

# Biodiversity assessment report for REF

Pacific Highway / Harrington Road  
and Cooperook Road Interchange  
Upgrade

August 2023



*Photo by Grant Bennett*

## Document details

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## Executive summary

The project is for the upgrade of the Harrington Road and Cooperook Road intersections with the Pacific Highway. This upgrade will establish a vehicle bridge which overpasses the Pacific Highway and directly connects Harrington Road and Cooperook Road. A total area of 15.92 hectares is proposed to be impacted by the proposal with 4.19 hectares of this containing native vegetation.

The project has been assessed as a Part 5 development under the *Environmental Planning & Assessment Act 1979*, in accordance with the *Biodiversity Conservation Act 2016*, Biodiversity Conservation Regulation 2017, *Environment Protection and Biodiversity Conservation Act 1999* - Matters of National Environmental Significance, *Fisheries Management Act 1994* and State Environmental Planning Policies (Resilience and Hazards 2021; Biodiversity and Conservation 2021). This report has additionally been formulated in accordance with relevant Transport for NSW guidelines.

### Survey methods

Site surveys were carried out over the study area in September 2022 and February 2023. These surveys identified the vegetation communities within the study area and ancillary areas, recorded all species within or utilising the study area (at the time of survey) and assessed the site habitats for potential use by threatened fauna species. A desktop assessment of relevant literature and databases was also conducted.

### Site vegetation

Field surveys identified three native vegetation communities within the study area, all of which occur within the construction footprint and ancillary areas. These comprise a Swamp Oak swamp forest, estuarine reedland and Typha rushland community, all of which conform to a *Biodiversity Conservation Act 2016* (BC Act) listed Threatened Ecological Community. Threatened Ecological Communities (TEC) identified within the study area comprise *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* and *Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*, both of which are listed as Endangered under the BC Act.

In addition to these, one vegetation community within the study area is also commensurate with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed TEC *Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community*. This TEC is listed as Endangered under the EPBC Act.

In addition to these native vegetation communities, four non-native vegetation communities comprising a mix of roadside weeds, exotic grassland and ornamental plantings, and managed lawn were recorded within the study area.

Field assessments did not identify any threatened flora species within the study area however one species, the Grey Mangrove (*Avicennia marina*), was recorded in the southern portion of the study area. This species is classified as Marine Vegetation under the *Fisheries Management Act 1994*, and the locations of each tree are not within the proposed construction footprint and ancillary areas.

### Site fauna

A range of fauna species were recorded utilising the study area or immediate surrounds, during the field assessments. Fauna species largely comprised common woodland and wetland birds however amphibians, reptiles and a fish species were also recorded. Field surveys did not identify any threatened fauna species within the study area however numerous species were identified as having at least a moderate to high chance of occurring within the study area.

### Impact of the Project

The project will require removal of native vegetation and species habitat in the construction footprint and ancillary areas. A total of 4.19 hectares of native vegetation is required to be removed for the project, all of which comprises the outer limits of a BC Act and/or EPBC Act TEC. Significance assessments have determined that the extent of vegetation removal is unlikely to place these TECs at risk of extinction.

The project does not require the removal of any Koala food trees although up to three Koala food trees may require branch trimming. No hollow-bearing trees require removal; however, marginal foraging habitat for a number threatened/migratory species may be indirectly impacted. Assessments of significance for these species have concluded that the impact from the proposal is unlikely to place these species at risk of extinction.

**Impact avoidance and minimisation**

Due to the nature of the project, there is limited scope for avoiding environmental impacts. Minimisation of the impacts of the project can be achieved through the implementation of mitigation measures outlined in this report. Mitigation measures include tree replacements, pre-clearing surveys, TEC exclusion zones and sedimentation and erosion control.

# 1. Introduction

## 1.1 Project background

Transport for NSW previously prepared a draft Pacific Highway Post Duplication Strategy to investigate the current performance of the highway and identify any safety issues at the remaining “at-grade intersections”. One such issue identified was the increased flow of traffic on the Pacific Highway and the requirement for local traffic travelling between the towns of Harrington and Coopernook to enter and exit the highway at staggered intersections. This current layout requires local traffic to complete a weaving manoeuvre across the high-speed Pacific Highway and has consequently been a contributing factor for multiple high-severity crashes at the site.

Transport for NSW is now proposing to upgrade these intersections so as to remove the requirement for local traffic to enter the highway, increasing safety at the interchange and enhancing connectivity between the Harrington and Coopernook townships.

For the purposes of this report, the study area encompasses the Harrington Road and Coopernook Road intersections with the Pacific Highway, approximately 12 kilometres north of the Princess Street, Cundletown and Taree interchange. It is located within the MidCoast Council Local Government Area (LGA). The location of the study area is mapped in Figure 1-1.

The entirety of the study area is situated on the Department of the Environment and Energy (DEE) Interim Biogeographic Regionalisation for Australia (IBRA) bioregion, *NSW North Coast* and the *Macleay Hastings* subregion (Department of the Environment and Energy 2016a and 2016b). The extent of the study area is also mapped as the NSW Landscape (formally Mitchell Landscape) *Manning- Macleay Coastal Alluvial Plains* (Department of Planning, Industry and Environment 2017) which is characterised by “wide valleys, channels, floodplains, swamps and terraces of the Manning and Macleay rivers and other coastal streams” (Department of Environment and Climate Change 2002).

The study area is located directly north of the Francis Longwirth Bridge which overpasses the Lansdowne River. This river flows into the Manning River, approximately 2.45 kilometres downstream of the bridge. An unnamed, non-perennial watercourse is also located in the north of the study area with direct flows to Coopernook Creek, whereby it joins the Lansdowne River approximately 920 metres upstream of the Francis Longwirth Bridge. The location of watercourses in relation to the study area is mapped in Figure 1-2.

## 1.2 The Proposed Activity

The project is for the upgrade of the Harrington Road and Coopernook Road intersections with the Pacific Highway. This upgrade proposes to establish a vehicle bridge which overpasses the Pacific Highway and directly connects Harrington Road and Coopernook Road. The bridge will accommodate a two-way road with roundabouts at each end connecting the overpass to each highway on/off-ramp and either Harrington Road or Coopernook Road. This design will allow the retention of the existing on/off ramps to the highway and further add a connection between Harrington Road and Coopernook Road which bypasses the entrance to the highway. The concept plan is displayed in Figure 1-3.

Concept plans for the project indicate that the new overpass will span approximately 470 metres between each roundabout. The establishment of this will also require the placement of new road signs along each road and the establishment of ancillary facilities. Three ancillary facilities have been proposed with one of these within the nominated study area, another located approximately 1.4 kilometres north of the proposed overpass and the remaining ancillary area located approximately 400 metres west. It is unknown whether all three ancillary facilities will be required to be used, however, for the purpose of this report, all three have been assessed.

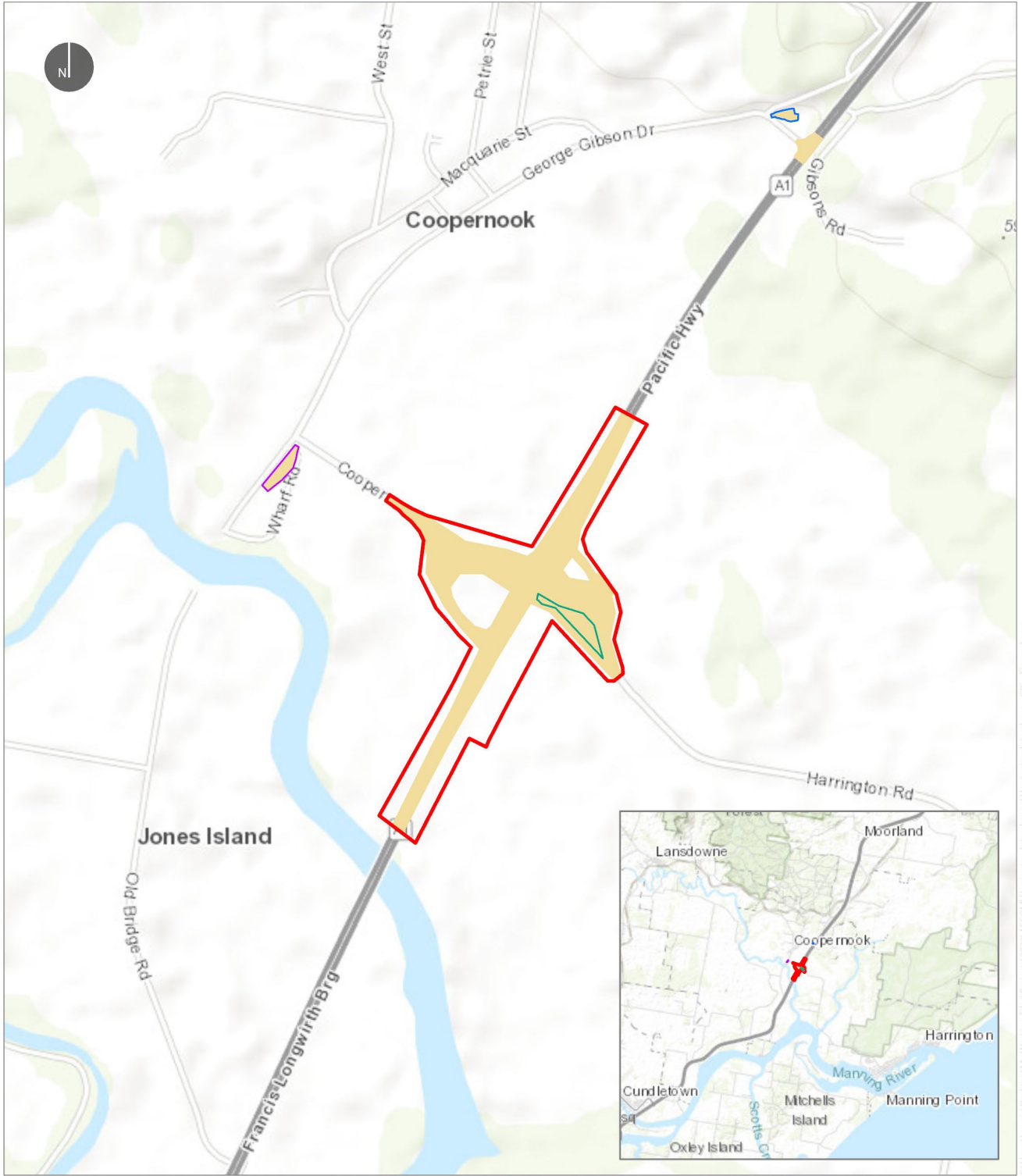
The development of all required infrastructure will see direct impacts to approximately 15.92 hectares of land, of which currently contains a mix of road infrastructure, bare ground and vegetation. The extent of native vegetation removal for the project is 4.19 hectares with a total of 12.79 hectares of native vegetation within the study area.

### 1.2.1 Assessment areas

The following provides a definition of the areas of the proposal referenced in this report:

- Construction footprint - defined as the area that will be directly impacted by construction works for the project. This includes the two new roundabouts, the new roads connecting these to the overpass, the widening of the Harrington Road or Coopernook Road intersections with the Pacific Highway, the alteration of the George Gibson Drive and Pacific Highway intersection, the road edges where new road signs are to be placed and the ancillary facilities. The construction footprint encompasses an area of approximately 15.92 hectares.

- Ancillary areas - defined as the areas that may be directly impacted by ancillary facilities for the project. This encompasses the areas named George Gibson North, George Gibson South Expanded and Old Harrington Road. The ancillary areas cover an additional area of 1.18 hectares.
- Study area – defined as the land surrounding the construction footprint which may be affected by indirect impacts and is subject to biodiversity surveys. The study area covers a total area of 26.20 hectares.
- Assessment area – includes the study area and the area of land within a 1500 metre buffer of the study area.



Data Sources: Wolfpeak 2021, Nearmaps 2022 Esri, © OpenStreetMap contributors, HERE, Garmin, USGS, METI/ NASA, Esri, © OpenStreetMap contributors, HERE, Garmin, USGS, NGA

**Legend**

- Study area
- Construction footprint
- George Gibson North Ancillary
- George Gibson South Expanded Ancillary
- Old Harrington Road Ancillary

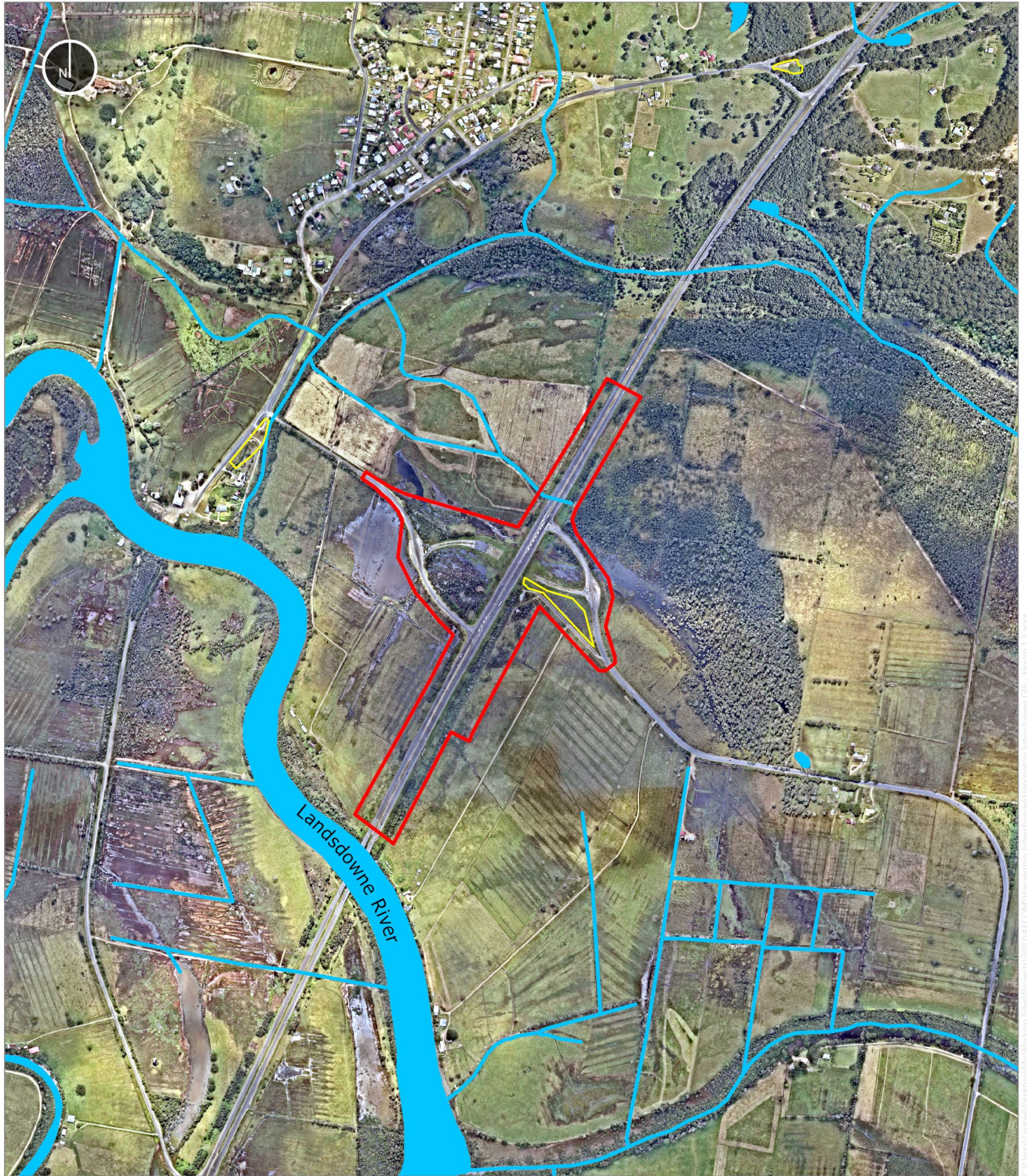


Figure 1-1: Proposal context

**Figure 1-1** | Location of the study area

**AECOM | Transport for NSW**  
Pacific Highway / Harrington Road and  
Coopers Creek Road Interchange Upgrade





Data Sources: Wolfpeak 2021, Nearmaps 2022



- Legend**
- Study area
  - Ancillary facilities
  - Watercourses

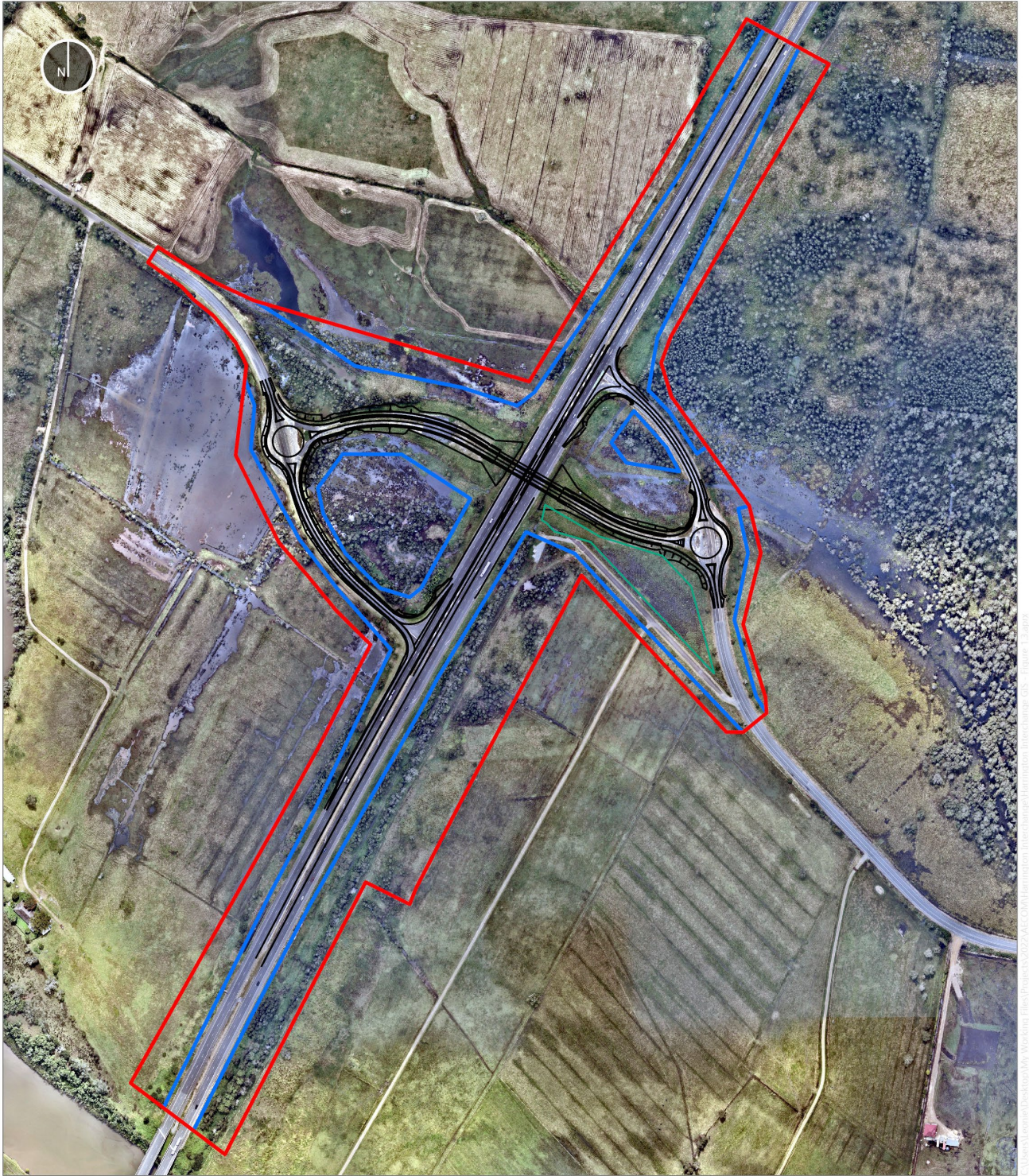


**Figure 1-2** | Watercourses near the study area

**AECOM | Transport for NSW**  
Pacific Highway / Harrington Road and  
Cooperook Road Interchange Upgrade

Figure 1-2: Watercourses





Data Sources: Wolfpeak 2021, Nearmaps 2022

0 37.5 75 150 225 300 Meters  
GDA2020 MGA Zone 56 1:5,500@A4

- Legend**
- Study area
  - Construction footprint
  - Old Harrington Road Ancillary
  - Construction design



