposal will remove are not considered to be of high importance to local forest owls and the proposal would not significantly decrease the importance of associated habitats or more extensive local forested habitats which are of considerable importance to local large forest owl populations.

(d) Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

The subject land did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

(e) Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

Threatening process means a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities. Key threatening processes are listed under the BC Act and at present there are 38 listed KTPs.

With respect to the forest owls, the proposal is commensurate with one KTP, being clearing of native vegetation. The proposal would add incrementally to this KTP; however, it is not likely to affect these species in the proposal locality, due to the limited effects to connectivity in the landscape and the very limited impacts to available habitat for these species locally and in the wider region.

Conclusion

The subject land predominately consists of existing road carriageways, with very small areas of linear shaped native. In the broader landscape these PCTs contain resources that may support the foraging and roosting habits of forest owls, although trees in associated communities are usually of insufficient size classes to develop hollows large enough for the breeding purposes of forest owls, and this is the case of tree classes associated with the subject land.

The lands surrounding the subject land are already of a fragmented nature, brought about by existing roadways, the M1 Pacific Motorway, considerable industrial and other developments to the south and also extensive cleared areas and residential lands surrounding the subject land.

The condition of the subject land during field surveys found that its habitats were only likely to support large forest owl species that can cope with a significantly changed natural landscape. In regard to large forest owls, Powerful Owl is most likely to include such habitat attributes in its in its home-range since its foraging habits are largely limited to arboreal mammals. Opportunities for Powerful Owl assessed on site during field surveys considered the subject land to be of moderate value for this species, due to the lack of breeding habitat.

Nevertheless, impacts proposed by the proposal would be largely limited to trimming current communities such that opportunities for Powerful Owl are unlikely to be significantly diminished beyond the current degradations evidenced within the subject land. Therefore, the proposal is unlikely to have a significant adverse effect on threatened large forest owl species in the locality.

Little Eagle (*Hieraaetus morphnoides*)

Little Eagle (*Hieraaetus morphnoides*) is listed as Vulnerable under the BC Act and was recorded within the biodiversity study area.

The proposal will result in the disturbance of 036 ha of habitats, which may provide potential foraging habitat for these species. No breeding habitat was identified within the study area for this species. It is likely that the habitat within the subject land would only be intermittently utilised by this species whist foraging within the greater locality.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats

(a) in the case of a threatened species, whether the proposed development or activity 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

Up to 0.36 ha of potential habitat is likely to be affected by the proposal. Due to the mobility and large home range of this species, and the linear footprint of this proposal, the proposed action is unlikely to affect their life cycle or ability to forage and breed. Local populations of threatened raptors are unlikely to be restricted to habitat within the subject land, as similar and higher quality habitat occurs widely in the locality. The impact of 0.36 ha of potential habitat would represent <1% of habitat in the greater locality and the study area would only represent a small part of the home ranges of locally occurring individuals.

Although the proposed action would result in the loss of potential foraging habitat, such habitat would only be a small component of locally occurring resources accessible to these species, and it is unlikely to constitute important habitat that would place this species at a greater risk of extinction. Therefore, the proposed works are considered unlikely to impact these species such that a viable local or intermittent seasonal population would be placed at a significant risk of extinction.

(b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(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

Not applicable.

(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

Not applicable.

(c) 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 proposed development or activity, 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 development or activity, 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.

The proposal is likely to affect up to 0.36 ha of potential foraging habitat for these species. No actively used nesting trees were identified during targeted surveys for this species.

Habitat connectivity is unlikely to be affected by the proposed action due to the mobility of birds of prey. Vegetation removal would largely be limited to a linear corridor. As the habitat within construction footprint is already impacted by edge effects, the proposed action would not adversely fragment or isolate any previously undisturbed patches of habitat. Furthermore, given these species' high mobility and that habitat of similar and higher quality occurs widely in the locality, it is considered unlikely that habitat would become further isolated or significantly fragmented beyond that currently existing in the subject land.

Up to 0.36 ha of potential habitat for threatened raptor species would be affected by the proposed action. An abundance of similar and higher quality foraging opportunities would be retained both within the study area and wider locality. Owing to the relatively small proportion of potential foraging habitat impacted and the vast abundance of habitat in the locality, the proposed action is unlikely to significantly affect the long-term survival of this species, although the loss of native vegetation habitat must be considered to be an incremental loss of local habitat. This loss of habitat however is unlikely to affect the long-term survival of these species.

(d) Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

The subject land did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

(e) Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to this species, the proposal is consistent with two KTPs under the BC Act, being clearing of native vegetation and removal of dead trees. The extent of native vegetation clearing (0.36 ha), and habitat removal associated with the proposed works, is considered relatively small in terms of the available habitat for this species within the surrounding landscape. The proposal involves works that are part of a KTP and will exacerbate these KTP, however the contribution is minimal. Although the loss of habitat would represent a small incremental loss of habitat, the proposed action is unlikely to have a significant impact upon these species.

Conclusion

Up to 0.36 ha of potential habitat would be impacted by the proposed action. Owing to the abundance of land in the locality and the existing disturbances of this habitat (fragmentation) the loss of this foraging habitat is unlikely to adversely affect this species. Although the loss of habitat would represent an incremental loss of potentially suitable habitat, the proposed action is unlikely to have a significant impact upon this species and its local population.

Squirrel Glider (*Petaurus norfolcensis*)

Status

The Squirrel Glider is listed as Vulnerable under the BC Act.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats.

Distribution

The species is widely, although sparsely distributed in eastern Australia, from northern Queensland to western Victoria. It occurs in coastal areas in NSW and its distribution extends over the ranges to the western slopes (Van Dyck and Strahan, 2008)

Habitat

It inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum Forest west of the Great Dividing Range and prefers mixed species stands with a shrub or Acacia midstorey.

On the NSW Central Coast, the species occurs in woodland habitats dominated by eucalypts that contain acacias and proteaceous plants such as banksias and grevilleas which provide sap and nectar, respectively, during those periods when canopy species are not producing nectar and pollen. It also requires an abundance of tree hollows for refuge and nest sites (Van Dyck and Strahan, 2008).

Ecology

Squirrel Gliders have a varied diet dominated by nectar and pollen, but including a number of other resources such as plant saps (acacias and eucalypts), a range of invertebrates and honeydew produced by leaf scale insects (Van Dyck and Strahan, 2008).

They live in family groups with multiple pairs and their offspring, using habitats which have a diversity of food resources to carry them through seasonal changes in availability (Van Dyck and Strahan, 2008), which can be used as a measure to assess habitat suitability for the species (Van Dyck and Strahan, 2008).

Threats

Threats to the Squirrel Glider are detailed in the Squirrel Glider profile (Office of Environment & Heritage, 2024b) and include:

- habitat loss and degradation
- fragmentation of habitat
- loss of hollow-bearing trees
- loss of understorey food resources
- inappropriate fire regimes
- reduction in food resources from drought
- mortality due to entanglement on barbed wire
- occupation of hollows by exotic species
- predation by exotic predators
- changes in spatial and temporal distribution of habitat due to climate change.

The proposal may incrementally reduce the extent of foraging resources available to the Squirrel Glider locally and may increase the fragmentation of Squirrel Glider movement corridors associated with the study area. Regarding the Squirrel Glider, the proposal is likely to be commensurate with one KTP, being clearing of native vegetation. This KTP is not likely to significantly affect the extent of suitable habitats, but may affect connectivity across Dora Street.

Specific impacts

The proposal will impact upon 0.69 ha of potential foraging habitat compared to retention of 3.47 ha. 9 hollow-bearing trees will require removal and ten will be retained. The area of habitat likely to be impacted, effectively occurs as widening the existing road verges along existing roads. Currently there are no linkages across Mandalong Road, but movement opportunities exist across Wyee Road, Freemans Drive and Dora Street. While the proposal is unlikely to diminish movement potentials for Squirrel Gliders across Wyee Road and Freemans Drive, the widening of Dora Street may reduce movements across Dora Street.

(a) in the case of a threatened species, whether the proposed development or activity 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

The subject land encompasses sections of the existing road carriageways of Mandalong Road, Wyee Road, Freemans Drive and Dora Street. It is estimated that around 0.69 ha of potential Squirrel Glider habitat would be impacted by the proposal. Habitat for the Squirrel Glider associated with the subject land was largely fragmented from larger tracts of contiguous vegetation particularly along Mandalong Road. occurs as somewhat isolated strips/islands of native vegetation between Gimberts Road and Mandalong Road, as well as strips of vegetation on the northern side of Gimberts Road.

While the Squirrel Glider is considered a sedentary species, due to their mobility and the linear nature of the subject land, potential habitat occurring in the subject land might be used as part of a larger home range. Any identified population of Squirrel Glider would not be restricted to habitat in the subject land, as similar foraging habitat occurs in adjacent habitats and more widely in the locality. Due to the relatively small amount of Squirrel Glider habitat likely to be affected, and the abundance of similar habitat elsewhere in the locality, the proposal is not considered likely to have a significant adverse effect on the extent of habitat locally for this species. Nevertheless, connectivity may be compromised across Dora Street, which is an important linkage for individuals using habitats to the north and south of Dora Street. Therefore, glider crossing installations will likely be required to maintain connectivity in the landscape for Squirrel Gliders.

(b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(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

Not applicable.

(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

Not applicable.

(c) 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 proposed development or activity, 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 development or activity, 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.

It is estimated that around 0.69 ha of native vegetation suitable to the Squirrel Glider would be affected by the proposal. Any local population of Squirrel Glider would not be restricted to habitat resources within the subject land. This species is not solely dependent on vegetation within the subject land and may only use these resources intermittently as part of their home range in similar and more significant habitat resources within the locality. Nevertheless, the modifications to Dora Street vegetation may prevent north south movements without glider crossings to offset potential impacts.

It is estimated that around 0.69 ha of potentially suitable foraging habitat would be affected by the proposal, but for most of subject land the removal of this vegetation would not represent additional barriers to connectivity beyond what is currently available for local gliders. Native vegetation to be removed would be limited to linear widenings of the existing road easements. As the subject land is largely confined to cleared areas, much of the proposal would not fragment or isolate any previously undisturbed patches of habitat. Indeed, native vegetation likely to be impacted by the proposal occurs as narrow strips/island of vegetation between Mandalong Road and Gimberts Road as well as small strips along the northern edge of

Gimberts Road. However, trimming of vegetation along Dora Street's northern side may remove connectivity at this location without the installation of glider crossings to maintain connectivity.

Given this species' relative mobility in continuous habitats and that similar and more significant habitat occurs widely in the locality, it is considered very unlikely that the area of habitat would become significantly decreased. However, the proposal has the potential to remove connectivity across Dora Street, which would separate animals either side of the roadway without glider crossing infrastructure to preserve continuity of access across the roadway.

It is estimated that around 0.69 ha of potentially suitable foraging habitat would be affected by the proposal, but for most of subject land the removal of this vegetation would not represent additional barriers to connectivity beyond what is currently available for local gliders. The vegetation associated with the proposal occurs as isolated patches/strips along existing roadways and an abundance of similar and more significant habitat areas for Squirrel Glider occurs adjacent to the subject land to the north.

Nevertheless, although the proposal will not significantly reduce the area of habitat for Squirrel Gliders in the locality, it may reduce the availability of that habitat to local gliders if the widening of Dora Street prevents movements between habitats to the north and south of Dora Street. Therefore, connectivity may only be preserved by the installation of glider crossings at this location.

(d) Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

The subject land did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

(e) Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

Threatening process means a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities. Key threatening processes are listed under the BC Act and at present there are 38 listed KTPs.

With respect to the Squirrel Glider, the proposal is commensurate with one KTP, being clearing of native vegetation. The proposal would add incrementally to this KTP; however, it is not likely to affect this species in the proposal locality, due to the limited effects to connectivity for this species in the landscape and the very limited impacts to available habitat for this species locally and in the wider region. Connectivity integrity will be retained through the Wildlife Connectivity Strategy and resultant mitigation measures.

Conclusion

The subject land predominately consists of existing road carriageways, with very small areas of native vegetation (0.22 ha), largely linear in shape, likely to be affected. Due to the proximity of potential habitats occurring within the subject land to more extensive habitats in the vicinity, onsite habitats may be used by this species as part of a larger home range. An abundance of similar and more significant habitat occurs in the locality that is suitable for Squirrel Glider habitation. While the proposal would add incrementally to the loss of potential habitat for this species, it is generally restricted to existing road carriageway and disturbed areas. Vegetation removal would be largely limited to a linear widening of an existing road easement, and as such, it is not likely to reduce the area of habitat for Squirrel Gliders in the locality.

However, connectivity between habitats to the north and south of Dora Street may be separated by the widening of current gaps between vegetation. Therefore, the proposal will likely need to install glider crossing infrastructure at Dora Street to avoid a significant impact upon connectivity for local Squirrel Glider populations.

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

Conservation Status

The Grey-headed Flying-fox is listed as Vulnerable under the BC Act and EPBC Act.

Distribution

This species is generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia (Department of the Environment, 2016). At any one time, the majority of animals only occupy a small proportion of this entire range (NSW National Parks and Wildlife Service, 2001), as the species selectively forages where food is available. Consequently, patterns of occurrence and relative abundance within its distribution varies between seasons and between years (Department of the Environment, 2016). The proposal study area does not occur at the limit of the known distribution of the Grey-headed Flying-fox.