Figure 1-3: The proposal

**Figure 1-3** | The proposal

**AECOM | Transport for NSW**  
Pacific Highway / Harrington Road and Coopernook Road Interchange Upgrade



### 1.3 Legislative Context

A Review of Environmental Factors (REF) is being prepared to satisfy Transport for NSW (TfNSW) duties under s.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 s.5.5 in making decisions on the likely significance of any environmental impacts. This biodiversity impact assessment forms part of the REF being prepared for the Pacific Highway / Harrington Road and Cooperook Road Interchange 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 is assessed using the test listed in Section 7.3 of the BC Act. Similarly, Part 7A of the *Fisheries Management Act 1994* (FM Act) requires that significance assessments are undertaken in accordance with Division 12 of the FM Act. Where a significant impact is likely to occur, a species impact statement (SIS) must be prepared in accordance with the Environment Agency Head’s requirements, 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 TfNSW 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, TfNSW road proposals 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 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 Biodiversity Assessment Method (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

### 2.1 Personnel

The following table outlines the roles and qualifications of staff members involved in the development of this report.

Table 2-1: Personnel

Name	Role	Qualifications
Leonie Stevenson	Report author Field surveys	BAM Accredited Assessor Bachelor of Science
Will Steggall	Vegetation surveys Report reviewer	BAM Accredited Assessor Bachelor of Environmental Science and Management
Antony von Chrismar	Vegetation surveys	BAM Accredited Assessor Bachelor of Applied Science Masters of Scientific Research - Environmental Resource Management
Grant Bennett	Field surveys	Bachelor of Applied Science (Parks, Recreation and Heritage)

### 2.2 Background research

The following databases and information sources were reviewed for the development of this report:

- BAM calculator (BAM-C).
- BioNet - the website for the Atlas of NSW Wildlife and Threatened Biodiversity Data Collection (TBDC) – downloaded 07/09/2022.
- BioNet Vegetation Classification database – reviewed 12/09/2022.
- Coastal management areas identified by the Resilience and Hazards SEPP 2022.
- Commonwealth Atlas of Groundwater Dependent Ecosystems (GDE) – viewed 07/09/2022.
- Core Koala Habitat identified by the Biodiversity and Conservation SEPP 2022.
- Department of Climate Change, Energy, the Environment and Water (DCCEEW) Protected Matters Search Tool – searched 06/07/2022.
- DCCEEW Species Profile and Threats Database – viewed 07/09/2022.
- Department of Planning, Industry and Environment Fauna Corridors for North East NSW – downloaded 24/02/2022.
- Department of the Environment and Energy IBRA Regions digital data layer – downloaded 02/06/2021.
- Department of the Environment and Energy IBRA Subregions digital data layer – downloaded 02/06/2021.
- National Flying-fox monitoring viewer (environment.gov.au) - viewed 14/09/2022.
- NSW DPI Fisheries Spatial Data Portal - viewed 07/09/2022.
- NSW Landscapes digital data layer– downloaded 24/02/2022.
- NSW State Vegetation Type Map – downloaded 29/08/2022.
- NSW Threatened Species Scientific Committee preliminary and provisional determinations – viewed 07/09/2022.
- Office of Environment and Heritage Threatened Biodiversity Profile Search - Viewed 13/09/2022.
- SEED Layer Intersection Tool – searched 07/09/2022.

## 2.3 Vegetation assessment

### 2.3.1 Vegetation mapping

In June 2022, the Department of Planning and Environment released the State Vegetation Type Map (SVTM) which maps NSW Plant Community Types (PCT) on a regional scale. This mapping uses the recently revised PCT classifications which at the time of drafting this report, were yet to be applied to the Biodiversity Offset Scheme (BOS). Review of this mapping revealed one native PCT mapped within the study area. This comprises a Coastal Floodplain Wetland PCT *Estuarine Sea Rush Swamp Oak Forest* (PCT: 4026) in three patches in the west of the study area. The remainder of the study area is mapped as non-native vegetation.

The extent of native vegetation within the study area was further assessed during field assessments whereby random meander walking transects throughout the extent of the study area, along with vegetation plot surveys, provided notable floristics, vegetation structure and geological data which defined the boundaries for each vegetation community.

### 2.3.2 Vegetation survey and classification

#### Vegetation zones

As per the BAM methodology, vegetation communities were categorised into vegetation zones based on community classifications and broad condition states. The condition state of each vegetation community was assessed using floristic and structural attribute data collected during survey of each vegetation community.

Attributes such as the extent of disturbance, canopy cover, presence of exotic species and the proportion of diagnostic species for each community were considered for each community. Areas of the same PCT which indicated a noticeable difference in vegetative and structural condition were assigned unique zones.

#### Plot-based vegetation survey

Seven vegetation plots were undertaken within the study area as per the BAM methodology. The number of vegetation plots was determined based on specifications within the BAM methodology of the minimum number of plots required per hectare for each vegetation zone (Table 2-2).

Table 2-2: Minimum number of plots required per zone area

Vegetation zone area (ha)	Minimum number of plots/midlines
<2	1 plot/midlines
>2-5	2 plots/midlines
>5-20	3 plots/midlines
>20-50	4 plots/midlines
> 50–100	5 plots/midlines
> 100–250	6 plots/midlines
> 250–1000	7 plots/midlines; more plots may be needed if the condition of the vegetation is variable across the zone.
> 1000	8 plots/midlines; more plots may be needed if the condition of the vegetation is variable across the zone.

Table 2-3 provides details of the number of plots undertaken in each vegetation zone.

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

Veg zone	PCT	Condition	Area (ha) in construction footprint and ancillary areas	No. plots required	No. plots completed (plot IDs)
Zone 1	PCT 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion	Moderate	1.73	1	2 plots (Plots 1 and 5)
Zone 2	PCT 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion	Disturbed	1.14	1	1 plot (Plot 2)
Zone 3	PCT 1808: Estuarine reedland	Moderate	1.04	1	1 plot (Plot 3)
Zone 4	PCT 1737: Typha rushland	Moderate	0.28	1	1 plot (Plot 4)
Non-native vegetation	Not analogous with a PCT	Disturbed	5.55	0	2 plots (Plots 6 and 7)

Each plot consists of a 20x20 metre plot in which floristic composition and structural attributes are collected, and a 20x50 metre plot which collects ecosystem function attributes. The following attributes were collected within each vegetation plot:

- Plot dimensions and orientation.
- Plot photographs.
- Vegetation Class and Plant Community Type (PCT).
- Physical features and disturbance history.
- Full flora species list.
- Growth form and percentage cover of each species.
- Exotic and High Threat Weed (HTW) plant cover.
- Presence of trees in defined size classes.
- Presence of hollow-bearing trees.
- Length of logs.
- Litter cover.

Plant species were identified to species or subspecies level and nomenclature conforms to that currently recognised by the Royal Botanic Gardens via PlantNET (Royal Botanic Garden 2022).

Details as to the location of each of these are provided in the table following and mapped in Figure 2-1.

Table 2-4: Vegetation plot details

Plot Number	Date	Vegetation zone	PCT ID	Easting	Northing	Bearing
1	08-Sep-2022	1	1235	463432	6477812	60
2	08-Sep-2022	2	1235	463511	6477523	20
3	13-Sep-2022	3	1808	463396	6477847	68
4	13-Sep-2022	4	1737	463733	6477843	310
5	13-Sep-2022	1	1235	463765	6477969	132
6	13-Sep-2022	-	-	463775	6477780	245
7	13-Sep-2022	-	-	463720	6477819	310

### 2.3.3 Patch size

The patch size for each zone was determined using aerial imagery via Geographic Information System (GIS). As per the BAM, a patch is defined as an area of continuous native vegetation with a vegetation gap of less than 100 metres.

### 2.3.4 Native vegetation cover

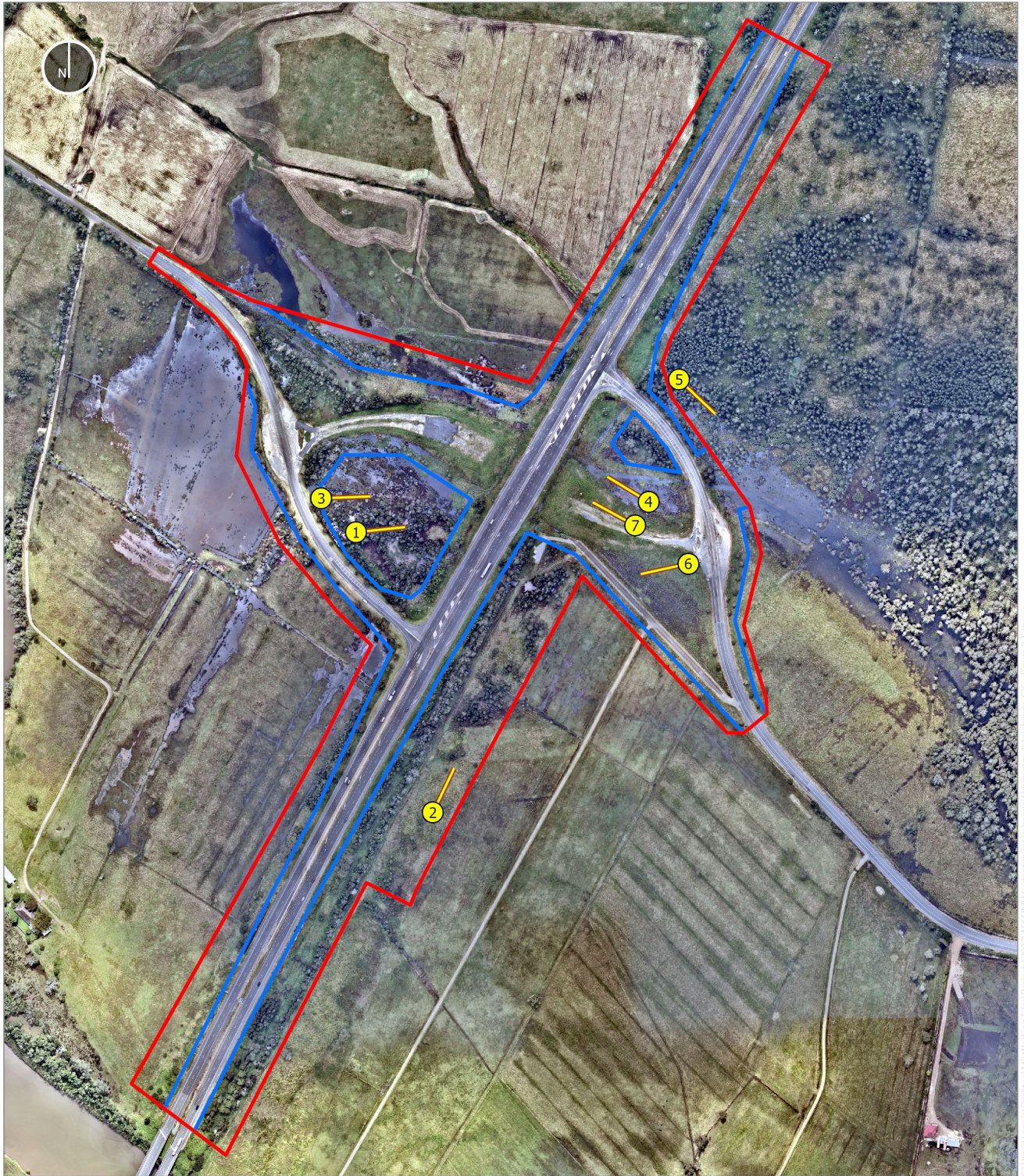
The extent of native vegetation cover within the assessment area was determined by cross referencing the NSW Native Vegetation Extent digital data layer (DPIE 2019a), State Vegetation Type Map (Department of Planning and Environment 2022b) and aerial imagery (Nearmap 2022).

Areas where mapped native vegetation cover aligned with aerial imagery were assessed as native vegetation. Any occurrences where these data sources were not in alignment were assessed as native vegetation, unless visible anthropogenic structures (i.e., houses, roads) were present within the aerial imagery. The results of the native vegetation cover assessment are provided in Table 2-5 below.

Table 2-5: Native vegetation cover in the assessment area

Assessment area (ha)	1190
Total area of native vegetation cover (ha)	395
Percentage of native vegetation cover (%)	33
Class (0 10, >10 30, >30 70 or >70%)	30-70%





Data Sources: Wolfpeak 2021, Nearmaps 2022

0 37.5 75 150 225 300 Meters  
GDA2020 MGA Zone 56 1:5,500@A4

**Legend**

- Study area
- Construction footprint
- BAM plot



**Figure 2-1** | Vegetation plot-based survey locations

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Figure 2-1: Vegetation plot-based survey locations



## 2.4 Threatened species assessment

A desktop assessment, habitat assessment and field surveys were undertaken across the study area. The methods used are described in the following sections with data obtained from these surveys used to inform the assessment of potentially occurring ecosystem and Species Credit Species.

### 2.4.1 Habitat suitability assessment

A habitat suitability assessment was undertaken to assess the likelihood of each threatened and/or migratory species, identified in the background searches with the potential to occur within the study area. These assessments involved a combination of field survey methods and desktop assessment. The following provides a summary of the survey methods utilised in forming the habitat suitability assessments.

#### **Habitat evaluation**

Habitats within the study area were assessed according to parameters such as:

- Structural and floristic characteristics of the vegetation.
- Degree and extent of disturbance.
- Availability of water.
- Size and abundance of tree hollows and fallen timber.
- Surface rocks, outcrops and caves.
- Presence of soils types.
- Vegetation connectivity.
- Presence of mistletoe, nectar, gum, seed and sap sources.

#### **Secondary evidence searches**

This survey method involved the inspection of the habitats within the study area for secondary evidence of use by threatened fauna. Searches involved:

- the inspection under fallen timber, rocks and debris.
- the inspection of dense vegetation, aquatic habitats and leaf litter for frogs and reptiles.
- the inspection of trees for Koalas and claw markings.
- searches for Glider sap incisions.
- searches for nests and dreys.
- searches for scats, owl regurgitation pellets, tracks and feeding signs.

#### **Hollow-bearing tree survey**

Searches for hollow-bearing trees (HBTs) were undertaken within the study area. Any HBTs identified were to be verified with the use of binoculars, inspected for signs of usage and assessed for their potential habitat value.

#### **Koala food tree survey**

Searches for locally preferred Koala food trees were undertaken in the study area. Any located were identified and GPS marked for location reference.

#### **Desktop assessment**

An assessment of the habitat suitability for each threatened and/or migratory species, identified in the background searches with the potential to occur within the study area, was conducted utilising field data obtained in the aforementioned surveys.

Species considered likely to occur within the study area were categorised as having either a low, moderate or high likelihood of occurrence. The results of the habitat suitability assessment for each threatened and/or migratory species is provided in Appendix B.

## 2.4.2 Targeted flora surveys

Field surveys targeting threatened flora species were undertaken within the study area via walking transects. Walking transects were conducted throughout the study area in September 2022 and involved thorough searches of the habitats most likely to support threatened flora.

## 2.4.3 Targeted fauna surveys

The following section summarises the field surveys undertaken within the study area during the assessment period.

### Diurnal bird survey

A total of three passive bird surveys were conducted within the study area diurnally in September. Bird surveys involved active binocular searches and passive recording of bird calls whilst walking around the extent of the study area. Surveys were undertaken early morning (a period of high activity for bird species) for a minimum of 30 minutes per survey. Surveys were undertaken by two personnel whereby all bird species observed or heard calling during the survey were recorded.

### Call playback

Call playback surveys involved broadcasting recorded calls of the Green and Golden Bell Frog from within the study area into suitable amphibian habitat. Calls were played at a volume approximating the natural intensity of the species through a portable 30W megaphone. The general methodology involved an initial period of listening; followed by playback of the calls simulating a natural pattern. This was followed by ten minutes of listening for fauna attracted by the calls. Call playback surveys were broadcast at dawn in September 2022.

### Herpetofauna surveys

A total of three diurnal herpetofauna searches were conducted within the study area during the survey period. Herpetofauna surveys involved active searches for amphibians and reptiles within suitable habitat of the study area as well as periods of listening for fauna calls or activity. Herpetofauna surveys were conducted in September immediately following call playback surveys.

### Dip-netting

A single dip-netting survey was conducted within the study area in September 2022. This survey consisted of using a 2mm mesh dip net to strategically catch fish observed swimming within the wetland area.

## 2.5 Limitations

Under the Transport for NSW guidelines for completing a biodiversity assessment report to support an REF, threatened species with a moderate to high likelihood of occurring within the study area are to be subject to targeted survey in line with Chapter 5 of the BAM. Where targeted surveys do not meet these requirements, in terms of required survey method, effort or timing; Transport for NSW guidelines may require the target species to be assumed present for the purpose of calculating potential credit requirements.

Prior agreement has excluded the need for application of this survey methodology for the purposes of this report. As such, survey methods employed in this assessment have been based off ecologist knowledge of survey methods with the greatest chance of detecting the species most likely to occur within the study area; and may not be in line with species-specific survey requirements under the BAM methodology.



### 3. Existing environment

The study area encompasses existing road infrastructure and the vegetated areas fringing the roadside. Significant modification is evident throughout with areas of high weed infestation, substrate modification and evidence of historic clearing. Surrounding land uses largely include cleared pastoral land with some modified forested areas remaining.

At the time of survey, a large portion of the study area was inundated with water due to its low elevation and situation on an alluvial floodplain.

#### 3.1 Plant community types and vegetation zones

Field surveys identified three native vegetation communities within the study area, all of which occur within the construction footprint. One of these communities was determined to be in two condition states with areas in moderate condition and in a more disturbed condition present.

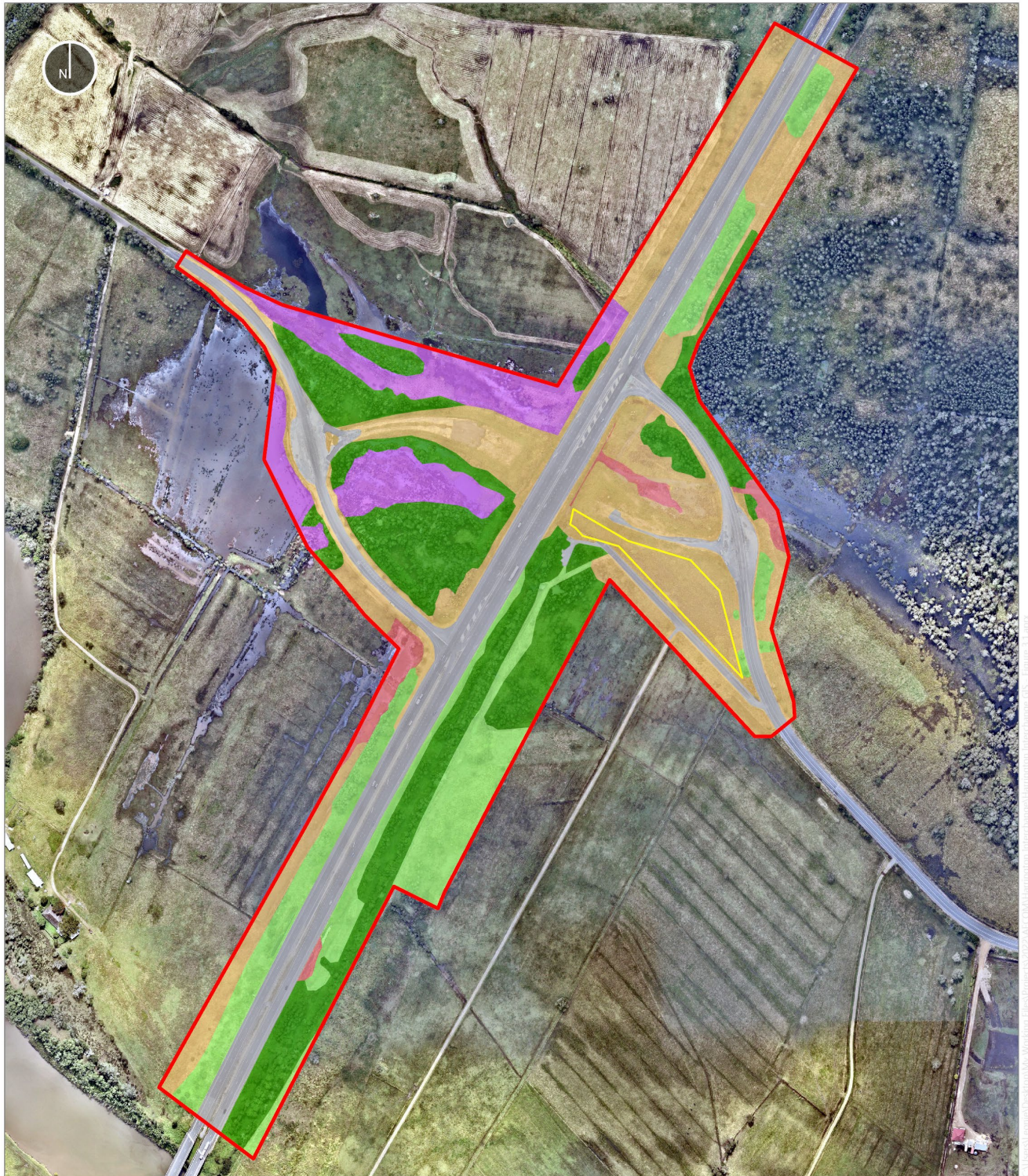
In addition to these native vegetation communities, three non-native vegetation communities comprising a mix of roadside weeds, exotic grassland and ornamental plantings and managed lawn were recorded; as well as areas containing no vegetation.

The following table summarises the extent of each vegetation community recorded within study area and their assigned vegetation zone. The extent of these communities within the study area and ancillary facilities are mapped in Figure 3-1 and Figure 3-2 with vegetation zones mapped in Figure 3-3 and Figure 3-4.

Table 3-1: Plant community types and vegetation zones including patch size and vegetation integrity (VI) score

Veg. zone	Plant community type (PCT)	Threatened ecological community	Area (ha)		Patch size class	VI score
			Study area	Construction footprint and ancillary areas		
Zone 1	PCT 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion	Endangered (BC Act and EPBC Act)	6.01	1.73	>100 ha	29.1
Zone 2	PCT 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion	Endangered (BC Act and EPBC Act)	3.50	1.14	>100 ha	16.1
Zone 3	PCT 1808: Estuarine reedland	Endangered (BC Act)	2.40	1.04	5-24 ha	50.0
Zone 4	PCT 1737: Typha rushland	Endangered (BC Act)	0.62	0.28	5-24 ha	27.4
Non-native vegetation	Not analogous with a PCT	Not a TEC	6.99	5.55	-	-





Data Sources: Wolfpeak 2021, Nearmaps 2022

- Legend**
- Study area
  - Ancillary facilities
  - Vegetation communities
  - PCT 1235 - Swamp Oak swamp forest (Moderate condition)
  - PCT 1235 - Swamp Oak swamp forest (Disturbed condition)
  - PCT 1808 - Estuarine reedland
  - PCT 1737 - Typha rushland
  - Exotic vegetation
  - Not vegetated

0 37.5 75 150 225 300 Meters  
GDA2020 MGA Zone 56 1:5,500@A4

**Figure 3-1** | Plant community types within the study area

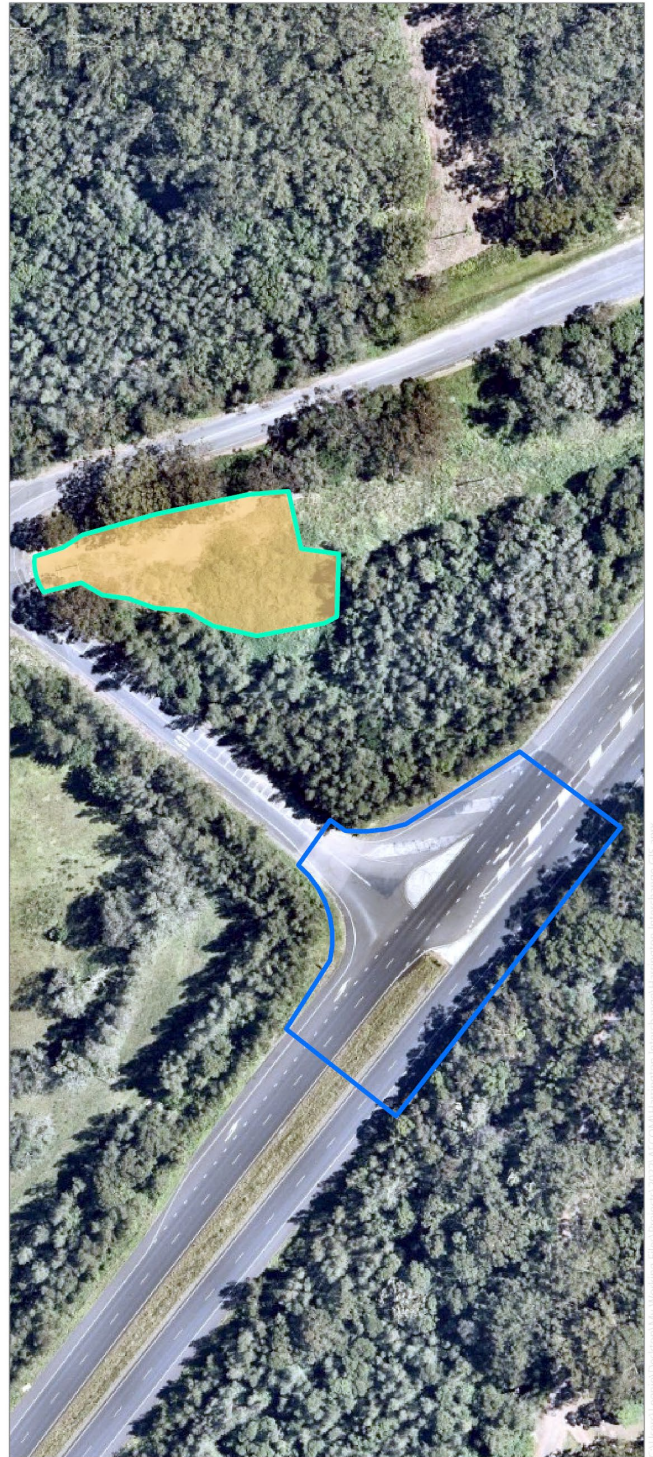
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Figure 3-1: Plant community types within the study area





Data Sources: Wolfpeak 2021, Nearmaps 2022



GDA2020 MGA Zone 56

- Legend**
- PCT 1235 - Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion (Moderate condition)
  - Ornamental plantings
  - Exotic vegetation
  - Ancillary facilities
  - Construction footprint

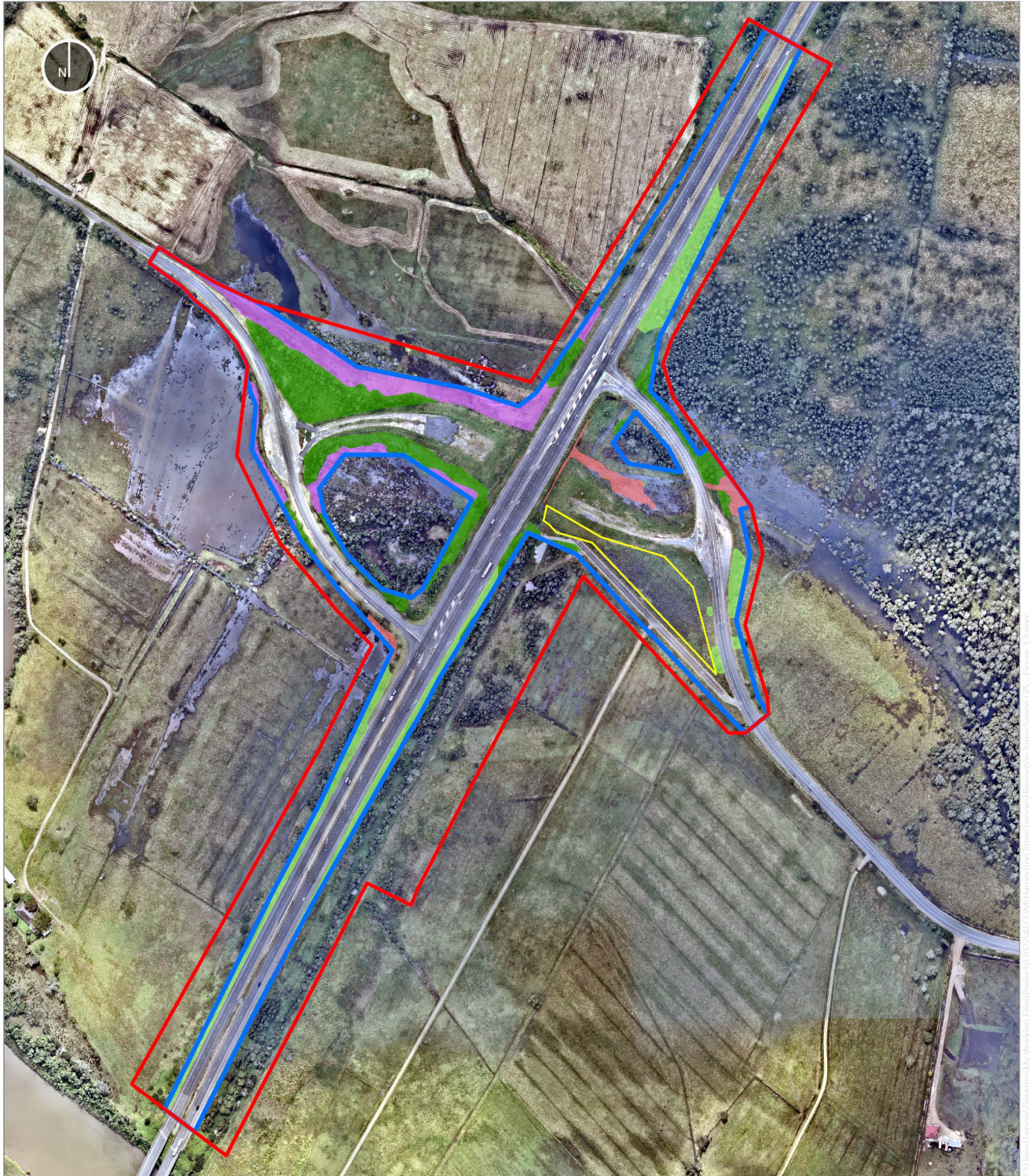


**Figure 3-2** | Plant community types within the additional impact areas

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Figure 3-2: Plant community types within the additional impact areas





Data Sources: Wolfpeak 2021, Nearmaps 2022

0 37.5 75 150 225 300 Meters  
GDA2020 MGA Zone 56 1:5,500@A4

- Legend**
- Study area
  - Construction footprint
  - Ancillary facilities
  - Zone 1 - Swamp Oak swamp forest (Moderate condition)
  - Zone 2 - Swamp Oak swamp forest (Disturbed condition)
  - Zone 3 - Estuarine reedland
  - Zone 4 - Typha rushland



**Figure 3-3** | Vegetation zones

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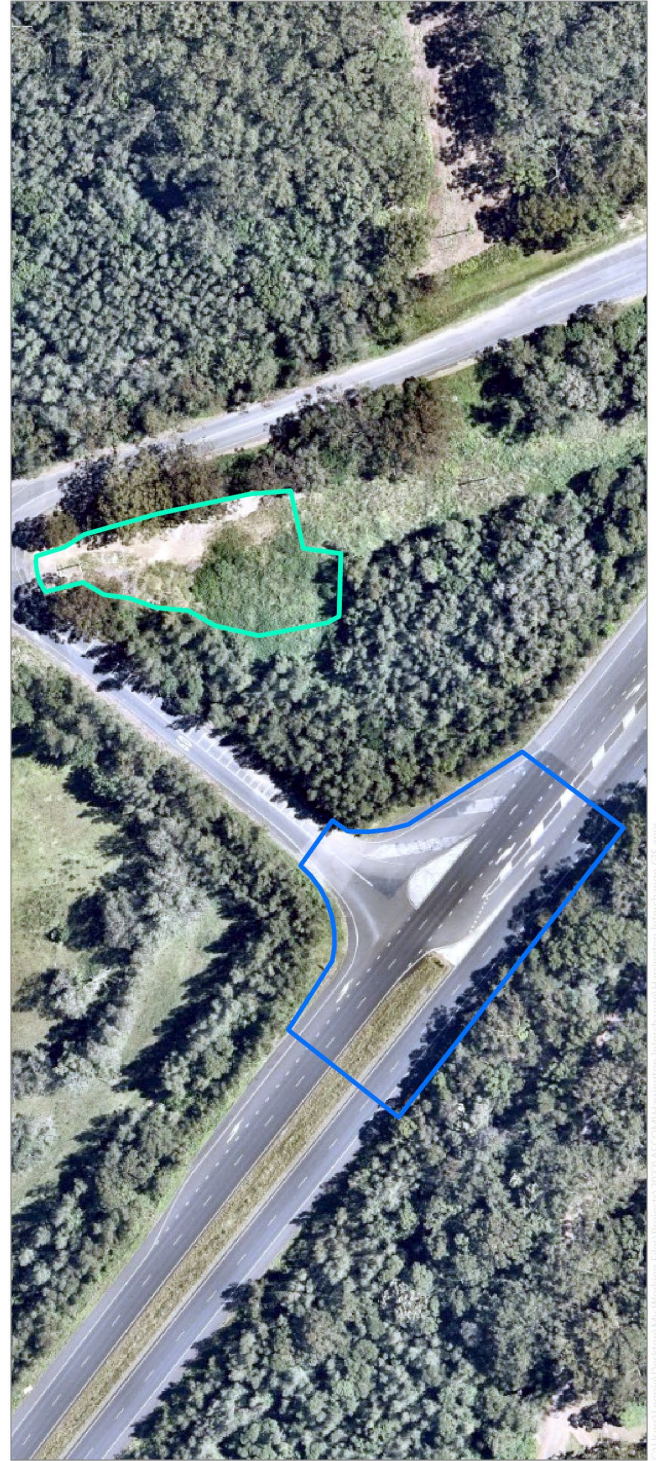
Figure 3-3: Plant community types and vegetation zones





Data Sources: Wolfpeak 2021, Nearmaps 2022

0 5 10 20 30 40 Meters



GDA2020 MGA Zone 56

0 5 10 20 30 40 Meters

**Legend**

- Zone 1 - Swamp Oak swamp forest (Moderate condition)
- Ancillary facilities
- Construction footprint



**Figure 3-4** | Vegetation zones within the additional impact areas

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Figure 3-4: Vegetation zones within the additional impact areas



## PCT 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion

### Description

Swamp Oak swamp forest occurs as low to very tall woodland and forest on poorly drained sites in coastal areas.