Habitat

The Grey-headed Flying-fox typically occur in subtropical and temperate rainforests, tall sclerophyll forests, woodlands, heaths, swamps and mangroves, as well as urban gardens and fruit crops (Churchill, 2008, NSW National Parks and Wildlife Service, 2001). Around 15 per cent of the species' distribution occurs on reserves within NSW National Parks and Wildlife Service estate (Office of Environment & Heritage, 2016b, Office of Environment & Heritage, 2016d). Accordingly, the Grey-headed Flying-fox is not considered to be adequately represented in conservation reserves.

Ecology

This species is considered an important pollinator and seed disperser of native trees, as they forage on the nectar and pollen of Eucalyptus, Angophora, Melaleuca and Banksia, as well as fruit of rainforest trees and vines (NSW National Parks and Wildlife Service, 2001, Van Dyck and Strahan, 2008). While the majority of foraging events occur within 20 km of their day roost, some individuals would disperse and commute up to 50 km (Van Dyck and Strahan, 2008).

Grey-headed Flying-foxes are highly mobile and as the availability of native fruits, nectar and pollen varies over time and throughout their range, they respond to this by migrating between camps up and down the east coast, sometimes travelling hundreds of kilometres (NSW National Parks and Wildlife Service, 2001). The population concentrates in May and June in northern NSW and Queensland where animals exploit winter-flowering trees such as Swamp Mahogany, Forest Red Gum and Paperbark, dispersing south during the summer (Department of the Environment and Heritage, 2003).

Grey-headed Flying-fox roost in large colonies of up to tens of thousands and may be shared with Little Red Flying-fox and Black Flying-fox(Churchill, 2008). Camps are generally located in gullies with dense vegetation (such as mangrove, rainforest, Melaleuca and Casuarina), close to water and generally located within 20 km of a regular food source (NSW National Parks and Wildlife Service, 2001). Site fidelity to camps is high with some camps in NSW used for over a century (NSW National Parks and Wildlife Service, 2001).These bats usually return annually to particular camps for rearing young (NSW National Parks and Wildlife Service, 2001).

Threats

- Loss of roosting and foraging sites
- Electrocution on powerline, entanglement in netting and barbed wire
- Heat stress
- Conflict with humans
- Incomplete knowledge of abundance and distribution across the species' range.

The proposal would add incrementally to the loss of seasonal/intermittent foraging resources for the Grey-headed Flying-fox. With regard to the Grey-headed flying-fox, the proposal is likely to be commensurate with one KTP, being clearing of native vegetation. This KTP is not likely to significantly affect this species in the locality.

Specific impacts

Roosting camps have previously occurred locally in Mandalong and regionally at Martinsville to the north-west, Blackalls Park to the north, and Belmont to the north-east. Due to their highly mobile nature, individuals from these camps may visit the subject land for foraging purposes intermittently and irregularly. A single individual was observed roosting in a tea-tree (*Melaleuca linearifolia*) adjacent to the subject land during field surveys. The individual was alone, and not observed during nocturnal field surveys or at the location on subsequent days. Therefore, the occurrence was taken to be transitory.

The proposal will impact upon 0.69 ha of potential foraging habitat compared to retention of 3.47 ha. The area of habitat likely to be impacted, effectively occurs as the widening of small sections of existing road verges of very busy and well-established roads.

(a) in the case of a threatened species, whether the proposed development or activity 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

The majority of the subject land encompasses the existing road carriageway of Mandalong Road and Gimberts Road. The proposal will impact upon 0.69 ha of potential foraging habitat compared to retention of 3.47 ha.

The Grey-headed Flying-fox is a blossom nomad that is known to commute long distances as food availability varies over time. Accordingly, this species is likely to be present in the locality intermittently and irregularly. No Grey-headed Flying-fox camps were observed in the subject land, although camps are known locally and regionally. A review of the National Flying-fox Monitor Reviewer indicate that the nearest nationally important Flying-fox camp occurs in Blackbutt Reserve, Newcastle. Camps sites are generally located in gullies with dense vegetation (mangrove, rainforest, Melaleuca and Casuarina) close to water and in proximity to foraging resources. Camp sites occur locally in Mandalong and regionally at Martinsville to the north-west, Blackalls Park to the north, and Belmont to the north-east, and they are known to fly up to 50 km for food resources (NSW National Parks and Wildlife Service, 2001). Therefore, the subject land may be used as part of a greater foraging range of local individuals. Any identified population of Grey-headed Flying-fox in the locality would not be restricted to habitat within the study area, as similar foraging habitat or that of higher quality occurs widely in the locality and is accessible to local populations.

Due to the relatively small amount of marginal Grey-headed Flying-fox foraging habitat to be removed from within the study area and the abundance of similar and greater quality habitat elsewhere in the locality, the proposal is not considered likely to have a significant adverse effect on the lifecycle of this species, which might result in a decline of a local population.

(b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(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

Not applicable.

(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

Not applicable.

(c) 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 proposed development or activity, 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 development or activity, 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.

The proposal will impact upon 0.69 ha of potential foraging habitat compared to retention of 3.47 ha. This habitat may seasonally provide foraging opportunities for the Grey-headed Flying-fox. Any local population of Grey-headed Flying-fox would not be restricted to habitat resources within the subject land, as this species is highly nomadic in response to spatial and temporal availability of foraging resources. The Grey-headed Flying-fox would use similar and potentially more

significant habitat resources within the locality. No Grey-headed Flying-fox camps would be directly affected because of the proposal.

Habitat within and immediately surrounding the subject land is already fragmented by the existing roadways, the M1 Pacific Motorway to the west, considerable industrial development to the south and both cleared lands and residential properties to the north. Most of the subject land would remove relatively small linear sections of fragmented vegetation communities. Given the Grey-headed Flying-fox is highly mobile and nomadic in relation to temporal and spatial availability of food (foraging up to 20 km from camp sites), and that similar or more significant habitat occurs in the locality, the small incremental increase to existing fragmentation, through the removal of 0.69 ha of potential marginal foraging habitat, is not likely to further isolate or fragment habitat significantly beyond that currently existing in the proposal locality.

The subject land is largely confined to the existing Mandalong Road and Gimberts Road carriageways. In total, around 0.69 ha of native vegetation, largely linear in shape, would be affected and occurs as isolated patches between the two pre-existing roadways. Roost/maternity camps were not observed in the subject land; however, they are known locally and regionally, and vegetation within the subject land represents seasonal foraging habitat opportunities for this species. The Grey-headed Flying-fox is a wide-ranging nomadic species that that relies on food sources that largely have irregular patterns of production, with nightly foraging events typically occurring within 20 km of camps, but some commutes can be up to 50 km. Given the extensive and contiguous nature of suitable habitat in the locality, the larger home ranges and mobile foraging habits of these species, and the loss 0.69 ha of potential marginal foraging habitat, the proposal is unlikely to affect the long-term survival of this species in the locality.

(d) Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

The subject land did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

(e) Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

Threatening process means a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities. Key threatening processes are listed under the BC Act and at present there are 38 listed KTPs.

With respect to the Grey-headed Flying-fox, the proposal is commensurate with one KTP, being clearing of native vegetation. The proposal would add incrementally to this KTP; however, it is not likely to adversely affect this species in the proposal locality.

Conclusion

The subject land is mostly confined to the existing road carriageways of Wyee Road, Mandalong Road, Freemans Drive and Dora Street. The proposal will impact upon 0.69 ha of potential foraging habitat compared to retention of 3.47 ha of native vegetation that contains seasonal foraging resources for the Grey-headed Flying-fox. Impacts to native vegetation are linear in shape, limited to adding incrementally to the widening an existing road corridor.

The Grey-headed Flying-fox is a blossom nomad that is known to commute long distances as food availability varies over time. Accordingly, this species is likely to be present in the locality intermittently and irregularly due to ever changing distribution of foraging resources. No Grey-headed Flying-fox camps were observed in the subject land, although camps are known locally and regionally. A review of the National Flying-fox Monitor Reviewer indicate that the nearest nationally important Flying-fox camp occurs in Blackbutt Reserve, Newcastle. Therefore, the subject land may be used as part of a greater foraging range of local individuals. Any identified population of Grey-headed Flying-fox in the locality would not be restricted to habitat within the subject land, as similar foraging habitat or that of higher quality occurs widely in the locality and is accessible to local populations.

Due to the relatively small amount of marginal Grey-headed Flying-fox foraging habitat to be removed from within the study area and the abundance of similar and greater quality habitat elsewhere in the locality, the proposal is not considered likely to have a significant impact on the Grey-headed Flying-fox.

Microchiropteran bats

As the subject land lacked abundant critical habitat components, such as hollow-bearing trees, caves, or similar man-made structures, the following hollow-dwelling and cave-dwelling microchiropteran bats have been considered together as the subject land largely represents potential foraging habitat only:

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Eastern Freetail-bat (*Mormopterus (Micronomus) norfolkensis*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Little Bentwing-bat (*Miniopterus australis*)
- Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*)
- Southern Myotis (*Myotis macropus*)
- Eastern Cave Bat (*Vespadelus troughtoni*).

Conservation Status

The above listed microchiropteran bats are listed as Vulnerable under the BC Act. The large-eared Pied Bat is also listed as Vulnerable under the EPBC Act.

Table D-8 Distribution and habitat

Common name (Scientific name)	Threats	Habitation and distribution	BC Act	EPBC Act
Hollow Dwelling Bats				
Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)	Its population and distribution are suspected to be reduced. It faces severe threatening processes. It is an ecological specialist (it depends on specialised diet or habitat).	Usually roosts in tree hollows in higher rainfall forests. Sometimes found in caves (Jenolan area) and abandoned buildings (Churchill, 2008).	V	
Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)	Vulnerable to loss of tree hollows and clearing and fragmentation of forest and woodland habitat.	A wide-ranging species across northern and eastern Australia. In the most southerly part of its range (Victoria, south-western NSW South Australia), it is a rare visitor in late summer/autumn. This species flies high and fast over forest canopies foraging for insects in most habitats across its wide range. Generally roosts in tree hollows (Churchill, 2008).	V	
Greater Broad-nosed Bat (*Scoteanax rueppellii*)	Its population is suspected to have been reduced. It is an ecological specialist (it depends on specialised diet or habitat).	The preferred hunting areas of this species include tree-lined creeks and the ecotone of woodlands and cleared paddocks, but it may also forage in rainforest. Typically, it forages at a height of 3–6 m but may fly as low as 1 m above the surface of a creek. It feeds on beetles, other large, slow-flying insects and small vertebrates. It generally roosts in tree hollows but has also been found in the roof spaces of old buildings (Churchill, 2008).	V	

Common name (Scientific name)	Threats	Habitation and distribution	BC Act	EPBC Act
Eastern Freetail-bat (*Mormopterus (Micronomus) norfolkensis*)	Vulnerable to loss of tree hollows and loss of feeding grounds by forestry activities, clearing for agriculture and housing. Its population is suspected to have been reduced. It is an ecological specialist and depends on particular types of diet or habitat (Churchill, 2008).	Thought to live in Sclerophyll Forest and woodland. Small colonies have been found in tree hollows or under loose bark. It feeds on insects above the forest canopy or in clearings at the forest edge (Churchill, 2008).	V	
Cave Dwelling Bats				
Large-eared Pied Bat (*Chalinolobus dwyeri*)	Clearing and isolation of forest and woodland habitats near cliffs, caves and old mine workings for agriculture, forestry or development. Damage to roosting and maternity sites from mining operations and recreational caving activities. Use of pesticides.	Occurs in moderately wooded habitats and roosts in caves, mine tunnels and the abandoned, bottle-shaped mud nests of Fairy Martins. Thought to forage below the forest canopy for small flying insects (Churchill, 2008).	V	V
Little Bentwing-bat (*Miniopterus australis*)	The species is an ecological specialist (it depends on particular types of diet or habitat) and it concentrates (individuals within populations of the species congregate or aggregate at specific locations).	Feeds on small insects beneath the canopy of well-timbered habitats including rainforest, Melaleuca swamps and dry Sclerophyll forests. Roosts in caves and tunnels and has specific requirements for nursery sites. Distribution becomes coastal towards the southern limit of its range in NSW. Nesting sites are in areas where limestone mining is preferred (Strahan, 1995).	V	
Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis)*	Loss of habitat, feral predators such as cats and foxes, disturbances of winter roosts, relies on very few nursery caves at high density (Dwyer, 1998).	Distributed across the east coast of Australia, rests in caves, old mines, stormwater channels and comparable structures including occasional buildings (Dwyer, 1998),. Typically found in well-timbered valleys where it forages, above tree canopy on small insects (Churchill, 2008).	V	

Common name (Scientific name)	Threats	Habitation and distribution	BC Act	EPBC Act
Large-footed Myotis (*Myotis macropus*)	Not certain. Is likely to be susceptible to changes in water quality, which may result from vegetation clearing and logging (sedimentation), sewage and fertilizer run-off (eutrophication), pesticide/herbicide leakage (chemical pollution) and altered flow regimes (changes to river ecology). Where populations concentrate in roosts which are susceptible to disturbance, human activities such as recreational use of caves and removal of old wooden bridges would also be a threat (Duncan et al., 1999). The species may have been subject of over-collection in the past (Richards, 1998).	Found in roosting caves, tunnels, tree hollows and possibly dense vegetation (Churchill, 1998). Roosts have been located in hanging trees. Buildings and underneath bridges have also been listed as roost sites for the species. The species is always associated with permanent, usually slow-flowing water bodies. Forages over small creeks, coastal rivers, estuaries lakes and inland rivers. Records come from a wide range of vegetation communities associated with water (Richards, 1998).	V	

Specific impacts

Around 0.98 ha of potentially suitable habitat was recorded in the subject land within four PCT's, represented by include PCT's 3582, 3583, 3998), 4020 and 4042. Areas of habitat likely to be impacted, effectively occur as the widening of small sections of the existing road verges along Mandalong Road, Dora Street, Wyee Road and Freemans Drive.