Within the study area, this community occurs as mature regrowth with sparse groundcover and areas of standing water. The canopy layer is dense, largely comprising exclusively Swamp Oak (*Casuarina glauca*) with a height range of 15-20 metres. In a small portion in the south of the study area, the canopy also consists of a mix of Forest Red Gum (*Eucalyptus tereticornis*) and Tallwood (*E.microcorys*), interspersing the Swamp Oak. The understorey comprises juvenile Swamp Oak with Common Silkpod (*Parsonia straminea*) dispersed throughout. The shrub layer is largely absent (a few scattered Flax-leaved Paperbark), and the groundcover comprises a mix of sedges and grasses including Tall Sedge (*Carex appressa*), Couch (*Cynodon dactylon*), Marsh Club-rush (*Bolboschoenus fluviatilis*) and Common Rush (*Juncus usitatus*). Weed species present include Coastal Morning Glory (*Ipomoea cairica*) and South African Pigeon Grass (*Setaria sphacelata*).

Table 3-2: Swamp Oak swamp forest description

PCT ID	1235
PCT name	Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
Vegetation class	Coastal Floodplain Wetlands
Vegetation formation	Forested Wetlands
Estimate of per cent cleared	75 %
Area in study area	9.71 ha
Area in the construction footprint and ancillary areas	2.87 ha (1.73 ha moderate condition; 1.14 ha disturbed condition)
Conservation status	BC Act - Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered) EPBC Act - Coastal Swamp Oak ( <i>Casuarina glauca</i> ) Forest of New South Wales and South East Queensland ecological community (Endangered)
Vegetation zones (condition) and plots	Zone 1 (Moderate) – Plots 1 and 5 Zone 2 (Disturbed) – Plot 2

### Justification for PCT selection:

The Swamp Oak swamp forest community within the study area was assigned a PCT based on an alignment of key landscape and vegetation characteristics detailed in the PCT Search Field of the BioNet Vegetation Classification (DPIE 2022b). This process identified two possible PCTs with the final determination of PCT 1235 assigned based on the presence or absence of species listed in the PCT Scientific Name and Upper Stratum Species along with other diagnostic features detailed in each PCTs Vegetation Description.

Table 3-3: Floristic and structural summary of PCT 1235 within the study area

Growth form	Typical species
Trees	Swamp Oak ( <i>Casuarina glauca</i> )
Shrubs	Flax-leaved Paperbark ( <i>Melaleuca linariifolia</i> )
Grass and grass-like	Couch ( <i>Cynodon dactylon</i> ), Blady Grass ( <i>Imperata cylindrica</i> ), Tall Sedge ( <i>Carex appressa</i> ), Sea Rush ( <i>Juncus kraussii</i> ), Marsh Club-rush ( <i>Bolboschoenus fluviatilis</i> ), Water Ribbons ( <i>Cladium procerum</i> ), Common Rush ( <i>Juncus usitatus</i> )
Forb	Swamp Dock ( <i>Rumex brownii</i> ), Lesser Joyweed ( <i>Alternanthera denticulata</i> ), Sea Celery ( <i>Apium prostratum</i> ), Indian Pennywort ( <i>Centella asiatica</i> ), Native Wandering Jew ( <i>Commelina cyanea</i> )
Fern	Common Bracken ( <i>Centella asiatica</i> )
Other	Common Silkpod ( <i>Parsonsia straminea</i> )
Exotic	South African Pigeon Grass ( <i>Setaria sphacelata</i> ), Water Buttons ( <i>Cotula coronopifolia</i> )
High Threat Exotic	Coastal Morning Glory ( <i>Ipomoea cairica</i> ), Lantana ( <i>Lantana camara</i> )

**Condition states**

Two condition classes were identified within the study area:

- Moderate (zone 1) – this condition class includes mature regrowth Swamp Oak Forest with sparse groundcover. It is located on the western side of the highway with a patchy distribution, and on the eastern side as linear strips along the highway. Photo 3-1 displays this moderate condition community within the study area.
- Disturbed (zone 2) – this condition class includes a highly modified community with a largely absent canopy layer (3% cover) and Tall Sedge (*Carex appressa*) as the dominant species. It is located as linear strips either side of the highway at the southern end of the subject site, as well as several small patches on the eastern side of the highway to the north. Photo 3-2 displays this disturbed condition community within the study area.

Photo 3-1: Plot 5 showing vegetation zone 1 (PCT 1235 – moderate condition)



Photo 3-2: Plot 2 showing vegetation zone 2 (PCT 1235 – disturbed condition)



### 3.1.1 PCT 1808: Estuarine reedland

#### Description

Estuarine reedland occurs in environments inundated by saline or brackish water, such as low-lying swamps, river flat depressions or banks on coastal lagoons, and is typically characterised by tall, dense swards of Common Reed (*Phragmites australis*). It may also occur on the landward side of saltmarsh flats, where it shares salt-tolerant species including Sea Rush (*Juncus kraussii*), Bare Twig-rush (*Baumea juncea*) and Creeping Brookweed (*Samolus repens*).

Within the study area, this community is dominated by Sea Rush (*Juncus kraussii*), with the occasional scattered Swamp Oak (*Casuarina glauca*) and Sand Couch (*Sporobolus virginicus*) occurring at the margins. The height ranges from 0 – 1.5 metres.

Table 3-4: Estuarine reedland description

PCT ID	1808
PCT name	Estuarine reedland
Vegetation class	Coastal Freshwater Lagoons
Vegetation formation	Freshwater Wetlands
Estimate of per cent cleared	41 %
Area in study area	2.49 ha
Area in the construction footprint and ancillary areas	1.04 ha
Conservation status	BC Act - Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered)
Vegetation zones (condition) and plots	Zone 3 (Moderate) – Plots 3



**Justification for PCT selection:**

This vegetation community was assigned a PCT based on an alignment of key landscape and vegetation characteristics detailed in the PCT Search Field of the BioNet Vegetation Classification (DPIE 2022b). This process identified two possible PCTs with the final determination of PCT 1808 assigned based on the closest floristic match of upper and ground stratum species.

Table 3-5: Floristic and structural summary of PCT 1808 within the study area

Growth form	Typical species
Trees	Swamp Oak ( <i>Casuarina glauca</i> )
Shrubs	-
Grass and grass-like	Sea Rush ( <i>Juncus kraussii</i> ), Sand Couch ( <i>Sporobolus virginicus</i> )
Forb	-
Fern	-
Other	-
Exotic	-
High Threat Exotic	-

**Condition states**

The extent of this vegetation community within the study area occurred in a single condition state. The condition of this PCT was categorised as moderate based on the absence of some characteristic flora species and the evident historical disturbance of the ground substrate. Photo 3-3 displays this moderate condition community within the study area.

Photo 3-3: Plot 3 showing vegetation zone 3 (PCT 1808 - moderate condition)]



### 3.1.2 PCT 1737: Typha rushland

#### Description

Typha rushland typically occurs along the margins of standing freshwater with muddy or sandy substrate and is dominated by Typha species. Coastal occurrences have elevations of less than 50 metres.

Within the study area, this community occurs in shallow basins in ponded water, with a moderately dense cover of reeds and sedges and areas of open water. Dominant species comprise Narrow-leaved Cumbungi (*Typha domingensis*) and *Schoenoplectiella mucronata*, with exotic South African Pigeon Grass (*Setaria sphacelata*) occurring throughout. Height ranges from 0 – 1.9 metres.

Table 3-6: Typha rushland description

PCT ID	1737
PCT name	Typha rushland
Vegetation class	Coastal Freshwater Lagoons
Vegetation formation	Freshwater Wetlands
Estimate of per cent cleared	70 %
Area in study area	0.62 ha
Area in the construction footprint and ancillary areas	0.28 ha
Conservation status	BC Act - Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered)
Vegetation zone (condition) and plot	Zone 4 (Moderate) – Plot 4

**Justification for PCT selection:**

This vegetation community was assigned the PCT 1737 based on an alignment of key landscape characteristics, geographic distribution and floristic attributes. The assigned PCT comprises the only *Typha*-dominated PCT within the geographical range for this community. This PCT is considered a weak match to the assigned PCT 1737 as a different *Typha* species is listed as the diagnostic species (*Typha orientalis*).

Table 3-7: Floristic and structural summary of PCT 1737 within the study area

Growth form	Typical species
Trees	-
Shrubs	-
Grass and grass-like	Narrow-leaved Cumbungi ( <i>Typha domingensis</i> ), Sea Rush ( <i>Juncus kraussii</i> ), Tall Sedge ( <i>Carex appressa</i> ), <i>Schoenoplectiella mucronata</i> , Sand Couch ( <i>Sporobolus virginicus</i> ), Marsh Club-rush ( <i>Bolboschoenus fluviatilis</i> ), Jointed Twig-rush ( <i>Machaerina articulata</i> ), <i>Eleocharis equisetina</i> , <i>Isolepis inundata</i>
Forb	Slender Knotweed ( <i>Persicaria decipiens</i> ), Water Primrose ( <i>Ludwigia peploides</i> ), Water Ribbons ( <i>Cycnogeton procerum</i> )
Fern	-
Other	-
Exotic	South African Pigeon Grass ( <i>Setaria sphacelata</i> ), Cape Waterlily ( <i>Nymphaea capensis</i> )
High Threat Exotic	-

**Condition states**

The extent of this vegetation community within the study area occurred in a single condition state. The condition of this PCT was categorised as moderate based on the absence of characteristic flora species, the presence of exotic species and the evident historical disturbance of the ground substrate. Photo 3-4 displays this moderate condition community within the study area.



Photo 3-4: Plot 4 showing vegetation zone 4 (PCT 1737 - moderate condition)



## 3.2 Threatened ecological communities

The identification of possible Threatened Ecological Communities (TECs) was based on the data collected in the survey and review of the relevant listings by the Department of Planning and Environment. The following sections detail the TECs identified within the study area.

### 3.2.1 BC Act TECs

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

The extent of the *Swamp Oak swamp forest* (PCT 1235) and the *Estuarine reedland* (PCT 1808) communities within the study area are analogous with the BC Act listed TEC, *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*. This TEC is typically characterized by a dense to sparse tree layer in which *Casuarina glauca* (Swamp Oak) is the dominant species. The community structure of this TEC is however known to “vary from open forests to low woodlands, scrubs or reedlands with scattered trees” (Department of Planning and Environment (2022e).

Both the *Swamp Oak swamp forest* and the *Estuarine reedland* within the study area structurally and geographically align with this TEC. Floristic attributes of these communities largely align; however, some diagnostic species are absent, which is likely to represent the disturbed nature of the communities rather than florid misalignment.

#### ***Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions***

The *Typha rushland* community within the study area is likely to represent a modified condition of the BC Act listed TEC, *Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*. The landscape characteristics, geographical position and structural elements of this community are all analogous with the TEC’s determination criteria; however, floristic attributes are less analogous. A total of 43% of the species recorded within this community, align with the diagnostic species for the TEC; however, other additional species recorded within the study area’s vegetation community align on a genus level.

Based on the close alignment of floristic attributes and the analogousness of the landscape characteristics, geographical position and structural elements of this community, it is considered that the Typha rushland community within the study area is likely to represent the TEC, *Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*.

### 3.2.2 EPBC Act TECs

#### ***Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community***

The Swamp Oak swamp forest community within the study area aligns with the EPBC Act-listed TEC, *Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community*. Conservation advice for this TEC (DCCEEW 2022b) outline that in order to conform to the TEC, “areas of the ecological community must meet both:

- the key diagnostic characteristics AND
- at least the minimum condition thresholds for Category C”.

The extent of this community within the study area meets the key diagnostic characteristic of the TEC. Condition thresholds for the community indicate Category B (a small patch that meets key diagnostics and has a predominantly native understorey and is contiguous with another large area of native vegetation) and Category A (a large patch that meets key diagnostics and has a predominantly native understorey) communities.





Data Sources: Wolfpeak 2021, Nearmaps 2022

**Legend**

- Study area
- BC Act TECs
  - Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
  - Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- EPBC Act TECs
  - Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community

0 37.5 75 150 225 300 Meters  
GDA2020 MGA Zone 56 1:5,500@A4

**Figure 3-5** | Threatened ecological communities within the study area

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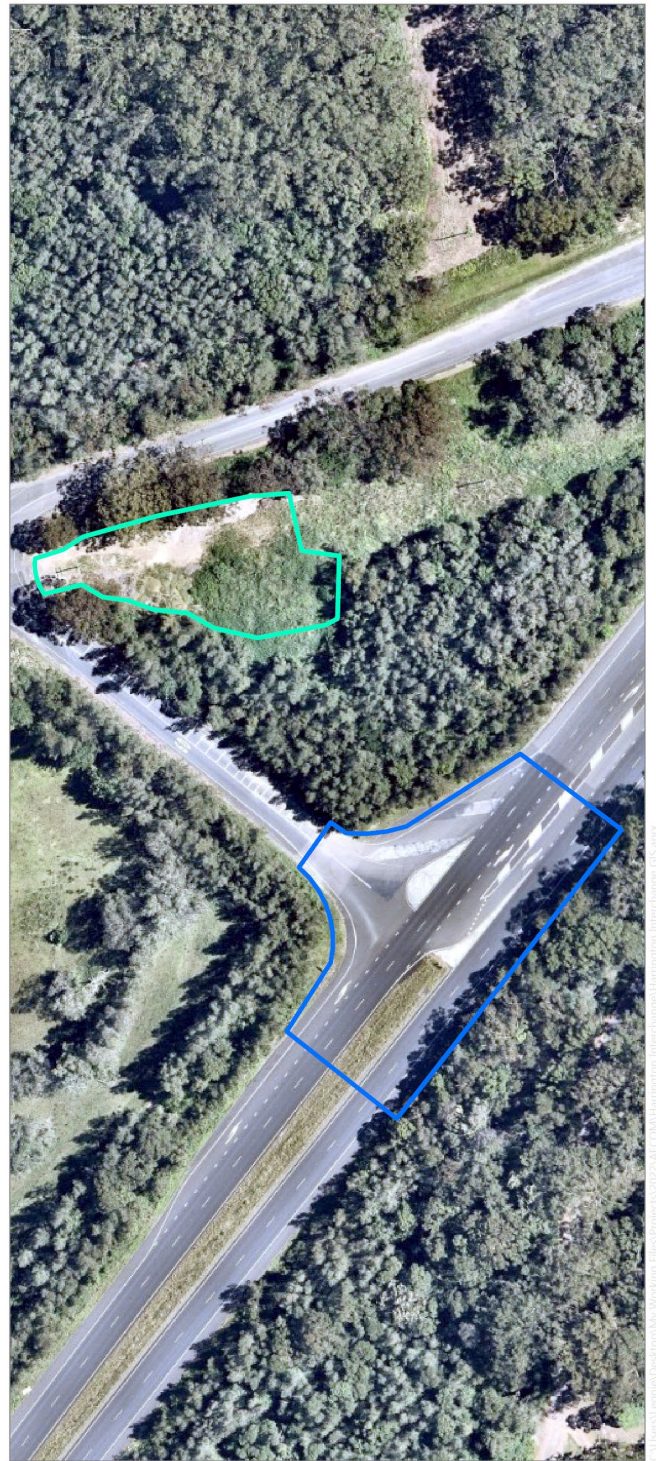
Figure 3-5: Threatened ecological communities within the study area







Data Sources: Wolfpeak 2021, Nearmaps 2022



GDA2020 MGA Zone 56

**Legend**

BC Act TECs

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

EPBC Act TECs

Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community

Ancillary facilities

Construction footprint



**Figure 3-6** | Threatened ecological communities within the additional impact areas

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Pacific Highway / Harrington Road and  
Cooperook Road Interchange Upgrade

Figure 3-6: Threatened ecological communities within the additional impact areas



### 3.3 Groundwater dependent ecosystems

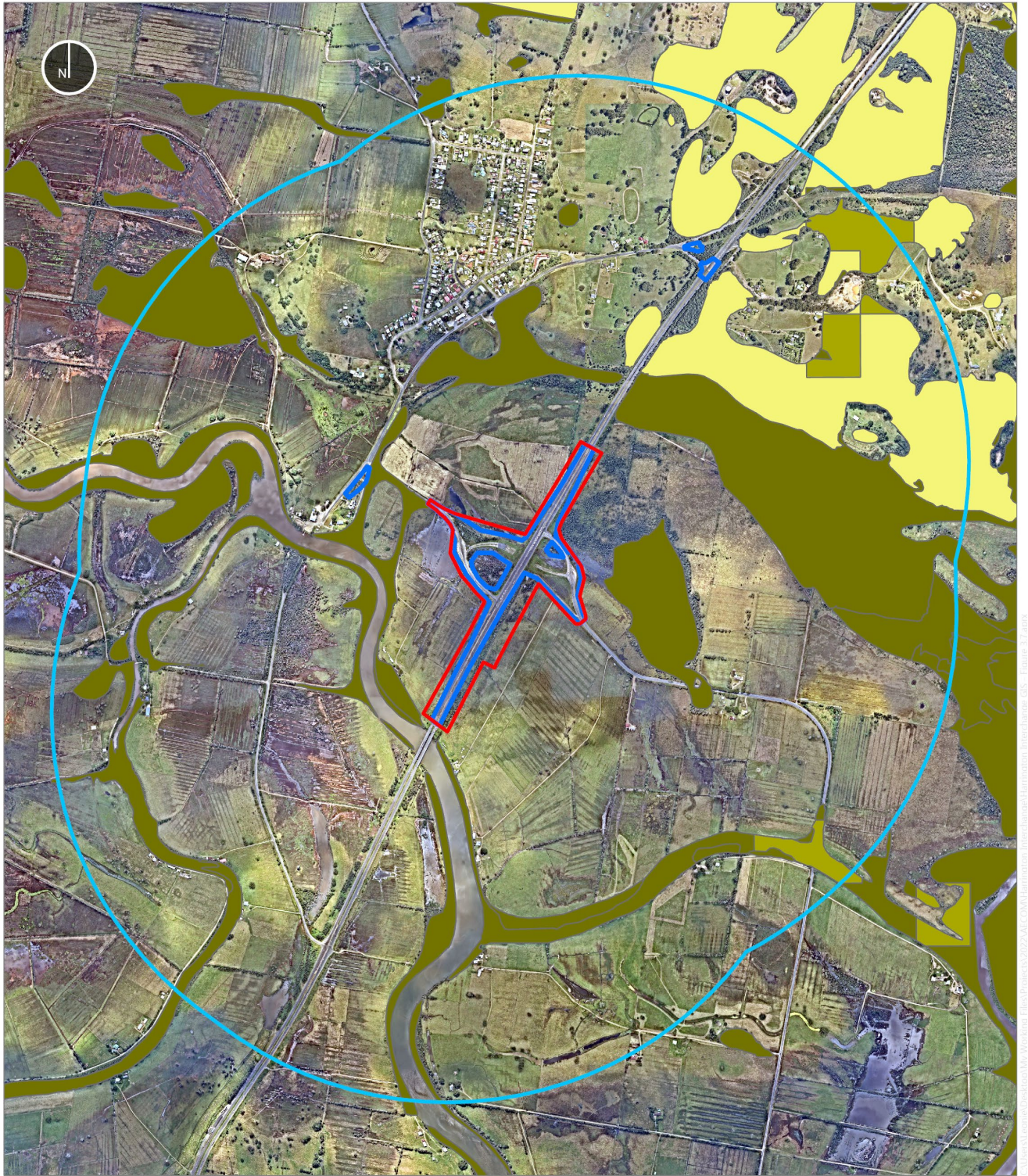
A groundwater dependent ecosystem (GDE) is one in which the plant and/or animal community is dependent on the availability of groundwater to maintain its structure and function. Desktop mapping of potential GDEs (BoM 2022) does not indicate any areas of the study area with the potential for groundwater interaction to occur. Mapping does however indicate areas with possible high, moderate and low potential for groundwater interaction in the broader assessment area.

The desktop GDE mapping (BoM 2022) indicates the following potential GDEs nearest the study area:

- Terrestrial vegetation associated with the Lansdowne River is mapped as having a high potential to be associated with subsurface presence of groundwater.
- Terrestrial vegetation associated with and south of the Cooperook River is mapped as having a high potential to be associated with subsurface presence of groundwater.
- Terrestrial vegetation associated with the stand of vegetation to the east of the study area is mapped as having a high potential to be associated with subsurface presence of groundwater.

Mapping is provided in Figure 3-7. Despite mapping not indicating potential GDEs within the study area, it is likely that study area communities have some degree of dependence on groundwater.





Data Sources: Wolfpeak 2021, Nearmaps 2022

**Legend**

- Study area
- Construction footprint
- Assessment area
- High potential GDE - from regional studies
- Moderate potential GDE - from regional studies
- Low potential GDE - from regional studies

0 150 300 600 900 1,200 Meters  
GDA2020 MGA Zone 56 1:21,502@A4

**Figure 3-7** | Groundwater dependent ecosystem mapping

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Pacific Highway / Harrington Road and Cooperbrook Road Interchange Upgrade

Figure 3-7: Groundwater dependent ecosystems



### 3.4 General survey results

#### 3.4.1 Key habitat features

Field surveys identified the presences of two small, stick nests within the study area. These nests were both located within the Swamp Oak swamp forest community in the south-east of the study area and neither appeared active at the time of survey. Both stick nests are located outside of the proposed construction footprint and ancillary areas whereby no direct impacts are anticipated. The location of the nests is provided in Figure 3-8.

Field surveys additionally identified numerous road culverts throughout the study area. Road culverts have the potential to provide a roosting resource for some Microchiropteran bat species (microbats), however at the time of survey, all culverts were inundated with water (see photo following). Water levels of this height evidently indicate the absence of microbats at that point in time.

Photo 3-5: Existing road culvert within the study area



Field surveys also identified a potential Koala foraging resource within the study area with a small portion of the Pacific Highway road reserve containing established and planted eucalypts. A total of 17 locally preferred Koala food trees were recorded during survey, all of which comprised of two species, Forest Red Gum (*Eucalyptus tereticornis*) and Tallowwood (*E. microcorys*). Each of these were identified in the south of the study area, along the edges of the Pacific Highway where they may be subject to trimming only. Figure 3-8 maps the location of these with photos following.

No other notable habitat features were recorded within the study area with an absence of hollow-bearing trees, large hollow logs and log piles.



Photo 3-6: Planted Koala food trees within the study area





Photo 3-7: Koala food trees within the study area



### 3.4.2 Recorded flora

Flora surveys identified a total of 55 species across the extent of the study area, none of which as listed as threatened under the BC Act and/or EPBC Act. A full list of flora species recorded during the survey is provided in Appendix A.

### 3.4.3 Recorded fauna

Fauna surveys identified a total of 57 fauna species utilising the study area during the survey period. These largely comprised bird species with amphibian, reptiles and a fish species also recorded. No mammals were recorded during the survey.

Amphibian species recorded during the survey period consisted of the common species, Striped Marsh Frog (*Limnodynastes peronii*) and Eastern Sedge Frog (*Litoria fallax*), both of which were heard calling from within the study area, east of the Pacific Highway.

Bird species were abundant within the study area and immediately adjacent with a total of 52 avian species recorded. Species recorded included common wetland birds such as the Chestnut Teal (*Anas castanea*), Pacific Black Duck (*Anas superciliosa*), White-faced Heron (*Egretta novaehollandiae*) and Pied Cormorant (*Phalacrocorax varius*). Other species recording included the Australian Reed Warbler (*Acrocephalus australis*), Azure Kingfisher (*Ceyx azureus*), Horsefield's Bronze Cuckoo (*Chalcites basalis*), Whistling Kite (*Haliastur sphenurus*) and the Red-browed Finch (*Neochmia temporalis*). Bird species were observed on the within the study area or within the adjoining wetlands; while others were seen flying overhead or heard calling from adjacent habitats.

Reptiles recorded on during the survey comprised of the Dark-flecked Garden Sunskink (*Lampropholis delicata*) and the Red-bellied Black Snake (*Pseudechis porphyriacus*). Both species were recorded in dense grasses in the study area during the survey.

Opportunistic observations identified the high abundance of Mosquito Fish (*Gambusia holbrooki*) within some wet areas of the study area. Species identification was confirmed via dip-net surveys.

A full list of fauna species recorded during the survey is provided in Appendix A.

### 3.5 Threatened species

Surveys conducted under this assessment did not identify any threatened species utilising the study area. Vegetation immediately adjoining the George Gibson North ancillary facility, does however comprise a possible threatened population. This ancillary facility is bordered by a dry sclerophyll forest along the north-western and northern boundary. Within this community occurs numerous mature trees believed to be Narrow-leaved Red Gum (*Eucalyptus seeana*). This tree species is not listed as a threatened species; however, due to the geographical occurrence, its presence would be representative of the BC Act-listed Endangered Population, *Eucalyptus seeana population in the Greater Taree local government area*.

The project does not propose to remove any Narrow-leaved Red Gum, however, mitigation measures will be required to minimise indirect impacts to this species.

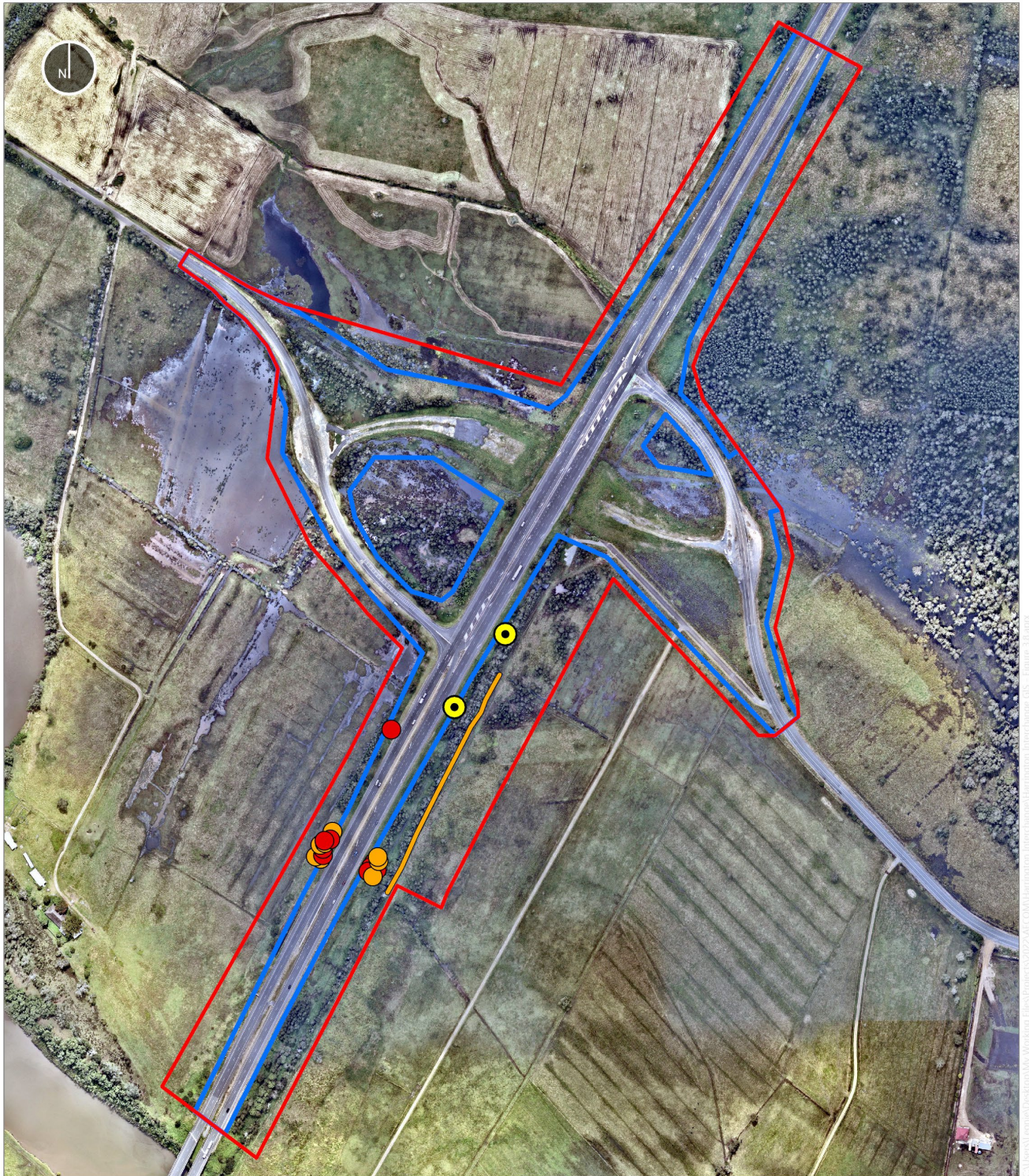
### 3.6 Aquatic results

Aquatic habitat within the study area is limited to roadside drainage lines and freshwater wetlands which are not required to be assessed under the *Fisheries Management Act 1994*.

One flora species recorded, does however conform to the definition of Marine Vegetation under the *Fisheries Management Act 1994*. A total of seven Grey Mangrove (*Avicennia marina*) trees were recorded along the edge of the roadside drainage line in the south-east of the study area. Additionally, a mangrove forest was recorded immediately behind native vegetation within the George Gibson South Expanded ancillary area. These are not located within the proposed ancillary area. The general location of these is mapped in Figure 3-8 and Figure 3-9.

This species is protected under the *Fisheries Management Act 1994*.





Data Sources: Wolfpeak 2023, Nearmaps 2022

0 37.5 75 150 225 300 Meters  
GDA2020 MGA Zone 56 1:5,500@A4

- Legend**
- Study area
  - Construction footprint
  - Stick nest
  - Mangroves
  - Koala food tree species
  - Forest Red Gum
  - Tallowwood

**Figure 3-8** | Habitat features and marine vegetation recorded within the study area

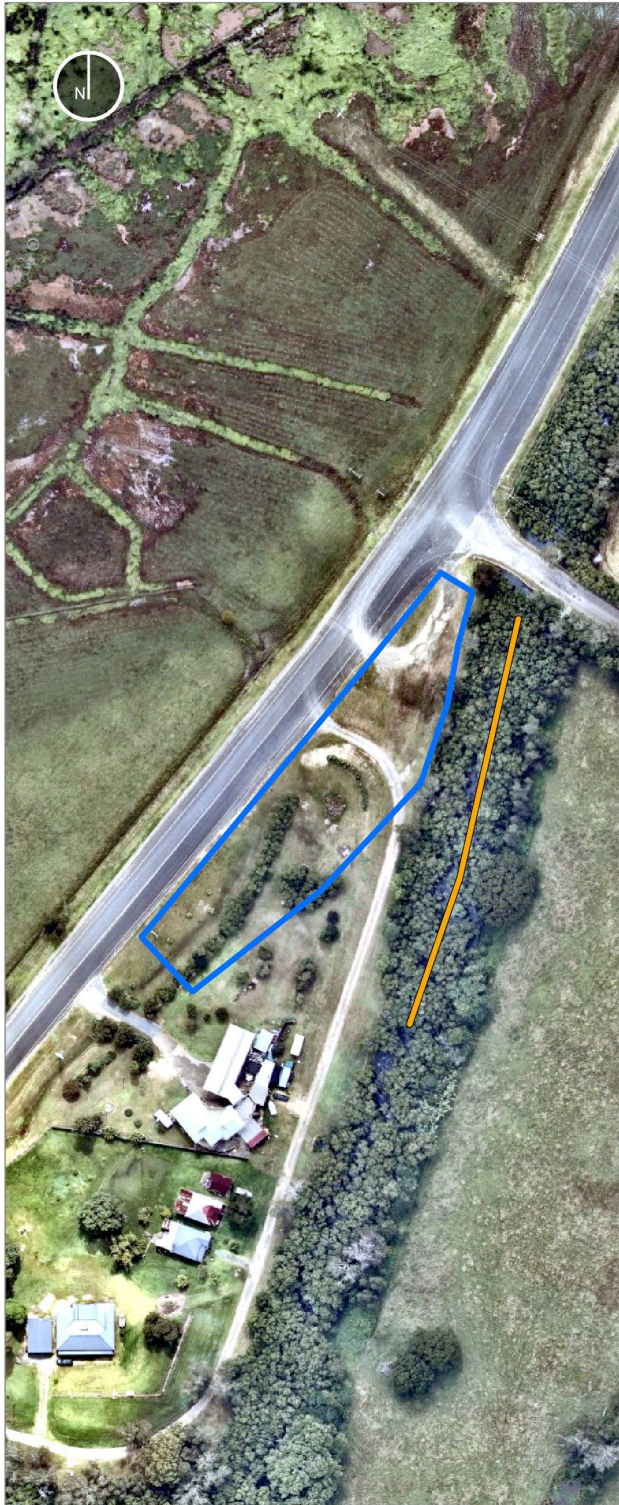
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Figure 3-8: Location of notable habitat features and Marine Vegetation

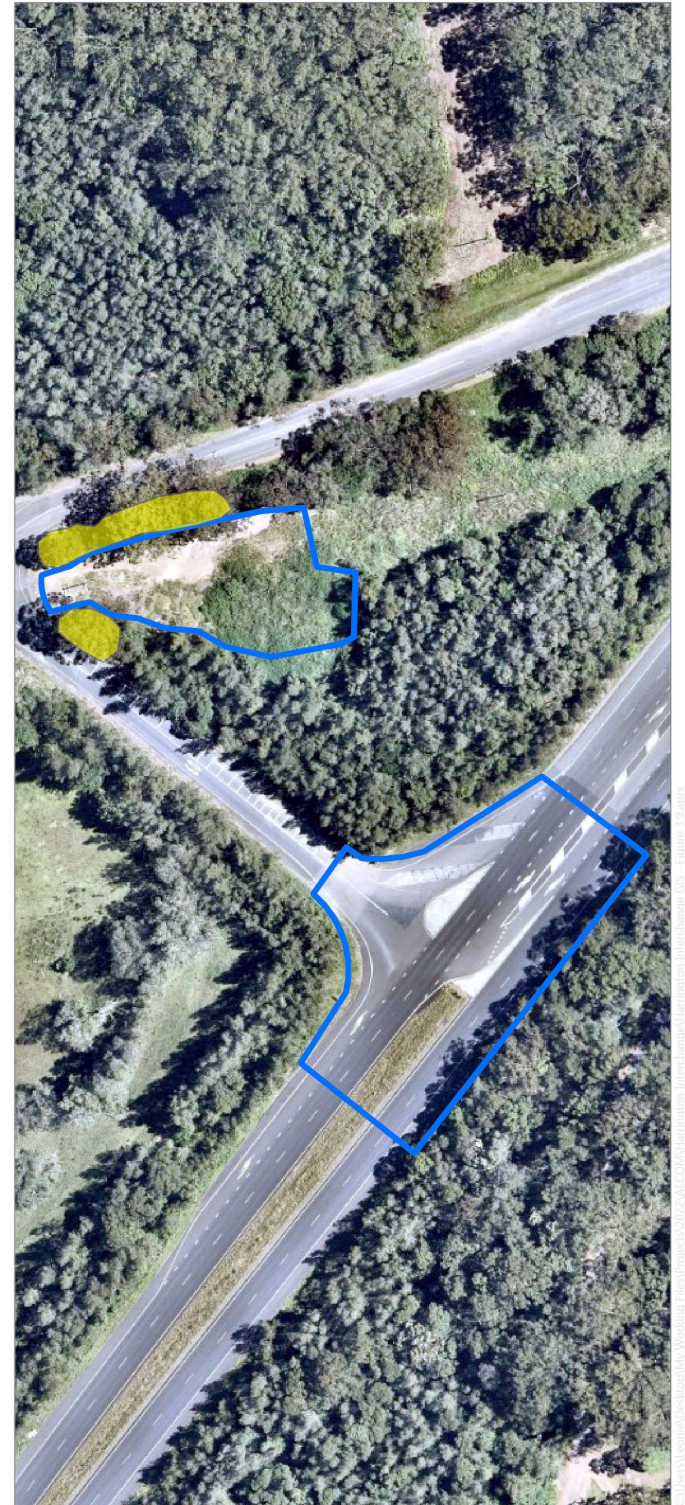
Biodiversity assessment report for REF





Data Sources: Wolfpeak 2021, Nearmaps 2022

0 5 10 20 30 40 Meters



GDA2020 MGA Zone 56

0 5 10 20 30 40 Meters

**Legend**

-  Mangroves
-  Construction footprint
-  Potential threatened population - E. seeana



**Figure 3-9** | Habitat features and marine vegetation recorded within the additional impact areas

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 Pacific Highway / Harrington Road and Cooperook Road Interchange Upgrade

Figure 3-9: Location of notable habitat features and Marine Vegetation (additional impact areas)



### 3.7 Areas of outstanding biodiversity value

The study area is not within a declared area of outstanding biodiversity value.