Species actually recorded were:

- Little Bent-winged Bat (*Miniopterus australis*)
- Large Bent-winged Bat (*Miniopterus orianae oceanensis*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*)
- Southern Myotis (*Myotis macropus*)
- Eastern Cave Bat (*Vespadelus troughtoni*)

No caves or similar habitats are present, however 9 hollow trees will be removed and 10 will be retained, all with small hollows.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats.

(a) in the case of a threatened species, whether the proposed development or activity 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

Most of the subject land encompasses narrow edges of existing road carriageways. In this location the subject land will only impact small areas of existing habitats.

Impacts to native vegetation will be linear in shape, only adding incrementally to the widening of existing road corridors.

Native vegetation impacted by the proposal is currently somewhat fragmented from larger tracts of contiguous vegetation and occurs largely as isolated strips of native vegetation between Mandalong Road and Gimberts Road with strips along the southern edges of Gimberts Road continuous with communities to the north. There is an abundance of similar and higher quality habitat in the wider locality which is suitable for microchiropteran bat foraging and habitation. Vegetation removal to make way for road widening would only remove linear strips of vegetation such that vegetation would remain along the

roads after trimming. The removal of small strips of vegetation would not significantly affect the potential for microchiropteran bats to use the road verges for foraging. Therefore, it is considered unlikely that the proposal would have an adverse effect on the lifecycle of microchiropteran bats such that they would be placed at risk of extinction.

(b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(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

Not applicable.

(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

Not applicable.

(c) 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 proposed development or activity, 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 development or activity, 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.

It is estimated that around 0.98 ha of foraging habitat for microbats would be affected by the proposal, and importantly, limited critical habitat resources, such as hollow-bearing trees were recorded therein. No caves or similar habitats are present, however 9 hollow trees will be removed and 10 will be retained, all with small hollows.

Native vegetation impacted by the proposal was somewhat fragmented from larger tracts of contiguous vegetation and occurs as edge strips of native vegetation along well-established roadways. There is an abundance of similar and higher quality habitat in the wider locality which is suitable for microchiropteran bat foraging and habitation. Vegetation removal to make way for road widening would only remove linear strips of vegetation such that vegetation would remain along roadways after trimming. The removal of small strips of vegetation would not significantly affect the potential for microchiropteran bats to use the road verges for foraging. Therefore, it is considered unlikely that the proposal would have an adverse effect on the lifecycle of microchiropteran bats such that they would be placed at risk of extinction.

Habitat within and immediately surrounding the subject land is already fragmented by the existing roadways, the M1 Pacific Motorway to the west, considerable industrial ad other developments surrounding the roads for much of their extent. Most of the subject land would remove relatively small linear sections of fragmented vegetation communities. Given microchiropteran bats are highly mobile and that similar and more significant habitat occurs in the locality, the small incremental increase to existing fragmentation, through the removal of 0.98 ha of potential but marginal foraging habitat, is not likely to further isolate or fragment habitat significantly beyond that currently existing in the proposal locality.

The subject land is largely confined to the existing road carriageways. In total, around 0.98 ha of native vegetation, largely linear in shape, would be affected and occurred as isolated patches between the two pre-existing roadways during onsite surveys. Potential for roost/maternity habitats were not observed in the subject land; however, there is an abundance of higher quality habitats in the wider locality offering seasonal foraging and roosting habitat opportunities for both hollow-dwelling and cave-dwelling microchiropteran bats, especially in the ranges to the west. Due to the general lack of roosting habitats, the subject land only offers foraging opportunities for local microchiropteran bats. Nevertheless, although the trimming of vegetation would reduce the area of vegetation present within the subject land, similar vegetation edges, which might currently provide foraging habitat opportunities would persist after the proposed works are completed. Therefore, although the observed habitat is not considered to be of high foraging importance to locally occurring microchiropteran bats, those foraging opportunities are unlikely to be significantly diminished because of the linear trimming of vegetation.

(f) Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

The subject land did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

(g) Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

Threatening process means a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities. Key threatening processes are listed under the BC Act and at present there are 38 listed KTPs.

With respect to the microchiropteran bats, the proposal is commensurate with one KTP, being clearing of native vegetation. The proposal would add incrementally to this KTP, however it is not likely to significantly affect microchiropteran bat species in the proposal locality, as the proposal would not significantly affect foraging opportunities for these species in the locality of the subject land.

Conclusion

The subject land is mostly confined to the existing road carriageways of Mandalong Road and Gimberts Road, except for minor widening of the road verges to facilitate roadway modifications. In this location it is estimated that around 0.98 ha of potential foraging habitat for microchiropteran bats would be affected by the proposal. Impacts to native vegetation are linear in shape, adding incrementally to the widening of the existing road corridors. No caves or similar habitats are present, however 9 hollow trees will be removed and 10 will be retained, all with small hollows.

Vegetation likely to be impacted by the proposal is currently continuous with larger tracts of contiguous vegetation to the north with vegetation between the two roads occurring as an isolated strip of native vegetation. An abundance of similar and more significant habitat occurs in the locality that is suitable for microchiropteran bats. Therefore, due to the small amount of potential habitat likely to be impacted, the persistence of similar foraging habitat post-proposal, and the abundance of more significant habitat in the proposal locality, it is considered unlikely that the proposal would have a significant impact on local species of microchiropteran bat.

Koala

The Koala (*Phascolarctos cinereus*) is listed as Endangered under both the BC Act.

Targeted surveys were completed to determine the presence and use of the habitats present within the biodiversity study area including SATs, spotlighting and opportunistic surveys. No potential signs of use such as scratches, scats, observations or vocalisations were recorded.

The proposal would impact upon 0.98 ha of forested habitats within the study area.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats

(a) in the case of a threatened species, whether the proposed development or activity 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

The subject land contains 0.98 ha of potential habitat for the Koala. This habitat is largely comprised of supplementary habitat that is unlikely to provide preferred habitat for the species. Preferred habitat for the species within the subject land is considered to be limited to Swamp Sclerophyll Forest otherwise surrounded by supplementary habitat and disjunct from other key areas of preferred habitat. It is considered unlikely that the study area is important to Koalas for breeding and feeding purposes.

This habitat to be potentially impacted would be linear in nature and largely occurs as modified forest/woodland subject to existing impacts associated with agriculture, mining, road, rail and power infrastructure and urban development. Existing effects (such as noise, dust, light pollution) and habitat fragmentation are existing disturbances reducing the functionality of the habitat. An abundance of similar and higher quality habitat occurs in the adjacent vegetation within and outside the study area that is suitable for Koala habitation. The impact of up to 0.98 ha of potential habitat would represent a small proportion of habitat available to this species.

Consequently, the proposed action is unlikely to have an adverse effect on the life cycle of the Koala such that a viable local population of these species are likely to be placed at risk of extinction.

(b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(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

Not applicable.

(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

Not applicable.

(c) 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 proposed development or activity, 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 development or activity, 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.

The proposal would impact on a maximum 0.98 ha of potential habitat for the Koala.

The proposed action would result in the construction of a new dual land carriageway. Despite the current fragmented nature of the landscape through which it would intersect, the proposed action would result in a new barrier that would likely lead to additional and incremental increases to existing fragmentation impacts on habitats within the landscape. Furthermore, the proposed action would also result in an increase in isolation of habitats as the current habitat patches would be made smaller thereby increasing the physical distance between some habitat fragments.

The roadway would not totally prevent fauna movement between habitat fragments (fauna can and likely do cross the road) as wildlife connectivity measures would be constructed to allow the continued movement of fauna through the landscape.

The habitat proposed for removal is small in proportion to the amount of continuous high quality habitat to the east of the study area. In light of the status and condition of the habitat to be removed and the nature of the impact it is unlikely that the proposed action would significantly impact important habitat that is important to the long-term survival of local populations of the Koala.

(d) Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

The subject land did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

(e) Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to the Koala, the proposal is commensurate with one KTP, being clearing of native vegetation. The proposal would add incrementally to this KTP, however it is not likely to significantly affect Koala in the proposal locality, as the proposal would not significantly affect opportunities for this species in the locality of the subject land.

Conclusion

The extent of native vegetation clearing, and habitat removal associated with the proposal small in terms of the available habitat for this species within the surrounding landscape. The habitat to be impacted occurs as a narrow corridor of marginal vegetation which is already subjected to fragmentation impacts associated with current and past land uses. The potential loss of habitat for the Koala is not considered to be important in regard to the maintenance of this species locally, and therefore the proposed works are not likely to have a significant impact upon this species.

Appendix E – Assessments of significance (EPBC Act)

Threatened biodiversity listed under the EPBC Act significance assessments have been completed in accordance with the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, 2013).

Assessments of significance have been completed for the following TEC as listed under the EPBC Act:

- River Flat Eucalypt Forest on Coastal Floodplains.

Assessments of significance have been completed for threatened species listed under the EPBC Act outlined in Table E-1.

Table E-1 EPBC Act listed threatened species for which assessments of significance have been completed

Scientific name	Common name	EPBC Act status	Potential occurrence (Moderate, High, Recorded)
Flora			
Acacia bynoeana	Bynoe's Wattle	V	Moderate
Angophora inopina	**Charmhaven Apple**	**V**	**Recorded**
Caladenia tessellata	Thick Lip Spider Orchid	V	Moderate
Corunastylis sp. Charmhaven (NSW896673)	Charmhaven Midge Orchid	CE	Moderate
Cryptostylis hunteriana	Leafless Tongue Orchid	V	Moderate
Diuris praecox	Rough Double Tail	V	Moderate
Genoplesium insigne	Variable Midge Orchid	CE	Moderate
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	Moderate
Rutidosis heterogama	Heath Wrinklewort	V	Moderate
Tetratheca juncea	**Black-eyed Susan**	**V**	**Recorded**
Fauna			
Anthochaera Phrygia	Regent Honeyeater	CE	Moderate
Callocephalon fimbriatum	Gang-Gang Cockatoo	E	Moderate
Calyptorhynchus lathami lathami	South-eastern Glossy Black Cockatoo	V	Moderate
Chalinolobus dwyeri	Large-eared Pied Bat	V	Moderate
Lathamus discolor	Swift Parrot	CE	Moderate
Phascolarctos cinereus	Koala	E	Moderate
Pteropus poliocephalus	**Grey-headed Flying-fox**	**V**	**Recorded**

Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland

Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland is listed as an Endangered Ecological Community under the EPBC Act. The proposal would involve the removal of 0.04 ha of this Endangered Ecological Community.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

An action is likely to have a significant impact on a Critically Endangered or Endangered ecological community if there is a real chance or possibility that it will:

(a) Reduce the extent of an ecological community

The proposal would reduce the extent of the Endangered Ecological Community by up to 0.04 ha.

The area of occupancy of Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland is estimated in the EPBC Act Conservation Advice as 115,000 ha. A study in the 1990's estimates that the extent within the lower and central Hunter region to be around 7,000 ha. Broadscale vegetation mapping within the locality of the locality of the proposal estimates that there is 3,371 ha of PCTs associated with the threatened ecological community to occur within the locality. The removal of up to 0.04 ha would equate to a negligible percentage of the community's estimated area of occupancy. It is expected that impacts associated with the proposal would not place the local occurrence of the threatened ecological community at risk of extinction.

(b) Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines

The proposed action would result in the widening of an existing road and intersection. Despite the current fragmented nature of the landscape through which it is located, the proposed action would result in a widened barrier that would likely lead to additional and incremental increases to existing fragmentation impacts on habitats within the landscape.

It is predicted that the fragmentation impacts caused by the proposed action would unlikely be enough to prevent the breeding and dispersal of plant pollinators or the dispersal of plant propagules (i.e. seed or other vegetative reproductive material) between habitat patches. Functional connectivity for many species would remain in the study area. However, local dispersion of some wildlife populations, isolation of key habitat resources, loss of genetic interchange, and loss of population viability for some species.

Functional habitat connectivity for more mobile species (e.g. birds, flying-foxes, insectivorous bats, insects, plants) would still remain. The roadway would not totally prevent fauna movement between habitat fragments (fauna can and likely do cross the road) as wildlife connectivity measures would be constructed to allow continued wildlife movement through the landscape.

Due to the current fragmented nature of the habitat within the subject land, wildlife connectivity measures to be implemented and the relatively small proportion of remnant Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland within its extent to be impacted, it is considered that this impact would be negligible across the threatened ecological community's range.

(c) Adversely affect habitat critical to the survival of an ecological community

No critical habitat has been identified for the community under Section 207A of the EPBC Act or included on the Register of Critical Habitat.

Areas (including habitat) that is considered most critical to the to the survival of the Endangered Ecological Community are considered to be those where the hydrological regime remains reasonably intact such that the vegetation diagnostic features are maintained. Patches that meet Categories A, B1, B2 and C1 in Table 2 of the of the EPBC Act Conservation Advice for the community are considered important for the community as they are closest to the benchmark values, with more intact hydrology, other ecological function, and other critical habitat features as demonstrated by the largest most connected and/or most intact native vegetation and species diversity of the ecological community.

Around 0.04 ha of the community within the subject land is likely to meet Category B2.

The critical habitat to be impacted is subject to varying degrees of disturbance and although it meets Category B2 and contains a hydrological regime which is largely intact it is questionable as to whether it is critical to the survival of this threatened ecological community due to its low vegetation integrity score which suggest that the vegetations diagnostic features are low in condition (primarily species diversity, structure and functionality). As such, the proposal is considered unlikely to adversely affect habitat critical to the survival of the threatened ecological community. In addition, 0.60 ha will be retained, which is the majority of occurrence within the biodiversity study area.