### 3.8 Wildlife connectivity corridors

The study area is situated in a largely cleared landscape whereby it is surrounded by cleared agricultural lands. Vegetation within the study area has minutely tentative links to a thin strip of riparian vegetation along Lansdowne River and a stand of vegetation to the east. A larger area of vegetation occurs to the north-east of the study area; however, this is only likely to be accessible to highly mobile fauna.

The study area is not located within a DPIE mapped corridor and numerous barriers to movement (including cleared lands and waterways) are present between the study area and the nearest mapped corridors. These barriers are likely to prevent access to most fauna with only highly mobile fauna able to traverse.

### 3.9 SEPP (Biodiversity and Conservation) 2021

Chapters 3 and 4 of this State Environmental Planning Policy (SEPP), which pertains to the State Environmental Planning Policy (Koala Habitat Protection) 2020 and 2021, do not apply to developments assessed under Part 5 of the *Environmental Planning & Assessment Act 1979*.

### 3.10 SEPP (Resilience and Hazards) 2021

Chapter 2 of the SEPP (Resilience and Hazards) 2021, which pertains to Coastal Management, applies to the proposed development. This chapter addresses provisions of the *Coastal Management Act 2016* in relation to the following coastal management areas:

- Coastal wetlands and littoral rainforest areas;
- Coastal vulnerability areas;
- Coastal environment areas; and
- Coastal use areas.

The study area does not contain any mapped Littoral Rainforest areas, and no mapped Littoral Rainforest areas occur within seven kilometres of the study area.

Mapped areas of Coastal Wetland do, however, occur within the assessment area with the margins to one of these occurring immediately outside the George Gibson South Expanded ancillary area. This wetland does not occur within this ancillary area however the proximity area to this wetland covers the entire George Gibson South Expanded ancillary area. It is recommended that a buffer to the mapped Coastal Wetland is provided (see recommendations provided in Section 6) to mitigate potential indirect impacts to the wetland. Should these mitigation measures not be enforced, an Environmental Impact Statement would be required to be completed for the project.

The proximity zone to this mapped wetland also overlays the far southern tip of the study area. Works proposed in this area consist of the possible installation of new road signs only. No earthworks are proposed in this mapped proximity area.

The extent of Coastal Wetland mapping in context of the study area is displayed in Figure 3-10 and Figure 3-11.





Data Sources: Wolfpeak 2023, Nearmaps 2022

0 95 190 380 570 760 Meters  
GDA2020 MGA Zone 56 1:13,428@A4

**Legend**

- Study area
- Construction footprint
- Coastal Wetland
- Coastal Wetland - Proximity Area

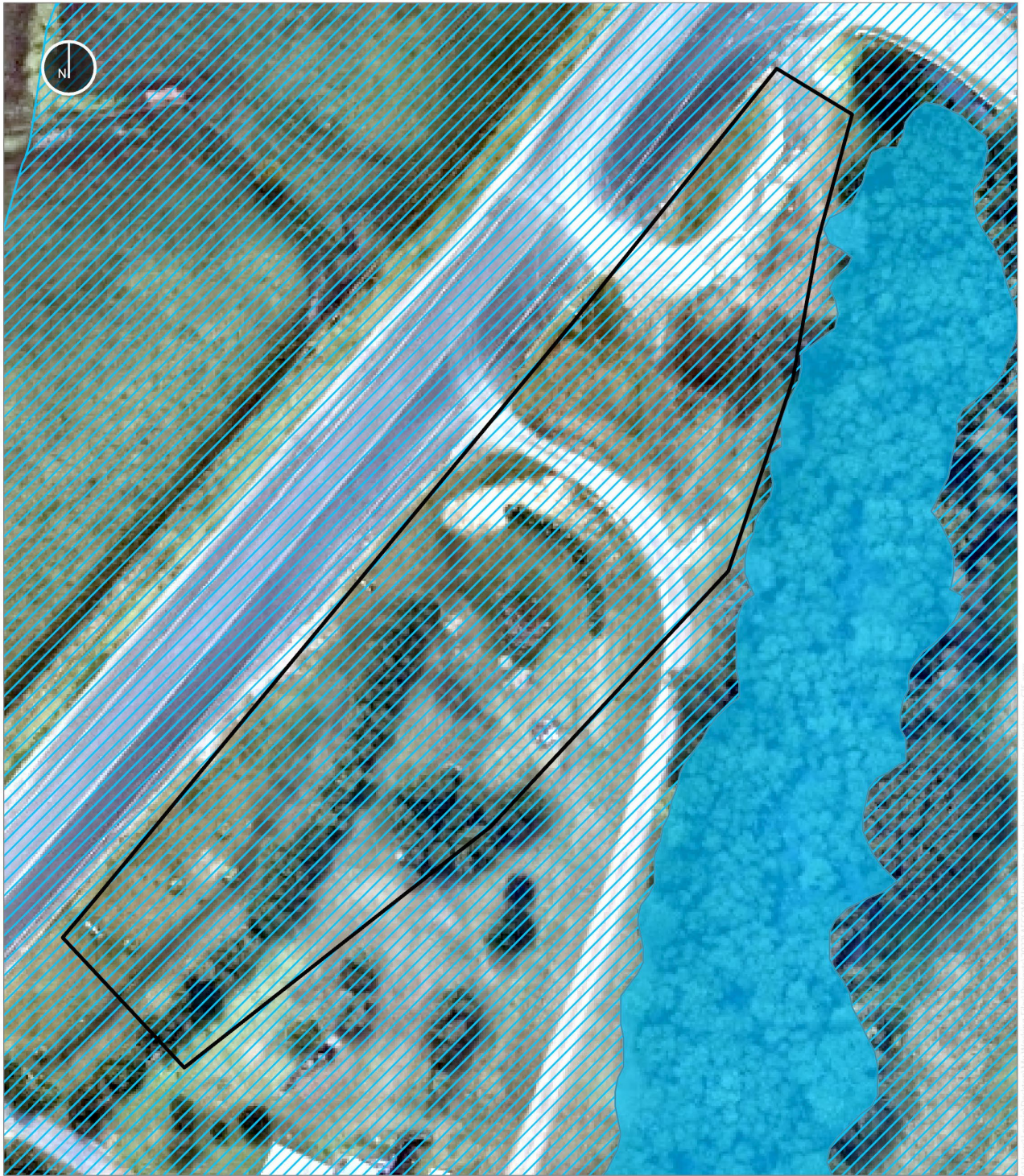


**Figure 3-10** | Coastal wetland mapping

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Pacific Highway / Harrington Road and  
Cooperook Road Interchange Upgrade

Figure 3-10: Coastal Wetland mapping within the context of the study area





Data Sources: Wolfpeak 2021, Nearmaps 2022

- Legend**
- Coastal Wetland
  - Coastal Wetland - Proximity Area
  - George Gibson South Expanded ancillary area

0 4.5 9 18 27 36 Meters  
GDA2020 MGA Zone 56 1:664@A4

**Figure 3-11** | Coastal wetland mapping within the George Gibson South Expanded ancillary area

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Pacific Highway / Harrington Road and Cooperook Road Interchange Upgrade



Figure 3-11: Coastal Wetland mapping within the George Gibson South Expanded ancillary area



### 3.11 Matters of national environmental significance

The provisions of the EPBC Act require determination of whether the proposal has, will or is likely to have a significant impact on a Matter of National Environmental Significance (MNES). An assessment of potential MNES which could occur in the assessment area was undertaken using the Protected Matters Search Tool (DAWE 2022a). This search identified a range of MNES with the potential to occur. An assessment of these is provided in Section 5.4.2 with a summary of these matters provided in the following table.

Table 3-8: MNES assessment summary

Category	Result	Relevance	Significant impact likely?
World Heritage Properties	None	The proposed works will not affect any World Heritage areas.	No
National Heritage Places	None	The proposed works will not affect any National Heritage Places.	No
Wetlands of International Importance	None	The proposed works will not affect any Wetlands of International Importance.	No
Great Barrier Reef Marine Park	None	The proposed works will not affect the Great Barrier Reef Marine Park.	No
Commonwealth Marine Environment	None	The proposed works will not affect any Commonwealth Marine Area.	No
Listed Threatened Ecological Communities	4	Four listed TECs are listed as known or likely to occur within the assessment area. Field assessments confirmed that one of these TECs occur within the study area.	No
Listed Threatened Species	92	Numerous threatened species are listed as known/likely/may occur within the assessment area. An assessment of these has determined that some of these have the potential to occur within study area.	No
Listed Migratory Species	67	Several migratory birds are considered potential occurrences in the assessment area.	No



## 4. Avoidance and minimisation

A key part of TfNSW's management of biodiversity for this proposal is the application of the 'avoid, minimise, mitigate and offset' hierarchy as follows:

1. Avoid and minimise impacts.
2. Mitigate impacts.
3. Offset impacts in accordance with TfNSW guidelines.

This chapter of the BAR demonstrates the efforts taken to avoid and minimise impacts on biodiversity values.

The project aims to increase public safety in a specific location along the Pacific Highway. Due to the nature of the project, there is limited scope for locating it in an alternative location to avoid impacts to native flora and fauna communities.

The project has however been designed so as to utilise existing infrastructure which minimises the scope of the required works, in turn, minimising the amount of vegetation clearing required and minimising the impacts to the surrounding environment.

## 5. Impact assessment

The project will require the removal of vegetation and the alteration of the study area which will have direct impacts on the existing flora communities and pose potential indirect impacts to the local fauna population. This section details the potential environmental impacts resulting from the construction and operational phases of the project.

### 5.1 Construction direct impacts

#### 5.1.1 Removal of native vegetation

The project will require the removal of approximately 4.19 hectares of native vegetation from three native vegetation communities. An additional 5.55 hectares of exotic roadside and grassland vegetation will require removal with the remainder comprising 6.21 hectares of non-vegetated roadways. No vegetation removal is required for the establishment of the ancillary areas.

All native vegetation communities requiring vegetation removal are analogous with a BC Act and/or EPBC Act TEC. These comprise 2.87 hectares of vegetation from a Swamp Oak swamp forest which aligns with the BC Act-listed Endangered Ecological Community (EEC) *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* and EPBC Act-listed EEC *Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland*; 1.04 hectares of an Estuarine reedland which also aligns with the BC Act-listed EEC *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*; and 0.28 hectares of vegetation from a Typha rushland community which aligns with the BC Act-listed EEC *Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*.

No hollow-bearing trees, fauna nests, Narrow-leaved Red Gum or mangroves are proposed to be removed. However, up to three preferred Koala food trees may require trimming for road sign installation.

The following table summarises the extent of direct impacts of the proposal on native vegetation.

Table 5-1: Summary of direct impacts on native vegetation

Veg. zone	Plant community type (PCT)	Broad condition class	TEC	Area to be impacted (ha)
Zone 1	PCT 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion	Moderate	Endangered (BC Act and EPBC Act)	1.73
Zone 2	PCT 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion	Disturbed	Endangered (BC Act and EPBC Act)	1.14
Zone 3	PCT 1808: Estuarine reedland	Moderate	Endangered (BC Act)	1.04
Zone 4	PCT 1737: Typha rushland	Moderate	Endangered (BC Act)	0.28

#### 5.1.2 Aquatic impacts

Marine vegetation identified within the study area is not located within the construction footprint/ancillary areas and is not proposed to be directly impacted by the works.

The construction footprint does, however, encompass areas that are commonly inundated with water for extended periods. Construction works within these areas have the potential to pose a risk to aquatic fauna which may utilise these areas.



### 5.1.3 Wetland impacts

The margins of a mapped Coastal Wetland occur immediately outside the George Gibson South Expanded ancillary area. Should direct impacts to this wetland occur, an Environmental Impact Statement would be required to be completed for the project.

### 5.1.4 Injury and mortality

The project does not propose to remove any hollow-bearing trees, hollow logs, log piles, nests or dreys; and Koala food trees within the study area may require a small amount of branch trimming only. Therefore, providing a low risk of fauna mortality during clearing operations.

## 5.2 Indirect and operational impacts

### 5.2.1 Inadvertent impacts on adjacent vegetation

If not properly demarcated and protected, it is possible that retained trees, wetlands and vegetation adjacent to the construction footprint and ancillary areas could be impacted by clearing, earthworks and construction vehicle movements. Impacts resulting from this are likely to be temporary however long-term impacts are possible, should vegetation clearing occur beyond the extent assessed. Recommendations have been provided to reduce this risk.

### 5.2.2 Impacts to potential threatened population

The establishment of an ancillary area directly adjacent to a potential threatened population has the potential to inadvertently damage the population is not properly protected. Recommendations have been provided to reduce this risk.

### 5.2.3 Erosion and sedimentation

Sedimentation and erosion impacts can occur at both the construction and operational phases of the project. Erosion and sedimentation may occur via erosion of fill material and disturbed soils, scouring of exposed soil, earthen banks and habitats adjacent to the construction footprint and ancillary areas via directed flow (e.g., stormwater), or where runoff is concentrated. If unmitigated, these can lead to the reduction water quality of downstream waterways and cause siltation, having flow-on effect to flora and fauna.

Standard mechanisms and controls will be required to ensure the prevention of erosion and sedimentation during throughout the project and to ensure such impacts do not extend beyond the construction footprint and ancillary areas.

### 5.2.4 Edge effects on adjacent native vegetation and habitat

The removal of trees and vegetation has potential to further expose areas of vegetation within the study area and surrounding to higher edge effects such as wind, light penetration and weed invasion. The vegetation within the study area is already subject to these impacts as a result of the historical development of the roads. The project is likely to increase edge effects only marginally within the study area beyond what is currently present.

### 5.2.5 Wildlife connectivity and habitat fragmentation

The vegetation requiring removal for the project is situated directly adjacent to existing road infrastructure and adjoining large areas of cleared agricultural land. Connectivity from vegetation within the study area to nearby vegetation is therefore already limited with cleared pasture lands and high-use road reserves forming a barrier to fauna. The required vegetation removal will increase the distance between these patches of vegetation; however, impacts from this are anticipated to be minimal due to presence of existing barriers. Any fauna currently able to cross the existing barriers are expected to be able to continue to do so post-development.

### 5.2.6 Injury and mortality

The project will see the introduction of additional road infrastructure to the study area. The introduction of this has the potential to increase the risk of fauna mortality and strike; however, only a marginal increased risk is anticipated due to the following reasons:

- the already high risk of fauna strike in the area posed by the high speed, high use Pacific Highway;

- the lack of roadkill records in the general area;
- the project is not anticipated to increase the presence of vehicles within the area; and
- that the project will reduce the speed of vehicles on Cooperbrook Road and Harrington Road, through the introduction of roundabouts.

### 5.2.7 Invasion and spread of weeds

A large portion of the study area comprises an exotic vegetation community. The following table provides a list of exotic flora species, recorded within the study area, in which the Department of Planning, Industry and Environment have listed as *High Threat Weeds*.

Table 5-2: High Threat Weeds recorded within the study area

Scientific name	Common name	Classification
<i>Bidens pilosa</i>	Cobbler's Pegs	High Threat Weed - not manageable
<i>Chloris gayana</i>	Rhodes Grass	High Threat Weed - not manageable
<i>Cinnamomum camphora</i>	Camphor Laurel	High Threat Weed - manageable
<i>Eragrostis curvula</i>	African Lovegrass	High Threat Weed - not manageable
<i>Ipomoea cairica</i>	Coastal Morning Glory	High Threat Weed - not manageable
<i>Lantana camara</i>	Lantana	High Threat Weed - manageable
<i>Senecio madagascariensis</i>	Fireweed	High Threat Weed - not manageable

In these areas, there is an abundance of weed species that have the potential to be further spread throughout the study area and surrounds should mitigations measures not be implemented. Mitigation measures to reduce the risk of weed spread have been recommended in this report.

### 5.2.8 Invasion and spread of pathogens and disease

Aquatic habitat is located within and adjacent to the study area. The increased human presence to these areas during construction has the potential to introduce or spread a range of pathogens and disease. One such pathogen is Chytrid Fungus (*Batrachochytrium dendrobatidis*) which is believed to be linked to the increase in decline of some frog species in Australia (Department of Planning and Environment 2020). Mitigation measures have been recommended to reduce the risk of introduction or spread of Chytrid fungus to the study area.

### 5.2.9 Changes to hydrology

The project may alter the surface hydrology of the study area. Changes have the potential to be minor should construction be restricted to the areas that have been already built-up in preparation for the establishment of the overpass. Should construction extend to the full limits of the construction footprint assessed in this report, the hydrology in parts of the study area is anticipated to be directly altered.

### 5.2.10 Noise, light, dust and vibration

Minor levels of dust may be generated during construction and may lead to minor impacts on directly adjoining vegetation.

Currently, noise is derived from traffic along the Pacific Highway and surrounding roads, hence fauna is likely to have some tolerance to anthropogenic noise. During the development's establishment, noise would be highest during construction. This has the potential to impact nocturnal fauna utilising the study area; however, impacts from this are anticipated to be minimal in consideration that the study area represents highly-trafficked roads which are frequented by large vehicles at night. Post-construction, noise levels will return to levels at present.

During the construction phase, additional illumination may be required should the works be conducted nocturnally. Recommendations have been made to reduce the risk of this additional illumination disturbing local fauna.



## 5.3 Assessments of significance

This section provides an assessment of significance for all threatened entities recorded in the study area or identified as having a moderate to high likelihood of occurring within the assessment area in the habitat suitability assessment (Appendix B).

### 5.3.1 BC Act 2016

The Test of Significance is prescribed in Part 7, Division 1, Section 7.2 of the *Biodiversity Conservation Act 2016*. The purpose of the Test of Significance is to determine whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats.

Habitat suitability assessments identified two threatened ecological communities and a total of 14 species listed under the BC Act that are considered to have a moderate to high chance of occurring on the study area with an additional one species known to occur based of recent reputable records of the species within the study area. A Significant Impact Assessment for these species is provided in Appendix D. The following table summarises the results of these assessments with an assessment of the potential Key Threatened Processes (KTP) following.

Table 5-3: Summary of BC Act significance assessments findings

Threatened species, or communities	Likely significant impact?
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	No
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	No
<i>Botaurus poiciloptilus</i> (Australasian Bittern)	No
<i>Circus assimilis</i> (Spotted Harrier)	No
<i>Ephippiorhynchus asiaticus</i> (Black-necked Stork)	No
<i>Epthianura albifrons</i> (White-fronted Chat)	No
<i>Haliaeetus leucogaster</i> (White-bellied Sea Eagle)	No
<i>Hieraetus morphnoides</i> (Little Eagle)	No
<i>Irediparra gallinacean</i> (Comb-crested Jacana)	No
<i>Ixobrychus flavicollis</i> (Black Bittern)	No
<i>Lophoictinia isura</i> (Square-tailed Kite)	No
<i>Ninox connivens</i> (Barking Owl)	No
<i>Ninox strenua</i> (Powerful Owl)	No
<i>Pandion cristatus</i> (Eastern Osprey)	No
<i>Tyto longimembris</i> (Eastern Grass Owl)	No
<i>Tyto novaehollandiae</i> (Masked Owl)	No
<i>Litoria aurea</i> (Green & Golden Bell Frog)	No

#### Key Threatening Processes

A Key Threatening Process (KTP) is defined as a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities. An assessment of KTPs in relation to the proposed works is provided in the table below.

Table 5-4: Contribution to Key Threatening Processes

Key Threatening Process	Will the proposal affect KTP?
Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners <i>Manorina melanocephala</i>	No
Alteration of habitat following subsidence due to longwall mining	No
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	Yes – works are likely to alter the flow regime of frequently flooded areas nearby; however, these are considered to be minor in comparison to the alterations that have historically occurred for the development of the existing roads.
Anthropogenic Climate Change	Yes – vegetation removal and greenhouse gasses generated by machinery used during construction.
Bushrock removal	No
Clearing of native vegetation	Yes – approximately 4.19 ha of native vegetation to be removed.
Competition and grazing by the feral European Rabbit, <i>Oryctolagus cuniculus</i>	No
Competition and habitat degradation by Feral Goats, <i>Capra hircus</i>	No
Competition from feral honeybees, <i>Apis mellifera</i>	No
Death or injury to marine species following capture in shark control programs on ocean beaches	No
Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments	No
Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	No
Herbivory and environmental degradation caused by feral deer	No
High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition	No
Importation of Red Imported Fire Ants <i>Solenopsis invicta</i>	No
Infection by Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species and populations	No
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	No
Infection of native plants by <i>Phytophthora cinnamomi</i>	No
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	No
Introduction of the Large Earth Bumblebee <i>Bombus terrestris</i>	No
Invasion and establishment of exotic vines and scramblers	No
Invasion and establishment of Scotch Broom ( <i>Cytisus scoparius</i> )	No
Invasion and establishment of the Cane Toad ( <i>Bufo marinus</i> )	No
Invasion of native plant communities by African Olive <i>Olea europaea subsp. cuspidata</i> .	No



Key Threatening Process	Will the proposal affect KTP?
Invasion of native plant communities by <i>Chrysanthemoides monilifera</i>	No
Invasion of native plant communities by exotic perennial grasses	No –provided recommendations for clearing measures and weed control are followed
Invasion of the Yellow Crazy Ant, <i>Anoplolepis gracilipes</i> into NSW	No
Invasion, establishment and spread of Lantana ( <i>Lantana camara</i> )	No –further spread of <i>Lantana camara</i> is not anticipated provided recommendations for clearing measures and weed control are followed
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	No
Loss of Hollow-bearing Trees	No
Loss or degradation (or both) of sites used for hill-topping by butterflies	No
Predation and hybridisation by Feral Dogs, <i>Canis lupus familiaris</i>	No
Predation by <i>Gambusia holbrooki</i> (Plague Minnow or Mosquito Fish)	No – <i>Gambusia holbrooki</i> are already abundant in the study area
Predation by the European Red Fox <i>Vulpes vulpes</i>	No
Predation by the Feral Cat <i>Felis catus</i>	No
Predation by the Ship Rat <i>Rattus rattus</i> on Lord Howe Island	No
Predation, habitat degradation, competition and disease transmission by Feral Pigs, <i>Sus scrofa</i>	No

### 5.3.2 EPBC Act 1999

The following assesses the MNES, identified in Section 3.11, that have the potential to occur within the study area.

#### Threatened Ecological Communities

The Protected Matters Search Tool identified the following EPBC Act-listed Threatened Ecological Communities that are known or are likely to occur within the assessment area:

- Coastal Swamp Oak (*Casuarina glauca*) Forest of NSW and South East Queensland.
- Coastal Swamp Sclerophyll Forest of NSW and South East Queensland.
- Littoral Rainforest and Coastal Vine Thickets of Eastern Australia.
- Lowland Rainforest of Subtropical Australia.

One of these TECs has been identified within the study area. This comprises the Coastal Swamp Oak (*Casuarina glauca*) Forest of NSW which occurs scattered throughout the study area. A Significant Impact Assessment for this TECs is provided in Appendix E.

#### Threatened Species

The Protected Matters Search Tool identified 92 EPBC Act threatened species with the potential to occur within the assessment area. A portion of these comprise migratory marine birds which are dependent on offshore marine environments, which do not occur within the study area. The remaining 66 species have been assessed in the habitat suitability assessment for their potential to occur within the study area.

Habitat suitability assessments identified two species listed under the EPBC Act that are considered to have a moderate to high chance of occurring within the study area with an additional one species known to occur based of recent reputable records of the species within the study area. A Significant Impact Assessment for these species is provided in Appendix E.

**Migratory Species**

The Protected Matters Search Tool has identified 67 EPBC Act migratory species with the potential to occur within the assessment area. The majority of these listed as Migratory Marine species. As no marine environments occur within the study area, these species have been excluded from further assessment. The remaining Migratory Wetland and Migratory Terrestrial species listed under the Protected Matters Search Tool have been assessed in the habitat suitability assessment for their potential to occur within the study area.

Habitat suitability assessments identified two migratory species listed under the EPBC Act that are considered to have a moderate to high chance of occurring on the study area. A Significant Impact Assessment for these species is provided in Appendix E.

**Entities subject to significance assessments**

The following table summarises the results of the significance assessments conducted for EPBC Act-listed entities.

Table 5-5: Summary of EPBC Act significance assessments findings

Threatened or migratory species, or communities	Likely significant impact?
Coastal Swamp Oak ( <i>Casuarina glauca</i> ) Forest of NSW and South East Queensland.	No
<i>Hirundapus caudacutus</i> (White-throated Needle-tail)	No
<i>Litoria aurea</i> (Green & Golden Bell Frog)	No
<i>Pandion haliaetus</i> (Eastern Osprey)	No



## 6. Mitigation

The following table outlines the measures proposed to be implemented to mitigate indirect impacts resulting from the proposal.

Table 6-1: Mitigation measures

ID	Impact	Mitigation measure	Timing and duration	Likely efficacy of mitigation	Responsibility
B01	Removal of vegetation and fauna habitat	Native vegetation and threatened flora/fauna habitat removal will be minimised where reasonable and feasible through the detailed design.	Detailed design	Effective	TfNSW
B02		Pre-clearing surveys will be undertaken in accordance with <i>Guide 1: Pre-clearing process</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Prior to construction	Effective	TfNSW Contractor
B03		Vegetation and habitat removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	TfNSW Contractor
B04		Native vegetation will be re-established in accordance with <i>Guide 3: Re-establishment of native vegetation</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Post construction	Effective	TfNSW Contractor
B05		The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) if threatened ecological communities, flora or fauna, not assessed in the biodiversity assessment, are identified in the proposal site.	During construction	Proven	TfNSW Contractor All personnel
B06		The loss of native trees is to be compensated through application of the Tree and Hollow Replacement Guidelines (TfNSW 2022). Guidelines specify the requirement for tree replacements which are to be managed under a Tree Replacement Plan. The Tree Replacement Management Plan is to be developed prior to the commencement of clearing works by a suitably qualified ecologist.	Prior to construction	Effective	TfNSW Contractor Ecologist
B07	Aquatic impacts	Should any water be present, transports procedure for clearing of riparian and aquatic vegetation is to be followed (Guide 10: Biodiversity Guidelines), along with the following dewatering procedure: <ul style="list-style-type: none"> <li>Wet areas are to be dewatered in accordance with industry standards.</li> <li>An aquatic ecologist or ecologist is to be present on site to supervise dewatering in order to retrieve any aquatic fauna present. Native species captures are to be released in suitable aquatic habitat nearby. Any exotic species captured (e.g., Mosquito Fish), are to be ethically euthanised on site by the ecologist.</li> </ul>	During construction	Effective	TfNSW Ecologist
B08		Aquatic habitat will be protected in accordance with <i>Guide 10: Aquatic habitats and riparian zones</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) and Section 3.3.2 <i>Standard precautions and mitigation</i>	During construction	Effective	TfNSW Contractor All personnel



ID	Impact	Mitigation measure	Timing and duration	Likely efficacy of mitigation	Responsibility
		<i>measures of the Policy and guidelines for fish habitat conservation and management Update 2013</i> (DPI (Fisheries NSW) 2013).			
B09	Wetland impacts	To mitigate indirect impacts from ancillary storage within the George Gibson South Expanded ancillary area, an exclusion zone of ten metres from the mapped Coastal Wetland is to be established. This is to be established with temporary fencing or tape whereby it is clearly marked that personnel and vehicles are not to enter and no material storage is to be placed in this area.	Prior to construction	Effective	TfNSW Contractor All personnel
B10		To ensure no indirect impacts to the coastal wetland adjoining the George Gibson South Expanded ancillary facility, no earthworks are to occur within a ten-metre buffer of the wetland boundary and suitable erosion and sediment control measures are to be installed.	Prior to construction	Effective	TfNSW Contractor All personnel
B11	Injury and mortality of fauna	Fauna will be managed in accordance with <i>Guide 9: Fauna handling</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	TfNSW Contractor All personnel
B12		The unexpected species find procedure is to be followed under <i>Guide 1: Pre-clearing process</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) if threatened fauna, not assessed in the biodiversity assessment, are identified in the proposal site.	During construction	Proven	TfNSW Contractor All personnel
B13		Pre-clearing surveys will be undertaken in accordance with <i>Guide 1: Pre-clearing process</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011). Pre-clearing surveys are to be undertaken by a qualified ecologist immediately prior to commencement of any vegetation removal involving machinery and/or tree-felling. The ecologist is to flag any habitat features which may contain fauna and trees which contain nests or dreys.	During construction	Proven	TfNSW Contractor Ecologist
B14	Inadvertent impacts on adjacent vegetation	In order to prevent inadvertent clearing beyond what is required and has been assessed, the area/trees to be cleared is to be clearly marked (e.g., with stakes and bunting or flagging tape/spray paint for individual trees) before clearing operations commence.	Prior to construction	Effective	TfNSW
B15		To avoid inadvertent damage to adjoining TECs, an exclusion zone is to be established around retained TECs. This is to clearly mark the limits of the construction footprint and ancillary areas; and prevent any machinery from entering areas beyond this boundary.	Prior to construction	Effective	TfNSW

ID	Impact	Mitigation measure	Timing and duration	Likely efficacy of mitigation	Responsibility
B16		Design is to specify a designated location for ancillary facilities (material stores, site office and parking) outside of mapped native vegetation. No clearing of native vegetation is to occur for the establishment of the ancillary facilities.	Prior to construction and during construction	Effective	TfNSW
B17		<p>All personnel are to be inducted to the site before starting work. Site inductions are to specify:</p> <ul style="list-style-type: none"> <li>• The significance of TECs, the potential threatened population and coastal wetlands; and the location of these within the study area.</li> <li>• The location of exclusion zones and that no personnel, materials or vehicles are to enter or be stored in these areas.</li> <li>• No clearing is to occur beyond the marked areas.</li> <li>• No clearing is to occur for the establishment of the ancillary facilities.</li> <li>• Vehicles are only to be parked in designated areas.</li> <li>• Materials are to be stored in designated areas and outside of areas mapped as containing native vegetation.</li> <li>• Clearing and earthworks are to avoid damage to root zones or retained vegetation.</li> <li>• Vehicles and personnel are not to enter TECs outside of the marked construction footprint and ancillary areas.</li> <li>• All procedures regarding vegetation clearing, fauna handling and unexpected species finds.</li> <li>• No littering.</li> </ul>	Prior to construction and during construction	Effective	TfNSW
B18	Impacts to potential threatened population	An exclusion zone is to be established around the potential threatened population of <i>Eucalyptus seeana</i> . The exclusion zone should be clearly demarcated with temporary fencing or tape to ensure no access to personnel, vehicles or material storage. This exclusion zone is to extend to the dripline of the identified trees that form part of the population. The establishment of this exclusion zone will mitigate the risks of direct impacts to the potential threatened population.	Prior to construction and during construction	Effective	TfNSW Contractor All personnel
B19		To reduce the risks of indirect impacts to the potential threatened population, an additional limited access zone is to be established around the population. This limited access zone is to incorporate an eight-metre buffer from the base of all eucalypts within the George Gibson North ancillary area. This limited access zone is not required to be demarcated however all personnel are to be aware that although driving through this area is permitted, parking of vehicles and heavy machinery in this area is not allowed. The establishment of this limited access area will mitigate the risk of soil compaction around the root zones of the retained vegetation.	Prior to construction and during construction	Effective	TfNSW Contractor All personnel



ID	Impact	Mitigation measure	Timing and duration	Likely efficacy of mitigation	Responsibility
B20		No tree removal is to occur within the George Gibson North ancillary area.	During construction	Effective	TfNSW Contractor
B21	Erosion and sedimentation	Erosion and sedimentation control measures will be required to ensure that nearby retained habitats and aquatic areas are not substantially affected by erosion and sedimentation. This is to involve the use of silt fences to ensure that surrounding aquatic habitats are not impacted. Erosion and sediment controls are to be implemented in all areas adjacent to a wetland or threatened ecological community.	Prior to construction and during construction	Effective	TfNSW Contractor
B22	Edge effects on adjacent native vegetation and habitat	Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	TfNSW Contractor
B23	Invasion and spread of weeds	Weed species will be managed in accordance with <i>Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	TfNSW Contractor
B24		Disturbance of the soils in the study area during vegetation removal and construction has the potential to spread weed species beyond where they currently occur. Hence, it is recommended that: <ul style="list-style-type: none"> <li>A wash down protocol for machines prior to entering the site and prior to leaving weed infested areas is recommended to minimise the spread of weeds. This is particularly important to protect the newly disturbed areas from being dominated by exotic weeds. Vehicle washdowns are not to occur in a location where runoff may enter the sites wetlands system.</li> <li>Disturbance of vegetation and soils in the study area should be limited to the areas of the proposed work and should not extend into adjacent vegetation.</li> <li>Cleared vegetation should be mulched on site by the clearing contractors and any mulch containing weed species, taken to a licenced landfill. Re-spreading of any weedy vegetation over the study area is not recommended.</li> </ul>	During construction	Effective	TfNSW Contractor All personnel
B25	Invasion and spread of pathogens and disease	Pathogens will be managed in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	TfNSW Contractor All personnel
B26		In the event that threatened amphibians are recorded, management measures to avoid and minimise the spread of amphibian chytrid fungus will be required. The DPIE document <i>Hygiene Guidelines: Protocols to protect priority biodiversity areas in NSW form Phytophthora cinnamomi, myrtle rust, amphibian chytrid fungus and invasive plants</i> (Department of Planning, Industry and Environment (2020) provides measures that	During construction	Effective	TfNSW Contractor All personnel

ID	Impact	Mitigation measure	Timing and duration	Likely efficacy of mitigation	Responsibility
		<p>should be followed on site to reduce the risk of spreading or introducing amphibian chytrid fungus.</p> <p>It is recommended that a hygiene management plan for the works is prepared as per the template in Appendix F of the guidelines. This will identify the specific risks and procedures for the works.</p> <p>The plan must include the following protocols as a minimum:</p> <p>Measures required prior to entering work site or moving to new areas:</p> <ul style="list-style-type: none"> <li>• Check personnel, clothing, footwear, backpacks and equipment for soil, plant material/propagules and other debris.</li> <li>• Remove all soil, plant material and other debris using a hard brush and (if required) clean water.</li> <li>• Ensure all attempt to dry hands, clothing, footwear, and equipment is made before proceeding.</li> <li>• Ensure plant and machinery is thoroughly cleaned inside and out before entering the site or moving between different areas (refer to page 12 and 17 of the guide). Use 70% alcohol wipes or a spray bottle to apply disinfectant to the interior of vehicle. Spray the exterior with disinfectant or hand pressure sprayer. Allow the disinfectant to remain in contact with the surface for at least 30 seconds before rinsing with clean water.</li> </ul>			
B27	Changes to hydrology	Changes to existing surface water flows will be minimised through detailed design.	Detailed design	Effective	TfNSW
B28	Noise, light, dust and vibration	<p>Shading and artificial light impacts will be minimised through detailed design.</p> <p>To ensure anthropogenic impacts are minimised, it is recommended that artificial lighting be kept to a minimum and be of a localised and low luminosity, with light directed to the ground and not onto retained vegetation. Sufficient artificial lighting will likely be required for security reasons and in the event any evening works are required.</p>	Detailed design, during construction	Effective	TfNSW All personnel



## 7. Offsets and other measures

Although not required under the BC Act, the proposal may require the provision of biodiversity credits under TfNSW guidelines.