(d) Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns

Though the proposed activity would modify the soil profile in the areas that require clearing of vegetation, this impact is unlikely to significantly modify abiotic factors such as the soil profile, groundwater levels of surface water drainage patterns necessary to the survival of remaining Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland surrounding the study area. Any potential impacts on hydrology would be mitigated through design and implementation of mitigation measures.

(e) Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting

Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland within the study area is located proximate to urban development and agricultural lands. As such, the Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland recorded is subject to associated edge effects and a disturbed state. Whilst the referred action may introduce edge effects to the Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland within the study area, these would be reduced and managed through recommended mitigation measures.

The action does not involve actions that would significantly change the existing disturbance regime such as the intensity or frequency of fires, the intensity or frequency of floods, or flora/fauna harvesting.

The proposed activity is considered unlikely to cause a substantial change in the species composition or occurrence of Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland.

(f) Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

(i) assisting invasive species, that are harmful to the listed ecological community, to become established

(ii) causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community

The proposed activity has potential to result in minor increases in the establishment, density or diversity of weed species. The Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland which occurs in the subject land also occurs within the broader locality and region which is surrounded and influenced by urban development, mining, agriculture and roads and as such subject to edge effects resulting in invasive species.

As such, the proposed activity is unlikely to exacerbate invasive species such that it would substantially reduce the quality or integrity of the community's occurrence. The proposal does not involve other processes that are likely to reduce the quality or integrity of Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland other than those described above.

(g) Interfere with the recovery of an ecological community.

There is no recovery plan under the EPBC Act for Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland. There are however several priority actions detailed in the threatened ecological community's EPBC Act Conservation Advice. These actions have been taken into consideration during the preliminary investigations and design phases to ensure the proposal does not significantly impact the threatened ecological community. Key actions adhered to by the proposed activity include:

- conserve remaining patches
- prevent detrimental changes to hydrology
- apply buffers zones

- manage actions to minimise impacts
- prevent the introduction and spread of exotic species.

The removal of up to 0.04 ha would interfere with in these actions in a minor way. Avoidance and minimisation of impacts on this community have been implemented however given the nature and location of the proposal complete avoidance of impacts is not achievable. This extent of impact is a low magnitude impact that will have no significant effect on the recovery of the Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland threatened ecological community. The residual impact of the proposal would be further mitigated via the implementation of mitigation measures and be offset in accordance with Transport's guidelines as per the recommendation it the EPBC Act Conservation Advice.

Conclusion

After consideration of the factors above, an overall conclusion has been made that the proposal is unlikely to result in a significant impact to the Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland Endangered Ecological Community. The predicted impacts are expected to be minor. A referral to the Commonwealth would not be required for impact to this threatened ecological community.

Charmhaven Apple (*Angophora inopina*)

The Charmhaven Apple is listed as Vulnerable under the EPBC Act.

Twenty-three individuals occur with the biodiversity study area, of these 3 will be impacted by the proposal.

The following Significant Impact Assessment is undertaken as a precautionary measure and to outline the confinement of impacts to specific areas and habitats that are not ecologically or topographically associated with habitats where Charmhaven Apple occurs.

Is this part of an important population?

Under the Act, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

Due to the very limited area of occurrence of the Charmhaven Apple individuals in the population are likely to be part of key source populations either for breeding or dispersal, likely to be necessary for maintaining genetic diversity and in the case of individuals on site near the western limit of their local range.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it would:

(a) Lead to a long-term decrease in the size of an important population of a species

The proposed works would not lead to a substantive long-term decrease in the size of an important population of Charmhaven Apple.

(b) Reduce the area of occupancy of an important population

The proposed works would not substantially reduce the area of occupancy an important population of the Charmhaven Apple.

(c) Fragment an existing important population into two or more populations

The proposed works would not substantially fragment the area of occupancy of the Charmhaven Apple into two or more populations.

(d) Adversely affect habitat critical to the survival of a species

No critical habitat is listed for this species under the EPBC Act.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006a).

Charmhaven Apple is limited to PCT 3583 in the wider biodiversity study area, while impacts in the subject land will remove small areas of PCT 3583, those areas do not include habitats where Charmhaven Apple have been observed.

(e) Disrupt the breeding cycle of an important population

The proposed works would not disrupt the breeding cycle of an important population of the Charmhaven Apple.

(f) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The proposed works would not modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the Charmhaven Apple is likely to decline.

(g) Result in invasive species that are harmful to a Vulnerable species becoming established in the species' habitat

The proposed works would not result in invasive species that are harmful to Charmhaven Apple becoming established in the Charmhaven Apple habitat.

(h) Introduce disease that may cause the species to decline

No. There are no known diseases that are likely to introduced in Charmhaven Apple habitat as a result of the proposal, which might cause the species to decline.

(i) Interfere substantially with the recovery of the species

Due to impacts associated with the subject land being confined to a habitat in which the Charmhaven Apple was not observed, the proposed works would not interfere substantially with the recovery of the species.

Conclusion

Twenty-three individuals occur with the biodiversity study area, of these 3 will be impacted by the proposal. This is not considered likely to impact the viability of the local population.

Tetratheca juncea

Tetratheca juncea is listed as Vulnerable under the EPBC Act and occur within the biodiversity study area but will not be impacted within the subject land.

Is this part of an important population?

Under the Act, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

Due to the very limited area of occurrence of *Tetratheca juncea* individuals in the population are likely to be part of key source populations either for breeding or dispersal and are likely to be necessary for maintaining genetic diversity.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it would:

(a) Lead to a long-term decrease in the size of an important population of a species

The proposed works would not lead to a substantive long-term decrease in the size of an important population of *Tetratheca juncea* as no clumps will be impacted.

(b) Reduce the area of occupancy of an important population

The proposed works would not substantially reduce the area of occupancy an important population of *Tetratheca juncea* as no clumps will be impacted.

(c) Fragment an existing important population into two or more populations

The proposed works would not substantially fragment the area of occupancy of *Tetratheca juncea* as no clumps will be impacted.

(d) Adversely affect habitat critical to the survival of a species

No critical habitat is listed for this species under the EPBC Act.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006a).

Adverse impacts critical to the survival of *Tetratheca juncea* will not occur as no clumps will be impacted.

(e) Disrupt the breeding cycle of an important population

The proposed works would not disrupt the breeding cycle of an important population of the *Tetratheca juncea*.

(f) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The proposed works would not modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that *Tetratheca juncea* is likely to decline.

(g) Result in invasive species that are harmful to a Vulnerable species becoming established in the species' habitat

The proposed works would not result in invasive species that are harmful to *Tetratheca juncea* becoming established in the habitat.

(h) Introduce disease that may cause the species to decline

No. There are no known diseases that are likely to introduced in *Tetratheca juncea* habitat as a result of the proposal, which might cause the species to decline.

(i) Interfere substantially with the recovery of the species

Due to impacts associated with the subject land being confined to a habitat in which the *Tetratheca juncea* was not observed, the proposed works would not interfere substantially with the recovery of the species.

Conclusion

No Tetratheca juncea clumps will be directly impacted by the proposal within the subject land. Twenty six clumps will be retained. Area of species polygon to be impacted is calculated as 0.15 ha compared to retention of 0.89 ha. This is not considered likely to impact the viability of the local population.

Genoplesium insigne (Variable Midge Orchid)

Genoplesium insigne is listed as Critically Endangered under the EPBC Act.

Occurs in southern Lake Macquarie and northern Central Coast LGAs. It's distribution is recorded as far as Cooranbong in the north, Warnervale in the south and Chain Valley in the east. Appears to be associated with Scribbly Gum (*Eucalyptus haemastoma*), Red Bloodwood (*Corymbia gummifera*) and *Angophora inopina* (not always present) in heathy woodland on lowlands of the Central Coast and variations containing *Angophora costata* (Smooth-barked Apple).

This species was not recorded within the study area during the survey program.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats

An action is likely to have a significant impact on a Critically Endangered species if there is a real chance or possibility that it will result in one or more of the following:

(a) Lead to a long-term decrease in the size of a population

Up to 0.98 ha of potential habitat would be affected by the proposed action. The subject land is not likely to be of high importance due to its relatively small area and the availability of greater quality habitat within the locality and wider region. Further, the study area does not occur within any key areas for the species.

The proposed action is not considered likely to significantly contribute to a long-term decline in the size of a population of this species.

(b) Reduce the area of occupancy of a species

The proposed action is likely to affect up to 0.98 ha of potential foraging habitat for this species. Although the proposed action would result in the loss of potential habitat, the incremental loss of potential habitat, only represents a small component of similar locally occurring resources accessible to this species. While the proposed action would remove up to 0.98 ha it is considered that the proposed action would not reduce the area of occupancy of this species given the better-quality habitat in the locality and greater region.

Nevertheless, the removal of up to 0.98 ha of potential habitat is considered to be an incremental loss of suitable habitat locally and as such has the potential to incrementally reduce the area of occupancy for the species.

(c) Fragment an existing important population into two or more populations

It is not considered likely that habitat would become further isolated or fragmented significantly beyond that currently existing in the subject land.

(d) Adversely affect habitat critical to the survival of a species

No critical habitat has been listed for this species to date.

Disrupt the breeding cycle of a population

The 0.98 ha of potential marginal quality habitat likely to be affected is representative of larger patches of locally occurring resources that would be likely for this species. Therefore, the removal of this potential habitat is unlikely to disrupt the breeding cycle of a population of this species.

(e) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The proposed action would disturb up to 0.98 ha of native vegetation considered to be potential habitat for this species. The removal of potential habitat is considered to be an incremental loss, decreasing the amount of suitable foraging habitat available locally. Given the marginal condition of habitat observed it is unlikely that the proposed action would modify, destroy, remove or isolate habitat for this species to the extent that is likely to cause the species to decline.

(f) Result in invasive species that are harmful to a Critically Endangered species becoming established in the species' habitat

It is not likely that invasive species (such as introduced predators) that are harmful to this species would become further established as a result of the proposed action.

(g) Introduce disease that may cause the species to decline

No. There are no known diseases that are likely to increase in the area as a result of the proposed action.

(h) Interfere substantially with the recovery of the species

It is unlikely that the impact of relatively small areas of marginal habitat would significantly exacerbate the recovery of the species and significantly impact this species.

Conclusion

The extent of native vegetation clearing and foraging habitat removal associated with the proposed action is considered to be small in terms of available habitat for the species within region and there is a general paucity of records for the species in the locality of the proposal. The proposed action is not considered to fragment any locally occurring populations, affect habitat critical to their survival, disrupt their breeding cycles, or interfere with the recovery of this species. The proposed action therefore, is considered to represent an incremental loss of available local habitat, although it is not considered likely to have a significant impact as it is unlikely to affect the long-term viability of the species.

Other EPBC Act vulnerable flora species

The following EPBC Act listed threatened flora species are all listed as Vulnerable under the EPBC Act.

- *Acacia bynoeana* (Bynoe's Wattle)
- *Caladenia tessellata* (Thick Lip Spider Orchid)
- *Diuris praecox* (Rough Double Tail)
- *Grevillea parviflora subsp. parviflora* (Small-flower Grevillea)
- *Rutidosis heterogama* (Heath Wrinklewort).

The flora species in this section have all been identified as having similar habitat potential within the subject land.

The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, 2013). Under the Act, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

Is this part of an important population?

It is unlikely that these species would form an important population and they have not been recorded during targeted surveys.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in one or more of the following:

(a) Lead to a long-term decrease in the size of an important population of a species

It is considered unlikely that proposal would lead to a decrease in the size of a population.

(b) Reduce the area of occupancy of an important population

It is considered unlikely that proposal would lead to a reductio in the area of occupancy of a population.

(c) Fragment an existing important population into two or more populations

It is predicted that the fragmentation and isolation impacts caused by the proposed action would unlikely be enough to prevent the breeding and dispersal of plant pollinators or the dispersal of plant propagules (i.e. seed or other vegetative reproductive material) between habitat patches.

The areas of potential habitat to be impacted upon for these species is likely to be highly modified as a result of past and current land uses. They are already affected by varying degrees of fragmentation (including other road, water and transmission infrastructure) within a highly modified mosaic landscape.

It is unknown whether the proposal would fragment an existing population into two or more population however it is considered unlikely given the study area is unlikely to contain preferred habitat for the species, potential habitats is already highly fragmented and the proposal being unlikely to disrupt pollination in the local populations if they are present. Removal of vegetation will not create a barrier to pollinators and will not fragment local populations if present.

It is considered unlikely that proposal would lead to the fragmentation of an important population.

(d) Adversely affect habitat critical to the survival of a species

No critical habitat is listed for these species is listed under the EPBC Act. Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment Water Heritage and the Arts, 2009).

If recorded the habitat may form habitat critical to the survival of a population although these species were not recorded during targeted surveys. It is considered unlikely however the proposal would impact on habitat critical to the survival of the species.

(e) Disrupt the breeding cycle of an important population

For threatened plants, effective pollination is important to maintain population viability. The separation of individual plants is a consideration when determining the local population and likelihood of cross pollination. The size and connection of habitat affects the ability of individual plants to disperse seed and genetic material, and also determines what constitutes a population and future viability.

These species are largely pollinated either by insects, mammals and birds, and seed dispersal is either limited or could occur across large landscape for those pollinated by mobile fauna species. Areas of unsuitable habitat for pollinators are likely to form an effective barrier for the transfer of pollen between habitat fragments, however due to the mobility of the species that pollinate these plants, populations within the locality are likely to be quite dispersed and widespread. Therefore, the proposed works are considered unlikely to impact these species such that a viable local or intermittent seasonal population would be placed at a significant risk of extinction.

(f) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

It is considered unlikely that proposal would lead to the modification, destruction, isolation or decrease the availability of quality of habitat to the extent that these species would decline.

(g) Result in invasive species that are harmful to a Vulnerable species becoming established in the species' habitat

The proposal has limited potential to spread weeds, through heavy machinery during and post construction works. Mitigation measures have been provided to minimise the likelihood of weed spread. It is not likely that invasive fauna species that are harmful to the species.

(h) Introduce disease that may cause the species to decline

There are two diseases that may impact these threatened flora species being Myrtle Rust and Phytophthora dieback. The proposal has potential to introduce these diseases however will implement mitigation measures such as hygiene and weed control measures to avoid potentially introducing or spreading the disease. It is unlikely that these species would be affected by the introduction of plant pathogens.

(i) Interfere substantially with the recovery of the species

No recovery plans have been developed for these species under the EPBC Act. The species Approved Conservation Advice however list priority and threat abatement actions to support these species. The proposal has potential to interfere with one of the actions listed for all specie being 'habitat loss, disturbance and modification'.

The proposal would not interfere with this action unless one of more of these species were recorded within the subject land. If recorded the proposal has potential to interfere with this action, the severity of which is unknown. Given the disturbed nature of potential habitat, results of surveys to date and preferred habitat is likely to be absent it is considered unlikely that the proposal would interfere with the recovery of the species.

Conclusion

It is considered unlikely that the proposal will have a significant impact on any of these species given their current known distribution, absence of preferred habitat and results of field surveys completed.

Swift Parrot and Regent Honeyeater

The Regent Honeyeater and Swift Parrot are listed as Critically Endangered under the EPBC Act.

These species have been assessed together, due to their shared dependence on the blossom resources of myrtaceous canopy trees and their nomadic habits to access those foraging resources, which occur widely along the boundaries of the subject land. The Swift Parrot, which only breeds in Tasmania, is only present on the mainland between April and September to seek nectar resources from winter flowering events. Preferred breeding habitat for the Regent Honeyeater does not occur within the subject land.

Neither of these species were recorded within the study area during the survey program.

The Swift Parrot breeds in Tasmania and there is no preferred breeding habitat present in the study area for the Regent Honeyeater and as such the proposed action would not impact breeding habitat for these two species. Further, important habitat mapped by DPE for the Regent Honeyeater has not been mapped within the study area nor would it be affected by the proposal.

Important Habitat is mapped within the biodiversity study for Swift Parrot. Impacts associated with the proposal are limited to potential foraging habitat that may be used by the species. The proposal will impact upon 0.27 ha of potential foraging habitat compared to retention of 2.08 ha. Note some of the impacted habitat is in fact a cleared unofficial car park on the north western corner of the Freemans Drive and Mandalong Rd intersection.

The information outlined in the following texts is written by a senior WSP ecologist, that has been instrumental in monitoring the movements of Regent Honeyeaters and Swift Parrots in the Morisset locality for more than 20 years in liaison with Birdlife Australia threatened bird species monitoring team personnel.

Both the Swift Parrot and Regent Honeyeater are known to periodically occur in the Morisset locality, but neither species are known to breed in the Morisset locality or reside permanently in the Morisset locality.

Swift Parrots only visit mainland Australia from Tasmania during the winter period from about April to October and there are no records of them breeding anywhere in mainland Australia. Regent Honeyeaters likely occur throughout the year in NSW, but due to their very low numbers and difficulty to track, there are still large gaps in knowledge pertaining to their seasonal movements and everchanging distributions.

In the wider regional contexts Regent Honeyeaters are known to breed on the western side of the Great Divide, within the Capertee locality, and in the coalfield forests near Kurri Kurri in the Lower Hunter Region.

Both species are highly nomadic due to their dependence on the ever-changing distribution of foraging resources throughout south-eastern Australia. Locally they are not recorded annually, with Regent Honeyeaters exhibiting a return rate in the vicinity of 4–5 years. Swift Parrots occur in the wider Lake Macquarie locality at higher return rates, but in varying numbers depending on how important local foraging resources might be considering other resources across their wintering range.

Both species visit the Morisset locality for foraging purposes, however those areas where they occur in Morisset are generally well known.

When present locally Regent Honeyeaters are known to use significant stands of Swamp Mahogany (Eucalyptus robusta) to the south of Morisset within the Morisset Hospital lands and Swamp Mahogany stands along Clacks Creek and its tributaries from the Showground, and Goodwin Oval to Stockton Creek. Locally Swift Parrots are also known to use the blossom of Forest Red Gum (Eucalyptus tereticornis) and they have been recorded in Blackbutt (E. pilularis) canopies, in Morisset and Cooranbong, presumably for lerp resources. Nevertheless, while their movements in some areas have been well documented, there are other areas occurring in the locality where survey is not possible due to private land ownership. Therefore, neither species can be entirely discounted from areas where known resources occur.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats

An action is likely to have a significant impact on a Critically Endangered species if there is a real chance or possibility that it will result in one or more of the following:

(i) Lead to a long-term decrease in the size of a population

Up to 0.98 ha of potential foraging habitat for the Regent Honeyeater and Swift Parrot would be affected by the proposed action. While habitat in the subject land has the potential to be used by these species, it is not likely to be of high importance due to its relatively small area and the availability of greater quality habitat within the locality and wider region. Further, the study area does not occur within any key or other known breeding areas for either species.

Any identified population of in the proposal locality would not be restricted to habitat within the subject land and due to the species' large home ranges and nomadic nature, similar foraging habitat can be accessed in the locality. Therefore, the proposed action is not considered likely to significantly contribute to a long-term decline in the size of a population of these species.

(j) Reduce the area of occupancy of a species

The proposed action is likely to affect up to 0.98 ha of potential foraging habitat for these species. Although the proposed action would result in the loss of potential foraging habitat, the incremental loss of potential habitat, only represents a small component of similar locally occurring resources accessible to this species. While the proposed action would remove up to 0.98 ha it is considered that the proposed action would not reduce the area of occupancy of these species given the better-quality habitat in the locality and greater region.

Nevertheless, the removal of up to 0.98 ha of potential habitat is considered to be an incremental loss of suitable habitat locally and as such has the potential to incrementally reduce the area of occupancy for the species during seasons when individuals of this species may be reliant on local resources.

(k) Fragment an existing important population into two or more populations

Habitat connectivity is not likely to be significantly affected by the proposed work, given that this species is highly mobile and nomadic, the proposed action would not present a significant barrier to these species. It is not considered likely that habitat would become further isolated or fragmented significantly beyond that currently existing in the subject land.

(l) Adversely affect habitat critical to the survival of a species

No critical habitat has been listed for the Regent Honeyeater or Swift Parrot to date.

As outlined in the National Recovery Plan Habitat critical to the survival of the Regent Honeyeater includes:

- any breeding or foraging areas where the species is likely to occur
- any newly discovered breeding or foraging locations.

The Regent Honeyeater, or important habitat for the species mapped by DPE, has not been recorded in association with the proposal. Although it appears that Regent Honeyeaters are usually associated with habitats to the west and south west of the proposal, it is likely that the species may use habitat resources in proximity to the proposal on at least a transient basis. As the species is not restricted to or reliant on habitat therein for foraging, it is unlikely that this proposed action would adversely affect habitat critical to the survival of this species.

The national recovery plan for the Swift Parrot identifies habitat critical to the survival of the Swift Parrot as 'areas of priority habitat for which the Swift Parrot has a level of site fidelity or possess phenological characteristics likely to be of importance to the Swift Parrot, or otherwise identified by the recovery team'. No critical habitat has been listed for the Swift Parrot to date. Important Habitat is mapped within the biodiversity study for Swift Parrot. Impacts associated with the proposal are limited to potential foraging habitat that may be used by the species. The proposal will impact upon 0.27 ha of potential foraging habitat compared to retention of 2.08 ha. Note some of the impacted habitat is in fact a cleared unofficial car park on the north western corner of the Freemans Drive and Mandalong Rd intersection.

Disrupt the breeding cycle of a population

Within the Regent Honeyeaters current distribution there are four known key breeding areas where the species is regularly recorded. These are the Bundarra-Barraba, Capertee Valley and Hunter Valley districts in New South Wales, and the Chiltern area in north-east Victoria. Meanwhile the Swift Parrot is only breeds in Tasmania, is only present on the mainland between April and September to seek nectar resources from winter flowering events.

The subject land does not occur within any known breeding areas for either of these species. Furthermore, this species are highly mobile and is known to disperse widely. The 0.98 ha of potential marginal quality habitat likely to be affected is representative of larger patches of locally occurring resources that would be accessible to this species. Therefore, the removal of this potential habitat is unlikely to disrupt the breeding cycle of a population of either species.

(m) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The proposed action would disturb up to 0.98 ha of native vegetation considered to be foraging habitat for these species. The removal of potential habitat is considered to be an incremental loss, decreasing the amount of suitable foraging habitat available locally. However, these species are likely to forage in the higher quality habitat within greater locality. Considering the mobile nature of these species, this action is unlikely to isolate the species habitat significantly. Given the marginal condition of habitat observed it is unlikely that the proposed action would modify, destroy, remove or isolate habitat for these species to the extent that is likely to cause the species to decline.

(n) Result in invasive species that are harmful to a Critically Endangered species becoming established in the species' habitat

It is not likely that invasive species (such as introduced predators) that are harmful to these species would become further established as a result of the proposed action.

(o) Introduce disease that may cause the species to decline

No. There are no known diseases that are likely to increase in the area as a result of the proposed action.

(p) Interfere substantially with the recovery of the species

For the Regent Honeyeater, the Action Plan for Australian Birds (Garnett and Crowley, 2000) addresses the need for further ecological research on the species and the conservation and protection of roosting habitat and identification of specific breeding requirements. Recovery strategies outlined in Regent Honeyeater Recovery Plan (Department of the Environment, 2016) include:

- improve the extent and quality of regent honeyeater habitat
- bolster the wild population with captive-bred birds until the wild population becomes self-sustaining
- increase understanding of the size, structure, trajectory and viability of the wild population
- maintain and increase community awareness, understanding and involvement in the recovery program.

The proposed action would be in conflict with the first objective above to a small extent, by not improving the extent of habitat for the Regent Honeyeater. It is unlikely that the impact of relatively small areas of marginal habitat would significantly exacerbate the recovery of the species and significantly impact this species.

The Action Plan for Australian Birds (Garnett and Crowley, 2000) notes pressure on Swift Parrot breeding areas from forestry and firewood collection in Tasmania. On the mainland though pressures relate to the loss of foraging habitats due to clearing for agriculture and residential development (Garnett and Crowley, 2000). A National Recovery Plan for the Swift Parrot *Lathamus discolor* was prepared in 2011 (Saunders, 2011). Recovery actions outlined in this plan include:

- identify the extent and quality of habitat
- manage and protect swift parrot habitat at the landscape scale
- monitor and manage the impact of collisions, competition and disease
- monitor population and habitat.

The proposed action would be in conflict with the second recovery action above, to manage and protect Swift Parrot habitat at the landscape scale. It is unlikely that the impact of relatively small areas of marginal habitat would significantly exacerbate the recovery of the species and significantly impact this species.

Conclusion

The Regent Honeyeater and Swift Parrot are known to occur intermittently in the wider Morisset locality of the subject land while suitable foraging resources are present. There are no records for either species associated with habitats within the subject land, although suitable habitat occurs to the north of the study area in Swamp Mahogany (*E. robusta*) stands along Mullards Creek and its feeder streams downstream of the subject land.

Swift Parrots do not breed in mainland Australia, breeding being limited to Tasmania. Regent Honeyeaters have not been recorded as breeding in the western Lake Macquarie hinterlands, including the Morisset locality.

The extent of native vegetation clearing and foraging habitat removal associated with the proposed action is considered to be small in terms of available habitat for the species within region and there is a general paucity of records for the species in the locality of the proposal. The irregular distribution of blossom resources, which is a key driver of nomadism of these species, may cause these species to occasionally forage within the subject land. Although it is considered unlikely that the loss of potential foraging habitat would cause the local extinction of either species, the removal of up to 0.98 ha of vegetation could be utilised by this species intermittently during periods of seasonal blossom variation. The proposed action is not considered to fragment any locally occurring populations, affect habitat critical to their survival, disrupt their breeding cycles, or interfere with the recovery of these species. The proposed action therefore, is considered to represent an incremental loss of available local habitat, although it is not considered likely to have a significant impact as it is unlikely to affect the long-term viability of the species.

Gang-Gang Cockatoo

The Glossy-Black Cockatoo is listed as Vulnerable under the EPBC Act.

The Gang-gang Cockatoo was not recorded within the study area however is considered to have a moderate likelihood of occurrence based on the habitats available. No breeding habitat was identified during targeted surveys for this species. Habitat for this species (0.98 ha respectively) is likely only to constitute potential foraging habitat for the species. This is largely based on associated vegetation types recorded within the study area, field surveys confirmed that there is limited foraging opportunities for this species available with this habitat

The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, 2013b). Under the Act, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

Is this part of an important population?

Survey did not record breeding onsite for this species, but the subject land represents potential foraging habitat for the Gang-gang Cockatoo. The study area does not occur at the limit of the species range, there is limited foraging habitat for the species present and is unlikely to be important in the maintenance of genetic material given their mobility, large distribution range and limited foraging habitat present. Therefore, a population of Gang-gang Cockatoos in the subject land is considered not likely to form part of an important population.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats —

An action is likely to have a significant impact on a Vulnerable species if there is a real chance or possibility that it will result in one or more of the following:

(a) Lead to a long-term decrease in the size of an important population of a species

Not applicable not an important population.

(b) Reduce the area of occupancy of an important population

Not applicable not an important population.

(c) Fragment an existing important population into two or more populations

Not applicable not an important population.

(d) Adversely affect habitat critical to the survival of a species

No critical habitat is listed for this species under the EPBC Act. Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment Water Heritage and the Arts, 2009).

The proposed works will remove 0.98 ha of native vegetation, which may represent potential marginal quality habitat for this species. As this species typically has a large home range, it is likely that suitable foraging resources could be accessed throughout the locality and beyond. Therefore, wooded habitat within the subject land would not meet the above criteria.

(e) Disrupt the breeding cycle of an important population

Not applicable not an important population.

(f) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The loss of 0.98 ha of wooded marginal quality habitat in the study area is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

(g) Result in invasive species that are harmful to a Vulnerable species becoming established in the species' habitat

Vertebrate pests and weeds are already established in the habitat. Adhering to mitigation measures such as weed management plans, and vehicle weed hygiene, would prevent further invasive weeds establishing in the study area. It is not likely that invasive species (such as introduced predators) that are harmful to the Gang-gang Cockatoo would become further established as a result of the proposed action.

(h) Introduce disease that may cause the species to decline

No. There are no known diseases that are likely to increase in the area as a result of the proposed action.

(i) Interfere substantially with the recovery of the species

There is no adopted or made Recovery Plan for this species. No key management sites are known to occur within the study area. Due to the limited marginal quality foraging habitat likely to be affect by the proposed works (0.98 ha) and as no breeding habitats are located in the vicinity of the study area, the proposed works may have a minor incremental impact however it is not considered likely to substantially interfere with the recovery of this species.

Conclusion

The extent of native vegetation clearing, and habitat removal associated with the proposed action is relatively small in terms of the available habitat for these species within the surrounding landscape. Although the loss of foraging habitat for Gang-gang Cockatoo is considered to be an incremental loss of suitable habitat locally, the proposed action is not likely to have a significant impact upon available resources for the species in the vicinity of the site or its wider locality and the habitat to be impacted is not considered important to the long-term survival of the species.

Glossy-Black Cockatoo

The Glossy-Black Cockatoo is listed as Vulnerable under the EPBC Act.

The Glossy-Black Cockatoo was not recorded within the study area however is considered to have a moderate likelihood of occurrence based on the habitats available. No breeding habitat was identified during targeted surveys for the Glossy-Black Cockatoo which is a dual species credit species under BAM. Habitat for this species (0.98 ha respectively) is likely only to constitute potential foraging habitat for the species. This is largely based on associated vegetation types recorded within the study area, field surveys confirmed that there is limited foraging opportunities for this species available with this habitat (i.e. largely absent but occasional sheoak individuals present).

The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, 2013b). Under the Act, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

Is this part of an important population?

The distribution of the Glossy-Black Cockatoo is widespread throughout suitable habitats that extend from Central Queensland to East Gippsland in Victoria. They inhabit open forests and woodlands of the coast and the Great Dividing Range where sheoak species occur which they almost exclusively feed off.

Survey did not record breeding onsite for this species, but the subject land represents potential foraging habitat for the Glossy-Black Cockatoo. The study area does not occur at the limit of the species range, there is limited foraging habitat for the species present (i.e. sheoak species that they upon) and is unlikely to be important in the maintenance of genetic material given their mobility, large distribution range and limited foraging habitat present. Therefore, a population of Glossy-Black Cockatoos in the subject land is considered not likely to form part of an important population.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats —

An action is likely to have a significant impact on a Vulnerable species if there is a real chance or possibility that it will result in one or more of the following:

(j) Lead to a long-term decrease in the size of an important population of a species

Not applicable not an important population.

(k) Reduce the area of occupancy of an important population

Not applicable not an important population.

(l) Fragment an existing important population into two or more populations

Not applicable not an important population.

(m) Adversely affect habitat critical to the survival of a species

No critical habitat is listed for this species under the EPBC Act. Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment Water Heritage and the Arts, 2009).

The proposed works will remove 0.98 ha of native vegetation, which may represent potential marginal quality habitat for this species. As this species typically has a large home range, it is likely that suitable foraging resources could be accessed throughout the locality and beyond. Therefore, wooded habitat within the subject land would not meet the above criteria.

(n) Disrupt the breeding cycle of an important population

Not applicable not an important population.

(o) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The loss of 0.98 ha of wooded marginal quality habitat in the study area is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

(p) Result in invasive species that are harmful to a Vulnerable species becoming established in the species' habitat

Vertebrate pests and weeds are already established in the habitat. Adhering to mitigation measures such as weed management plans, and vehicle weed hygiene, would prevent further invasive weeds establishing in the study area. It is not likely that invasive species (such as introduced predators) that are harmful to the Glossy-Black Cockatoo would become further established as a result of the proposed action.

(q) Introduce disease that may cause the species to decline

No. There are no known diseases that are likely to increase in the area as a result of the proposed action.

(r) Interfere substantially with the recovery of the species

There is no adopted or made Recovery Plan for this species. No key management sites are known to occur within the study area. Due to the limited marginal quality foraging habitat likely to be affect by the proposed works (0.98 ha) and as no breeding habitats are located in the vicinity of the study area, the proposed works may have a minor incremental impact however it is not considered likely to substantially interfere with the recovery of this species.

Conclusion

The extent of native vegetation clearing, and habitat removal associated with the proposed action is relatively small in terms of the available habitat for these species within the surrounding landscape. Although the loss of foraging habitat for Glossy-Black Cockatoo is considered to be an incremental loss of suitable habitat locally, the proposed action is not likely to have a significant impact upon available resources for the species in the vicinity of the site or its wider locality and the habitat to be impacted is not considered important to the long-term survival of the species.

Large-eared Pied Bat

The Large-eared Pied Bat is listed as Vulnerable under the EPBC Act.

It was not recorded during targeted surveys.

The proposal would impact up to 0.98 ha of native vegetation.

The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, 2013b). Under the Act, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

Is this part of an important population?

Large-eared Pied Bats occur across a range of wooded habitats in association with sandstone escarpments which contain their preferred cave roosting habitat sources. The subject land does not contain suitable habitat for roosting locations for Large-eared Pied bats with no significant escarpment habitats within its close vicinity. There are no areas in the vicinity of the subject land which are known locations for aggregations of this species, so local individuals are unlikely to be necessary for maintaining genetic diversity. Individual Large-eared Pied Bats occurring within the subject land are not at or near the limit of the species' range. Therefore, a population of Large-eared Pied Bat in the subject land is not considered to be important part of an important population.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats —

An action is likely to have a significant impact on a Vulnerable species if there is a real chance or possibility that it will result in one or more of the following:

(a) Lead to a long-term decrease in the size of an important population of a species

Not applicable not an important population.

(b) Reduce the area of occupancy of an important population

Not applicable not an important population.

(c) Fragment an existing important population into two or more populations

Not applicable not an important population.

(d) Adversely affect habitat critical to the survival of a species

No critical habitat is listed for this species under the EPBC Act. Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment Water Heritage and the Arts, 2009).

The proposed action would remove up to up to 0.98 ha of remnant vegetation that is likely to be in moderate condition, which represents foraging habitat for this species. This species is highly mobile, it is likely that suitable foraging resources could be accessed widely throughout the locality and beyond.

Therefore, foraging habitat impacted by the proposed action would not meet the above criteria as critical habitat.

(e) Disrupt the breeding cycle of an important population

Not applicable not an important population.

(f) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The foraging habitat for the Large-eared Pied Bat impacted by the proposed action occurs largely as modified woodland/forest. The habitat to be impacted represents a small proportion of available habitat locally. As such, the available or quality of habitat is unlikely to be impacted to the extent that the species is likely to decline.

(g) Result in invasive species that are harmful to a Vulnerable species becoming established in the species' habitat

It is not likely that invasive species (such as introduced predators) that are harmful to the Large-eared Pied Bat would become further established as a result of the proposal.

(h) Introduce disease that may cause the species to decline

No. There are no known diseases that are likely to increase in the area as a result of the proposed action.

(i) Interfere substantially with the recovery of the species

Due to disturbed nature and limited areas foraging habitat likely to be affect by the proposed action compared to that which occurs in the locality and surrounding landscape and absence of breeding habitat within or adjacent to the study area, the proposed action is not likely to interfere with the recovery of this species.

Conclusion

The Large-eared Pied Bat roosts in caves, crevices in cliffs, old mine workings and the disused, bottle-shaped mud nests of the Fairy Martin. The Large-eared Pied Bat frequents low to mid-elevation dry open forest and woodland close to these habitat features, and often occupy well-timbered areas containing gullies. Although the Large-eared Pied Bat has previously been recorded in the proposal locality, current records indicate this species dependence on habitat to the west of the subject land; specifically including the Watagan Mountains and associated topographical features that retain critical natural roosting and breeding structures and fertile gullies used for foraging.

A small amount of potentially suitable foraging habitat (0.98 ha) would be affected by the proposal, although this is unlikely to be significant to local populations, due to the abundance of similar and greater quality foraging habitat in the wider locality and the continued presence of similar foraging conditions around the subject land post-proposal. In addition, although roosting and breeding sites are known regionally, no such structures are likely to be impacted because of the proposal. Accordingly, the proposal is not likely to have a significant impact on an important population of large-eared Pied Bat.

Koala

The Koala is listed as Endangered under the EPBC Act.

Targeted surveys were completed to determine the presence and use of the habitats present within the study area (including SATs, spotlighting and opportunistic surveys). No signs of use such as scratches, scats, observations or vocalisations were recorded.

The proposal would impact upon 0.98 ha of forested habitats within the study area that form part of the species habitat.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats —

An action is likely to have a significant impact on an Endangered species if there is a real chance or possibility that it will result in one or more of the following:

(a) Lead to a long-term decrease in the size of a population

No evidence of this species occurrence was recorded and it is no likely that the proposal would lead to a long-term decrease in the size of a population.

(b) Reduce the area of occupancy of a species

The area of occupancy for Koala is estimated to be 19,400 km^2 . These figures are based on the mapping of point records from 2000 from state governments, museums and CSIRO. There is no real chance or possibility that the proposal will reduce the area of occupancy for Koala. The area of occupancy for this species is extensive.

(c) Fragment an existing important population into two or more populations

Despite the impact of 0.98 ha, associated remnant vegetation would be retained in the study area that would continue to provide linkages to surrounding habitat. THIs species was not recorded and the proposal is considered unlikely to significantly exacerbate existing levels of fragmentation.

(d) Adversely affect habitat critical to the survival of a species

The Conservation Advice for *Phascolarctos cinereus* (Koala) combined populations of Queensland, NSW and the Australian Capital Territory (Department of Agriculture Water and the Environment, 2022) outlines a number of important criteria to consider in terms of 'habitat critical for survival' of Koala including:

- whether the habitat is used during periods of stress (examples: flood, drought or fire)
- whether the habitat is used to meet essential life cycle requirements (examples: foraging, breeding, nesting, roosting, social behaviour patterns or seed dispersal processes)
- the extent to which the habitat is used by important populations
- whether the habitat is necessary to maintain genetic diversity and long-term evolutionary development
- whether the habitat is necessary for use as corridors to allow the species to move freely between sites used to meet essential life cycle requirements
- whether the habitat is necessary to ensure the long-term future of the species or ecological community through reintroduction or re-colonisation
- any other way in which habitat may be critical to the survival of a listed threatened species or a listed threatened ecological community.

The advice also outlines crucial habitat elements include patches and corridors for gene flow. Over longer-time frames habitat critical includes climate refugia such as drainage lines, riparian zones and patches that are resilient to drying conditions due to favourable hydrological systems. Additionally, it includes areas that may be temporarily unoccupied, because of seral (maturity or time) changes to habitat quality that arise through processes such as fire, drought, timber harvesting or disease (shifting habitat mosaic) or degradation and are available for future recolonisation.

It is considered unlikely that the habitat present forms critical habitat to the Koala. It provides largely foraging opportunities for the species which could be accessed widely throughout the locality and beyond.

(e) Disrupt the breeding cycle of a population

The biodiversity study area does not contain a resident source population of Koala and would provide habitat for a low-density population only that may utilise the site intermittingly for local dispersal movements. There is no known breeding population of Koala in the study area. As such, there is no real chance or possibility that the project will disrupt the breeding cycle of a population.

(f) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

There is no real chance or possibility that the proposal will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

(g) Result in invasive species that are harmful to an Endangered species becoming established in the species' habitat

The proposal is unlikely to result in an invasive species harmful to the Koala becoming established in the habitat. The potential for weed invasion was considered possible with a proposal of this nature and appropriate controls are required during construction and operation to reduce this threat. Invasive species would be managed under the construction environmental management plan using best practice methods. Consequently, there is no real chance or possibility that the proposal will result in invasive species that are harmful to Koala becoming established in the habitat.

(h) Introduce disease that may cause the species to decline

Chlamydia bacteria in Koalas and Koala Retrovirus are primarily transmitted between Koala individuals (Department of Environment & Climate Change, 2008). There are no known disease issues affecting this species in relation to the proposed action. The proposal would be unlikely to increase the potential for significant disease vectors to affect the species. It is the intention to use current best practice hygiene protocols as part of the construction environmental management plan to prevent the introduction or spread of pathogens. Consequently, there is no real chance or possibility that the proposal will introduce disease that may cause the species to decline.

(i) Interfere substantially with the recovery of the species

The National Recovery Plan for the Koala *Phascolarctos cinereus* (combined populations of Queensland, NSW and the Australian Capital Territory) (Department of Agriculture, 2022) outlines a number of key objectives for the recovery effort of the species including:

- the area of occupancy and estimated size of populations that are declining, suspected to be declining, or predicted to decline are instead stabilised then increased
- the area of occupancy and estimated size of populations that are suspected and predicted to be stable are maintained or increased
- metapopulation processes are maintained or improved
- partners, communities and individuals have a greater role and capability in listed Koala monitoring, conservation and management.

The objectives of this recovery plan are underpinned by four supporting strategies and two on-ground (direct) strategies, or action areas, as a way of organising and implementing coordinated action:

- build and share knowledge (Strategy 1)
- engage and partner with the community in listed Koala conservation (Strategy 2)
- increase the area of protected habitat for the listed Koala (Strategy 3)
- integrate listed Koala conservation into policy, statutory and land use plans (Strategy 4)
- strategically restore listed Koala habitat (Strategy 5)
- actively manage listed Koala metapopulations (Strategy 6).

The proposed action will not interfere with these objectives or supporting strategies.

Conclusion

Due to the above, the proposed action is not likely to result in a significant impact on the Koala.

Grey-headed Flying-fox

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

The Grey-headed Flying-fox has been assessed due to the species widespread occurrence locally, its high mobility and the occurrence of native tree species that are known to be used by this species for the purpose of foraging. Fauna habitat assessments undertaken assessed that the Grey-Headed Flying-fox was likely to occur intermittently within the subject land due to the existence of potential foraging habitat. The species was also recorded within the biodiversity study area. No roost camps for this species were located during surveys. The proposal will result in the removal of 0.98 ha of native vegetation, which provides potential foraging habitat for this species.

The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, 2013b). Under the Act, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

Is this part of an important population?

Grey-headed Flying-foxes occur across a range of wooded habitats where their favoured food, eucalypt blossom occurs. They set up roosting camps in association with blossom availability, which are usually situated in dense vegetation and associated with water. Grey-headed Flying-foxes can migrate up to 75 km north during the winter and during this time young flying-foxes establish camps.

The subject land and biodiversity study area does not contain suitable habitat for roosting camps and no significant roosting camps occur within its close vicinity. Therefore, a population of Grey-headed Flying-foxes in the subject land is not considered to be important, as no roost sites would be affected by the proposed action.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats —

An action is likely to have a significant impact on a Vulnerable species if there is a real chance or possibility that it will result in one or more of the following:

(a) Lead to a long-term decrease in the size of an important population of a species

Not applicable not an important population.

(b) Reduce the area of occupancy of an important population

Not applicable not an important population.

(c) Fragment an existing important population into two or more populations

Not applicable not an important population.

(d) Adversely affect habitat critical to the survival of a species

No critical habitat is listed for this species under the EPBC Act. Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment Water Heritage and the Arts, 2009).

The proposed action would remove 0.98 ha of habitat, which represents potential foraging habitat for this species. As this species is highly mobile, with individuals foraging up to 50 km from roost sites, it is likely that suitable foraging resources could be accessed widely throughout the locality and beyond. Therefore, this would not meet the above criteria.

(e) Disrupt the breeding cycle of an important population

Not applicable not an important population.

(f) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The proposed action would remove up to 0.98 ha of potential habitat for this species. It is not expected that the proposed action would significantly modify, destroy, remove, isolate or decrease the availability or quality of habitat for the Grey-headed Flying-fox to cause the species to decline. Although vegetation clearing would represent a loss within the area, it is not considered likely that the action would result in disturbance to the extent that the species would decline.

(g) Result in invasive species that are harmful to a Vulnerable species becoming established in the species' habitat

It is not likely that invasive species (such as introduced predators) that are harmful to the Grey-headed Flying-fox would become further established as a result of the proposed action.

(h) Introduce disease that may cause the species to decline

No. There are no known diseases that are likely to increase in the area as a result of the proposed action.

(i) Interfere substantially with the recovery of the species

Due to the small proportion of foraging habitat likely to be affect by the proposed action and as no roost camps are located in the vicinity of the subject, the proposed action is not likely to interfere with the recovery of this species.

Conclusion

The extent of native vegetation clearing and habitat removal associated with the proposed action proportionally small in terms of the available habitat for these species within the surrounding landscape. Although the loss of foraging habitat for Grey-headed Flying-fox is considered to be an incremental loss of suitable habitat locally, the proposed action is not likely to have a significant impact upon available resources for flying-foxes in the vicinity of the subject land or its wider locality and the habitat to be impacted is not considered important to the long-term survival of the Grey-headed Flying-fox.

Appendix F – Tree survey inventory

Table F-1 Trees likely to be removed

Tree number	Tree species	DBH (cm)	Height (m)	Comments	Latitude	Longitude
T004	*Callistemon citrinus*	10.5	2		-33.112	151.4816
T005	*Pandanus*	14.2	2.5		-33.112	151.4816
T009	*Pandanus*	8	3.5		-33.1121	151.4814
T010	*Callistemon citrinus*	16	6		-33.1121	151.4814
T012	*Brush Box*	19	7		-33.1121	151.4813
T017	*Brush Box*	17	7		-33.1122	151.481
T019	*Brush Box*	11	10		-33.1122	151.4809
T026	*Queensland Wattle*	9	2		-33.1123	151.4805
T027	*Callistemon citrinus*	15	6		-33.1123	151.4805
T034	*Brush Box*	16	6		-33.1124	151.4803
T043	*Acacia longifolia*	9	2		-33.1125	151.4797
T044	*Callistemon citrinus*	9	6		-33.1125	151.4797
T046	*Callistemon citrinus*	10	7		-33.1126	151.4796
T048	*Corymbia maculata*	10	15		-33.1126	151.4797
T049	*Corymbia maculata*	15	15		-33.1126	151.4797
T049	*Hakea dactyloides*	12	7		-33.1126	151.4797
T050	*Hakea dactyloides*	11	9		-33.1126	151.4796
T053	*Brush Box*	13	6		-33.1126	151.4795
T054	*Brush Box*	15	5		-33.1127	151.4794
T058	*Callistemon salignus*	18	12		-33.1128	151.4793
T059	*Brush Box*	14.5	8		-33.1127	151.4792
T068	*Callistemon salignus*	19	10		-33.1129	151.4787
T080	*Melaleuca nodosa*	18	7		-33.1148	151.4783
T081	*Melaleuca nodosa*	17	8		-33.1148	151.4783
T088	*Brush Box*	15	7		-33.112	151.4808
T089	*Ficus sp.*	15	9		-33.1121	151.4807
T098	Stag	15	6		-33.1122	151.4802
T104	*Allocasuarina torulosa*	12	4		-33.1123	151.4798
T113	*Melaleuca nodosa*	8	6		-33.1123	151.4798
T114	*Allocasuarina torulosa*	19	7		-33.1123	151.4798
T116	*Allocasuarina torulosa*	17	7		-33.1123	151.4798
T117	*Melaleuca nodosa*	10	8		-33.1123	151.4798
T126	*Melaleuca nodosa*	9	7		-33.1123	151.4797

Tree number	Tree species	DBH (cm)	Height (m)	Comments	Latitude	Longitude
T127	*Allocasuarina torulosa*	18	13		-33.1124	151.4798
T128	*Melaleuca nodosa*	10	5		-33.1123	151.4797
T130	*Melaleuca nodosa*	17	9		-33.1124	151.4798
T131	*Allocasuarina torulosa*	11	8		-33.1123	151.4797
T132	*Allocasuarina torulosa*	12	8		-33.1124	151.4797
T133	*Allocasuarina torulosa*	13	8		-33.1124	151.4797
T134	*Melaleuca nodosa*	19	10		-33.1124	151.4797
T135	*Melaleuca nodosa*	16	6		-33.1123	151.4797
T139	*Melaleuca nodosa*	18	7		-33.1123	151.4797
T160	*Grevillea robusta*	11	4		-33.1124	151.4787
T184	*Melaleuca nodosa*	10	5		-33.1136	151.4759
T186	*Melaleuca nodosa*	19	7		-33.1136	151.4759
T187	*Melaleuca nodosa*	6	6		-33.1136	151.4759
T188	*Melaleuca nodosa*	19	7		-33.1136	151.4759
T189	*Melaleuca nodosa*	5.5	3		-33.1136	151.4759
T190	*Melaleuca nodosa*	16	2.5		-33.1136	151.4759
T191	*Melaleuca nodosa*	10	6		-33.1136	151.4759
T193	*Melaleuca nodosa*	11	7		-33.1136	151.4759
T194	*Melaleuca nodosa*	5	6		-33.1136	151.4759
T195	*Melaleuca nodosa*	12	4		-33.1136	151.4759
T196	*Melaleuca nodosa*	15	8		-33.1136	151.4758
T197	*Melaleuca nodosa*	17	8		-33.1136	151.4758
T202	*Melaleuca nodosa*	6	5		-33.1136	151.4758
T203	*Melaleuca nodosa*	12	6		-33.1136	151.4758
T205	*Melaleuca nodosa*	15	8		-33.1136	151.4758
T206	*Melaleuca nodosa*	13	6		-33.1136	151.4758
T215	*Melaleuca nodosa*	13	7		-33.1136	151.4757
T217	*Melaleuca nodosa*	12	7		-33.1136	151.4757
T218	*Melaleuca nodosa*	13	8		-33.1136	151.4757
T229	*Casuarina glauca*	9	12	2 stems	-33.1137	151.4755
T231	*Casuarina glauca*	5.5	5	3 stems	-33.1137	151.4755
T232	*Casuarina glauca*	6	8		-33.1137	151.4755
T233	*Casuarina glauca*	6	8	4 stems	-33.1137	151.4754
T234	*Casuarina glauca*	9	9	2 stems	-33.1137	151.4755
T237	*Casuarina glauca*	12	9		-33.1137	151.4754
T238	*Casuarina glauca*	8	8		-33.1137	151.4754
T239	*Casuarina glauca*	13	8	9 stems	-33.1137	151.4754

Tree number	Tree species	DBH (cm)	Height (m)	Comments	Latitude	Longitude
T241	*Casuarina glauca*	12	9	3 stems	-33.1137	151.4754
T243	*Casuarina glauca*	8	2.5	2 stems	-33.1137	151.4753
T244	*Casuarina glauca*	8	6		-33.1137	151.4754
T246	*Casuarina glauca*	6	5		-33.1137	151.4753
T262	*Allocasuarina littoralis*	6	2.5		-33.1134	151.4764
T271	*Allocasuarina littoralis*	5.5	5		-33.1134	151.4764
T274	*Allocasuarina littoralis*	12	5.5	2 stems	-33.1134	151.4764
T295	*Melaleuca nodosa*	9	7.5		-33.1134	151.4766
T296	*Casuarina glauca*	19	9		-33.1132	151.4768
T297	*Casuarina glauca*	8	9		-33.1132	151.4768
T298	*Casuarina glauca*	11	9		-33.1132	151.4768
T300	*Casuarina glauca*	16	9		-33.1132	151.4768
T302	*Casuarina glauca*	17	9		-33.1132	151.4769
T312	*Casuarina glauca*	16	12		-33.1133	151.4774
T314	*Casuarina glauca*	19	11		-33.1134	151.4773
T323	*Casuarina glauca*	14	12		-33.1134	151.4772
T330	*Casuarina glauca*	19	14		-33.1134	151.4772
T332	*Casuarina glauca*	15	8		-33.1134	151.4772
T339	*Casuarina glauca*	16	14		-33.1134	151.4773
T342	*Eucalyptus robusta*	17	9		-33.1134	151.4771
T349	*Leptospermum polygalifolium*	15	5		-33.1134	151.477
T350	*Leptospermum polygalifolium*	13	4		-33.1135	151.477
T353	*Leptospermum polygalifolium*	16	6		-33.1135	151.4769
T358	*Leptospermum polygalifolium*	12	4.5		-33.1135	151.4769
T359	*Leptospermum polygalifolium*	10	4.5		-33.1135	151.4769
T361	*Leptospermum polygalifolium*	10	5		-33.1135	151.4769
T363	*Leptospermum polygalifolium*	12	5		-33.1135	151.4769
T365	*Leptospermum polygalifolium*	12	5		-33.1135	151.4768
T366	*Casuarina glauca*	11	9		-33.1135	151.4768
T368	*Casuarina glauca*	11	7		-33.1135	151.4768
T369	*Casuarina glauca*	10	9		-33.1135	151.4768
T372	*Casuarina glauca*	17	7.5		-33.1135	151.4768
T376	*Casuarina glauca*	18	18		-33.1136	151.4768
T379	*Leptospermum polygalifolium*	12	3		-33.1135	151.4767
T380	*Eucalyptus robusta*	18	10		-33.1136	151.4767
T382	*Banksia spinulosa*	14	3.5		-33.1135	151.4767
T383	*Casuarina glauca*	12	12		-33.1136	151.4767

Tree number	Tree species	DBH (cm)	Height (m)	Comments	Latitude	Longitude
T386	*Eucalyptus robusta*	12	13		-33.1136	151.4767
T387	*Casuarina glauca*	10	11		-33.1136	151.4767
T388	*Leptospermum polygalifolium*	12	3.4		-33.1136	151.4766
T390	*Leptospermum polygalifolium*	11	7.5		-33.1136	151.4767
T391	*Leptospermum polygalifolium*	10	2.5		-33.1136	151.4767
T397	*Eucalyptus robusta*	18	6		-33.1136	151.4766
T400	*Casuarina glauca*	13	7.5		-33.1136	151.4765
T402	*Leptospermum polygalifolium*	19	6		-33.1136	151.4766
T403	*Casuarina glauca*	14	15		-33.1136	151.4766
T405	*Eucalyptus robusta*	11	8		-33.1137	151.4765
T407	*Casuarina glauca*	14	10		-33.1136	151.4765
T408	*Casuarina glauca*	13	8		-33.1136	151.4765
T409	*Melaleuca nodosa*	17	4		-33.1136	151.4764
T410	*Leptospermum polygalifolium*	12	4		-33.1135	151.4765
T438	*Eucalyptus robusta*	15	18		-33.1137	151.475
T439	*Allocasuarina torulosa*	9	18		-33.1137	151.475
T442	*Allocasuarina torulosa*	7	5		-33.1138	151.475
T454	*Allocasuarina torulosa*	8	6		-33.1138	151.4749
T459	*Allocasuarina torulosa*	8	11		-33.1138	151.4749
T461	*Allocasuarina torulosa*	10	3		-33.1138	151.4748
T462	*Allocasuarina torulosa*	8	5		-33.1138	151.4748
T464	*Allocasuarina torulosa*	10	5		-33.1138	151.4748
T465	*Allocasuarina torulosa*	15	7		-33.1138	151.4748
T466	*Allocasuarina torulosa*	10	15		-33.1138	151.4748
T467	*Allocasuarina torulosa*	12	12		-33.1138	151.4748
T470	*Melaleuca nodosa*	13	2		-33.1139	151.4748
T473	*Melaleuca nodosa*	12	3		-33.1139	151.4748
T477	*Melaleuca nodosa*	14	6		-33.1141	151.4746
T478	*Melaleuca nodosa*	8	2		-33.1139	151.4747
T479	*Eucalyptus tereticornis*	15	7		-33.1139	151.4746
T480	*Eucalyptus tereticornis*	8	9		-33.1139	151.4746
T481	*Eucalyptus tereticornis*	11	4		-33.1139	151.4746
T482	*Allocasuarina torulosa*	13	13		-33.114	151.4746
T484	*Eucalyptus tereticornis*	9	20		-33.1139	151.4746
T485	*Eucalyptus robusta*	15	13		-33.114	151.4746
T488	*Eucalyptus tereticornis*	10	10		-33.114	151.4746
T497	*Casuarina glauca*	19	11		-33.1137	151.4765

Tree number	Tree species	DBH (cm)	Height (m)	Comments	Latitude	Longitude
T500	*Glochidion ferdinandi*	7	4		-33.1137	151.4765
T502	*Glochidion ferdinandi*	8	4.5		-33.1137	151.4765
T504	*Acacia fimbriata*	7	3		-33.1136	151.4764
T505	*Corymbia gummifera*	13	3.5		-33.1136	151.4764
T507	*Acacia fimbriata*	15	3.5		-33.1136	151.4764
T508	*Casuarina glauca*	13		4	-33.1136	151.4764
T510	*Melaleuca nodosa*	12	5		-33.1137	151.4764
T512	*Melaleuca nodosa*	12	4.5		-33.1137	151.4764
T513	*Leptospermum polygalifolium*	16	6		-33.1137	151.4764
T516	*Leptospermum polygalifolium*	13	4		-33.1137	151.4763
T517	*Casuarina glauca*	6	8		-33.1137	151.4763
T518	*Leptospermum polygalifolium*	16	5		-33.1137	151.4763
T519	*Eucalyptus robusta*	5.5	2.5		-33.1136	151.4763
T520	*Casuarina glauca*	10	6		-33.1137	151.4763
T521	*Casuarina glauca*	8	8.5		-33.1137	151.4763
T523	*Leptospermum polygalifolium*	19	4.5		-33.1137	151.4763
T524	*Melaleuca nodosa*	13	5		-33.1137	151.4763
T526	*Casuarina glauca*	12	12		-33.1137	151.4764
T527	*Casuarina glauca*	11	13		-33.1137	151.4763
T528	*Araucaria bidwillii*	8	4		-33.1137	151.4763
T530	*Allocasuarina torulosa*	11	9		-33.1137	151.4762
T534	*Allocasuarina torulosa*	16	9		-33.1137	151.4762
T535	*Eucalyptus robusta*	12	6		-33.1136	151.4763
T536	*Leptospermum polygalifolium*	18	3.5		-33.1136	151.4762
T537	*Casuarina glauca*	17	6		-33.1137	151.4762
T540	*Casuarina glauca*	13	12		-33.1137	151.4762
T542	*Casuarina glauca*	11	14		-33.1138	151.4762
T543	*Casuarina glauca*	8	9.5		-33.1138	151.4762
T544	*Casuarina glauca*	11	13		-33.1138	151.4762
T545	*Glochidion ferdinandi*	5	2.5		-33.1138	151.4762
T547	*Glochidion ferdinandi*	5	3		-33.1138	151.4762
T548	*Corymbia gummifera*	19	11		-33.1137	151.4762
T549	*Leptospermum polygalifolium*	18	6		-33.1137	151.4762
T550	*Leptospermum polygalifolium*	12	4.5		-33.1137	151.4762
T551	*Leptospermum polygalifolium*	14	4		-33.1137	151.4762
T553	*Casuarina glauca*	14	7.5		-33.1137	151.4761
T554	*Eucalyptus robusta*	16	10		-33.1137	151.4761

Tree number	Tree species	DBH (cm)	Height (m)	Comments	Latitude	Longitude
T558	*Leptospermum polygalifolium*	11	5		-33.1138	151.4761
T561	*Leptospermum sp. spider*	7	3.5		-33.1137	151.4761
T565	*Casuarina glauca*	6	7		-33.1138	151.4761
T568	*Eucalyptus robusta*	10	12		-33.1138	151.4761
T571	*Leptospermum polygalifolium*	8	5		-33.1138	151.4761
T572	*Leptospermum polygalifolium*	16	4		-33.1138	151.476
T577	*Leptospermum polygalifolium*	9	3.5		-33.1138	151.476
T578	*Casuarina glauca*	14	13		-33.1138	151.476
T579	*Leptospermum polygalifolium*	15	5		-33.1138	151.4759
T580	*Casuarina glauca*	16	14		-33.1138	151.4759
T581	*Corymbia gummifera*	12	5.5		-33.1138	151.4759
T583	*Glochidion ferdinandi*	7	3		-33.1138	151.4759
T584	*Casuarina glauca*	12	11		-33.1138	151.4759
T585	*Leptospermum polygalifolium*	10	3.5		-33.1139	151.4759
T588	*Casuarina glauca*	13	9		-33.1139	151.4758
T595	*Leptospermum polygalifolium*	16			-33.1139	151.4757
T601	*Eucalyptus robusta*	9	5.5		-33.1142	151.4741
T604	*Cinnamomum camphora*	18	5		-33.1142	151.4739
T606	*Cinnamomum camphora*	10	4.5		-33.1142	151.4739
T606	*Cinnamomum camphora*	15	7		-33.1142	151.4739
T611	*Pittosporum undulatum*	13	6		-33.1143	151.4737
T613	*Cinnamomum camphora*	10	3		-33.1143	151.4737
T616	*Cinnamomum camphora*	10	3.5		-33.1143	151.4737
T629	*Cupressus lusitanica*	12	10		-33.1147	151.4725
T631	*Cupressus lusitanica*	18	13		-33.1148	151.4724
T636	*Cupressus lusitanica*	12	8		-33.1148	151.4724
T638	*Cupressus lusitanica*	14	14		-33.1148	151.4724
T640	*Cupressus lusitanica*	10	10		-33.1148	151.4724
T642	*Cupressus lusitanica*	15	9		-33.1148	151.4724
T643	*Cupressus lusitanica*	9	8		-33.1148	151.4723
T644	*Cupressus lusitanica*	12	10		-33.1148	151.4724
T645	*Pinus radiates*	12	14		-33.1148	151.4723
T646	*Pinus radiata*	19	14		-33.1148	151.4723
T647	*Pinus radiata*	6	7		-33.1148	151.4723
T648	*Cupressus lusitanica*	14	13		-33.1148	151.4724
T649	*Pinus radiata*	6	6		-33.1148	151.4723
T651	*Cupressus lusitanica*	15	7		-33.1148	151.4723

Tree number	Tree species	DBH (cm)	Height (m)	Comments	Latitude	Longitude
T652	*Pinus radiata*	11	9		-33.1148	151.4724
T653	*Pinus radiata*	13	8		-33.1148	151.4723
T654	*Pinus radiata*	11	8		-33.1148	151.4724
T655	*Allocasuarina littoralis*	13	7		-33.1148	151.4723
T657	*Cupressus lusitanica*	13	4.5		-33.1148	151.4723
T658	*Pinus radiata*	5	4		-33.1148	151.4723
T659	*Cupressus lusitanica*	18	14		-33.1148	151.4723
T660	*Cupressus lusitanica*	9	4.5		-33.1148	151.4723
T662	*Cupressus lusitanica*	15	12		-33.1148	151.4722
T663	*Pinus radiata*	15	13		-33.1148	151.4723
T664	*Pinus radiata*	12	12		-33.1148	151.4723
T665	*Pinus radiata*	17	14	3 stems	-33.1148	151.4722
T666	*Pinus radiata*	16	13		-33.1148	151.4723
T667	*Pinus radiata*	13	12.5		-33.1148	151.4723
T668	*Pinus radiata*	19	14		-33.1148	151.4723
T669	*Cupressus lusitanica*	13	11		-33.1148	151.4723
T671	*Cupressus lusitanica*	13	9		-33.1148	151.4723
T672	*Cupressus lusitanica*	10	12		-33.1149	151.4723
T674	*Pinus radiata*	10	11		-33.1148	151.4722
T675	*Pinus radiata*	6	8		-33.1148	151.4723
T676	*Pinus radiata*	7	11		-33.1148	151.4722
T677	*Pinus radiata*	10	12		-33.1148	151.4722
T678	*Pinus radiata*	17	14		-33.1148	151.4722
T679	*Pinus radiata*	6	4.5		-33.1148	151.4722
T680	*Pinus radiata*	12			-33.1148	151.4722
T681	*Pinus radiata*	6	8		-33.1148	151.4722
T682	*Pinus radiata*	11	12		-33.1148	151.4721
T683	*Pinus radiata*	17	14		-33.1148	151.4722
T684	*Pinus radiata*	12	12	3 stems	-33.1149	151.4722
T685	*Pinus radiata*	16	14		-33.1149	151.4722
T687	*Pinus radiata*	7	7		-33.1149	151.4721
T690	*Pinus radiata*	10	9		-33.1149	151.4721
T691	*Pinus radiata*	19	14		-33.1149	151.4721
T694	*Acacia parvipinnula*	19	9		-33.1149	151.4721
T695	*Pinus radiata*	15	12		-33.1149	151.472
T696	*Pinus radiata*	16	13		-33.1149	151.472
T705	*Melaleuca nodosa*	7	5		-33.1155	151.4703
T706	*Melaleuca nodosa*	14	4		-33.1155	151.4703

Hollow bearing tree data

Table F-2 Inventory of hollow bearing trees

Tree ID	Tree species	DBH (cm)	Height (m)	Hollow stem classes								General comments
				<5 cm (trunk)	<5 cm (limb)	6-15 cm (trunk)	6-15 cm (limb)	16-25 cm (trunk)	16-25 cm (limb)	>25 cm (trunk)	>25 cm (limb)	
B	*Eucalyptus haemastoma*	80	18		2	1			1			Bats, birds and Arboreal mammal
C	*Eucalyptus haemastoma*	65	17		1							Bat possibilities
D	*Eucalyptus capitella*	91	16				1					Possible Glider roosting and breeding Bats and Arboreal mammal
E	*Corymbia gummifera*	30	8				1					Fallen limb in fork of tree Bats and Arboreal mammal.
F	*Corymbia gummifera*	70	18			1						Bats and Arboreal mammal
G	*Eucalyptus capitellata*	100	18		1							Bat possibilities
H	*Eucalyptus haemastoma*	85	17		3		1					Bats and Arboreal mammal
I	*Eucalyptus haemastoma*	50	15			1						Bats and Arboreal mammal.
J	*Eucalyptus haemastoma*	90	18		5		2					Bats and Arboreal mammal
K	*Eucalyptus haemastoma*	55	19	1	1							Bat possibilities
L	Dead Stag	50	15			1						Fissures present Bats and Arboreal mammal
M	*Eucalyptus haemastoma*	50	19		2	1						Bats and Arboreal mammal

Tree ID	Tree species	DBH (cm)	Height (m)	Hollow stem classes								General comments
				<5 cm (trunk)	<5 cm (limb)	6-15 cm (trunk)	6-15 cm (limb)	16-25 cm (trunk)	16-25 cm (limb)	>25 cm (trunk)	>25 cm (limb)	
N	*Corymbia gummifera*	100	19		1		1					Bats and Arboreal mammal
O	*Eucalyptus haemastoma*	110	17	3		1						Bats and Arboreal mammal.
P	Dead Stag	60	18	1		1						Fissures present Bats and Arboreal mammal
Q	*Eucalyptus robusta*	130	18	1	1							Bat possibilities
R	*Eucalyptus haemastoma*	70	18	1	1							Bat possibilities
S	*Eucalyptus haemastoma*	95	16	1	2							Bat possibilities
T	*Eucalyptus haemastoma*	65	16		1							Bat possibilities

NSW GOVERNMENT