### 7.1 Thresholds

The TfNSW document, No Net Loss Guidelines (2022), outlines the offset thresholds which are to be used to identify the biodiversity impacts in this BAR that trigger thresholds. The following table summarises these offset thresholds in relation to the proposal.

Table 7-1: Offset thresholds (TfNSW No Net Loss Guidelines)

Impact	Threshold	Response
Works involving clearing of a <u>CEEC</u>	Where there is any clearing of an <u>CEEC</u> in 'moderate to good' condition	No
Works involving clearing of an <u>EEC</u>	Where clearing of a <u>EEC</u> $\geq 2$ ha in 'moderate to good' condition	The proposal involves the clearing of a total of 4.19 hectares of moderate condition EECs.
Works involving clearing of <u>VEC</u>	Where clearing of <u>VEC</u> $\geq 5$ ha in 'moderate to good' condition	No
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 $\geq 1$ ha in 'moderate to good' condition	No
Works involving removal of known threatened flora species and their habitat	Where loss of individuals is $\geq 10$ or where clearing of habitat is $\geq 1$ ha	No
Type 1 or Type 2 key fish habitats	Where there is a net loss of habitat	No
<b>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.</b>	<b>Any clearing of hollows</b>	<b>No</b>
	<b>Any clearing of trees <math>\geq 5</math>cm DBH</b>	<b>Yes</b>

Table 7-2: Assessment of native vegetation impacts against thresholds

Veg. zone	Plant community type (PCT)	Condition	TEC	Impact area (ha)	Threshold triggered?
Zone 1	PCT 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion	Moderate	Endangered (BC Act and EPBC Act)	1.73	Offset threshold not triggered as clearing extent is less than 2ha. Hollow replacement not required. Tree replacement required for large (50-100cm DBH), medium (20-50cm DBH) and small trees (5-19cm

Veg. zone	Plant community type (PCT)	Condition	TEC	Impact area (ha)	Threshold triggered?
Zone 2	PCT 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion				DBH). Tree replacements are required at a 8:1, 4:1 and 2:1 ratio respectively.
		Disturbed	Endangered (BC Act and EPBC Act)	1.14	Offset threshold not triggered as clearing extent is less than 2ha. Hollow replacement not required. Tree replacement required for medium (20-50cm DBH) and small trees (5-19cm DBH). Tree replacements are required at a 4:1 and 2:1 ratio respectively.
Zone 3	PCT 1808: Estuarine reedland	Moderate	Endangered (BC Act)	1.04	Offset threshold not triggered as clearing extent is less than 2ha. Tree and hollow replacement not required.
Zone 4	PCT 1737: Typha rushland	Moderate	Endangered (BC Act)	0.28	Offset threshold not triggered as clearing extent is less than 2ha. Tree and hollow replacement not required.

## 7.2 Biodiversity offset strategy/tree and hollow replacement plan

In accordance with the Tree and Hollow Replacement Guidelines (TfNSW 2022), the proposal will require replacement trees to be planted for each tree over 5cm diameter at breast height (DBH) removed. Tree replacements are to be managed under a Tree Replacement Plan, which is to detail (at a minimum) the specific number of replacement trees required, the location for proposed plantings, planting requirements and management actions. A Tree Replacement Management Plan is to be developed prior to the commencement of clearing works by a suitably qualified ecologist.



## 8. Conclusion

This report has assessed the environmental impact of the upgrade of the Harrington Road and Cooperbrook Road intersections with the Pacific Highway. Field assessments identified a total of three native vegetation communities within the study area that will be directly impacted through vegetation removal. Large areas of cleared land or exotic vegetation are also present. Native vegetation communities within the construction footprint and ancillary areas are analogous with BC Act and/or EPBC Act listed TECs.

Seven Grey Mangroves which as classified as Marine Vegetation under the *Fisheries Management Act 1994* and two stick nests, were identified in the south of the study area. These were outside the construction footprint and ancillary areas; and are not anticipated to be directly impacted by the project. Locally preferred Koala food trees are also located within the study area however none of these are proposed to be removed with only branch thinning possibly required for the installation of new signs. No locally hollow-bearing trees, dreys, hollow logs or log piles were recorded within the study area.

No threatened flora or fauna species were recorded within the study area during the survey period. Habitat suitability assessments identified numerous threatened/migratory fauna species within the potential to occur within the study area. Those with suitable habitat and recent local records; or considered as having a moderate to high likelihood of occurring within the study area were subject to tests of significance under the BC Act and/or EPBC Act. Significance assessments determined that due to the minimal vegetation/habitat removal required and the already disturbed nature of the study area, the proposal is unlikely to place any Threatened Ecological Community, threatened fauna species or migratory species at risk of extinction. As such, the purchase and retirement of biodiversity offset credits or EPBC Act referral are not required.

Assessment under the TfNSW Biodiversity Assessment Guidelines determined that offset thresholds were not triggered; however, tree replacements are required. Details as the species, number and location of tree replacements, as well as details regarding planting procedures and monitoring, are to be outlined in a Tree Replacement Plan.

An assessment of potential impacts of the proposal identified several indirect impacts potentially associated within the works. These largely relate to anthropogenic disturbances, weed invasion and inadvertent clearing of adjoining vegetation. Specific mitigation measures are recommended to reduce the potential for indirect impacts.

## 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 <a href="#">About BioNet Vegetation Classification   NSW Environment and Heritage</a> .
Construction footprint	The area to be directly impacted by the proposal during construction activities. See also definition for subject land.



Term	Definition
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.
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: <ul style="list-style-type: none"> <li>• <i>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.</i></li> <li>• <i>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.</i></li> <li>• <i>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).</i></li> </ul>
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, <ol style="list-style-type: none"> <li>trees (including any sapling or shrub or any scrub)</li> <li>understorey <u>plants</u></li> </ol>

Term	Definition
	<p>c) groundcover (being any type of herbaceous vegetation)</p> <p>d) <u>plants</u> occurring in a wetland.</p> <p>A <u>plant</u> is native to New South Wales if it was established in New South Wales before European settlement (BC Act).</p> <p>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.</p>
NSW (Mitchell) landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000 (DPIE 2020a).
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	<p>An area of native vegetation that:</p> <ul style="list-style-type: none"> <li>• <i>occurs on the development site or biodiversity stewardship site</i></li> <li>• <i>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).</i></li> </ul> <p>Patch size may extend onto adjoining land that is not part of the development site or biodiversity stewardship site (DPIE 2020a).</p>
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	<p>Spatial databases required to prepare a BAR</p> <ul style="list-style-type: none"> <li>• <i>BioNet NSW (Mitchell) Landscapes – Version 3.1</i></li> <li>• <i>NSW Interim Biogeographic Regions of Australia (IBRA region and sub-regions) – Version 7</i></li> <li>• <i>NSW soil profiles</i></li> <li>• <i>hydrogeological landscapes</i></li> <li>• <i>acid sulfate soils risk</i></li> <li>• <i>digital cadastral database</i></li> <li>• <i>Vegetation Information Systems maps</i></li> <li>• <i>Geological sites of NSW.</i></li> </ul>
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 500m buffer



Term	Definition
	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.
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 <a href="http://www.bionet.nsw.gov.au">www.bionet.nsw.gov.au</a> .
Vegetation integrity (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. 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
DPIE	Department of Planning, Industry and Environment
EEC	Endangered ecological community
EHG	NSW Environment and Heritage Group within the Department of Planning and Environment
EIS	Environmental Impact Statement
EP&A Act	<i>Environment Planning and Assessment Act 1979</i> (NSW)
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (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
HBT	Hollow-bearing tree
IBRA	Interim Biogeographically Regionalisation of Australia
LGA	Local Government Area
MNES	Matters of national environmental significance
OEH	Office of Environment and Heritage
PCT	Plant community type
PMST	Protected Matters Search Tool
REF	Review of Environmental Factors
SAIL	Serious and Irreversible Impacts
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSD	State Significant Development
SSI	State Significant Infrastructure



Term	Definition
TBDC	Threatened Biodiversity Data Collection
TECs	Threatened ecological communities (VECs, EECs and CEECs)
TfNSW	Transport for NSW
VEC	Vulnerable Ecological Community

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## Appendix A: Species recorded

### Recorded flora

Plant type	Scientific name	Common name	Presence in each plot							Incidental observation
			1	2	3	4	5	6	7	
Canopy Trees	<i>Aegiceras corniculatum</i>	River Mangrove								X
Canopy Trees	<i>Alphitonia excelsa</i>	Red Ash								X
Canopy Trees	<i>Araucaria heterophylla*</i>	Norfolk Island Pine								X
Canopy Trees	<i>Avicennia marina</i>	Grey Mangrove								X
Canopy Trees	<i>Casuarina glauca</i>	Swamp Oak	X	X	X		X		X	
Canopy Trees	<i>Corymbia gummifera</i>	Red Bloodwood								X
Canopy Trees	<i>Eucalyptus amplifolia</i>	Cabbage Gum								X
Canopy Trees	<i>Eucalyptus seeana<sup>1</sup></i>	Narrow-leaved Red Gum <sup>1</sup>								X
Canopy Trees	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark								X
Small Trees/Shrubs	<i>Acacia falcata</i>	Hickory Wattle							X	
Small Trees/Shrubs	<i>Agapanthus praecox*</i>	African Lily								X
Small Trees/Shrubs	<i>Agave attenuate*</i>	Foxtail Agave								X
Small Trees/Shrubs	<i>Calliandra haematocephala*</i>	Powder Puff Tree								X
Small Trees/Shrubs	<i>Callistemon viminalis</i>	Weeping Bottlebrush								X
Small Trees/Shrubs	<i>Cinnamomum camphora**</i>	Camphor Laurel							X	
Small Trees/Shrubs	<i>Cirsium vulgare*</i>	Spear Thistle								X
Small Trees/Shrubs	<i>Colocasia esculenta*</i>	Taro								X



Transport  
for NSW

Plant type	Scientific name	Common name	Presence in each plot							Incidental observation	
			1	2	3	4	5	6	7		
Small Trees/Shrubs	<i>Hibiscus tiliaceus*</i>	Cottonwood Hibiscus									X
Small Trees/Shrubs	<i>Lantana camara**</i>	Lantana	X								
Small Trees/Shrubs	<i>Melaleuca linariifolia</i>	Flax-leaved Paperbark						X			
Small Trees/Shrubs	<i>Pittosporum undulatum</i>	Native Daphne									X
Small Trees/Shrubs	<i>Senna pendula*</i>	-									X
Small Trees/Shrubs	<i>Sonchus asper*</i>	Prickly Sowthistle								X	
Small Trees/Shrubs	<i>Solanum mauritianum*</i>	Wild Tobacco Bush									X
Ferns	<i>Pteridium esculentum</i>	Common Bracken		X							
Sedges, Rushes and Aquatics	<i>Bolboschoenus fluviatilis</i>	Marsh Club-rush				X	X				
Sedges, Rushes and Aquatics	<i>Carex appressa</i>	Tall Sedge	X	X		X	X				
Sedges, Rushes and Aquatics	<i>Cladium procerum</i>	Water Ribbons					X				
Sedges, Rushes and Aquatics	<i>Cotula coronopifolia*</i>	Watter Buttons	X								
Sedges, Rushes and Aquatics	<i>Cyperus sp.</i>	-					X				
Sedges, Rushes and Aquatics	<i>Eleocharis equisetina</i>	-				X					
Sedges, Rushes and Aquatics	<i>Isolepis inundata</i>	-				X					
Sedges, Rushes and Aquatics	<i>Juncus kraussii</i>	Sea Rush	X		X	X					
Sedges, Rushes and Aquatics	<i>Juncus usitatus</i>	Common Rush					X				
Sedges, Rushes and Aquatics	<i>Machaerina articulata</i>	Jointed Twig-rush				X					
Sedges, Rushes and Aquatics	<i>Nymphaea capensis*</i>	Cape Waterlily				X					
Sedges, Rushes and Aquatics	<i>Schoenoplectiella mucronata</i>	-				X					

Transport  
for NSW

Plant type	Scientific name	Common name	Presence in each plot							Incidental observation
			1	2	3	4	5	6	7	
Sedges, Rushes and Aquatics	<i>Typha domingensis</i>	Narrow-leaved Cumbungi				X				
Grasses	<i>Axonopus fissifolius</i> *	Narrow-leaved Carpet Grass								X
Grasses	<i>Capillipedium sp.</i>	Scented Top Grass							X	
Grasses	<i>Chloris gayana</i> **	Rhodes Grass							X	
Grasses	<i>Cynodon dactylon</i>	Couch	X				X		X	
Grasses	<i>Eragrostis curvula</i> **	African Lovegrass							X	
Grasses	<i>Imperata cylindrica</i>	Blady Grass		X						
Grasses	<i>Paspalum mandiocanum</i> *	Broadleaf Paspalum							X	
Grasses	<i>Paspalum sp.</i>	-		X						
Grasses	<i>Setaria sphacelata</i> *	South African Pigeon Grass				X	X	X	X	
Grasses	<i>Sporobolus virginicus</i>	Sand Couch			X	X				
Grasses	<i>Stenotaphrum secundatum</i> *	Buffalo Grass								X
Groundcovers	<i>Alternanthera denticulata</i>	Lesser Joyweed					X			
Groundcovers	<i>Apium prostratum</i>	Sea Celery					X			
Groundcovers	<i>Bidens pilosa</i> **	Cobbler's Pegs							X	
Groundcovers	<i>Centella asiatica</i>	Indian Pennywort					X			
Groundcovers	<i>Commelina cyanea</i>	Native Wandering Jew					X			
Groundcovers	<i>Conyza bonariensis</i> *	Flaxleaf Fleabane							X	
Groundcovers	<i>Crotalaria sp.</i> *	Rattlepod							X	
Groundcovers	<i>Cyclosporum leptophyllum</i> *	Slender Celery							X	

## Transport for NSW

Plant type	Scientific name	Common name	Presence in each plot							Incidental observation
			1	2	3	4	5	6	7	
Groundcovers	<i>Cynogeton procerum</i>	Water Ribbons				X				
Groundcovers	<i>Ludwigia peploides</i>	Water Primrose				X				
Groundcovers	<i>Macroptilium atropurpureum*</i>	Siratro								X
Groundcovers	<i>Medicago polymorpha *</i>	Burr Medic							X	
Groundcovers	<i>Persicaria decipiens</i>	Slender Knotweed				X	X			
Groundcovers	<i>Persicaria strigosa</i>	Spotted Knotweed		X						
Groundcovers	<i>Plantago lanceolata*</i>	Lamb's Tongue							X	
Groundcovers	<i>Rumex brownii</i>	Swamp Dock		X			X			
Groundcovers	<i>Rumex crispus*</i>	Curled Dock						X		
Groundcovers	<i>Senecio madagascariensis**</i>	Fireweed							X	
Groundcovers	<i>Tagetes minuta*</i>	Stinking Roger							X	
Groundcovers	<i>Trifolium arvense*</i>	Haresfoot Clover							X	
Groundcovers	<i>Trifolium pratense*</i>	Red Clover								X
Groundcovers	<i>Verbena bonariensis*</i>	Purpletop							X	
Vines and Scramblers	<i>Ipomoea cairica**</i>	Coastal Morning Glory	X				X		X	
Vines and Scramblers	<i>Parsonia straminea</i>	Common Silkpod					X			
Vines and Scramblers	<i>Vicia sativa*</i>	Common Vetch								

Key: Exotic species (\*), High Threat Weed (\*\*), possible species (<sup>1</sup>).



Recorded fauna

Class	Scientific name	Common name	Observation type	Status	
				BC Act	EPBC Act
Actinopterygii	<i>Gambusia holbrooki</i>	Mosquito Fish	Observed, netted	Not listed	Not listed
Amphibia	<i>Limnodynastes peronii</i>	Striped Marsh Frog	Heard call	Not listed	Not listed
Amphibia	<i>Litoria fallax</i>	Eastern Sedge Frog	Heard call	Not listed	Not listed
Aves	<i>Acanthiza lineata</i>	Striated Thornbill	Heard call, Observed	Not listed	Not listed
Aves	<i>Acanthiza pusilla</i>	Brown Thornbill	Heard call, Observed	Not listed	Not listed
Aves	<i>Acridotheres tristis</i>	Common Myna	Observed	Not listed	Not listed
Aves	<i>Acrocephalus australis</i>	Australian Reed-Warbler	Heard call, Observed	Not listed	Not listed
Aves	<i>Alisterus scapularis</i>	Australian King-Parrot	Observed	Not listed	Not listed
Aves	<i>Anas castanea</i>	Chestnut Teal	Observed	Not listed	Not listed
Aves	<i>Anas superciliosa</i>	Pacific Black Duck	Heard call, Observed	Not listed	Not listed
Aves	<i>Ardea intermedia</i>	Intermediate Egret	Heard call, Observed	Not listed	Not listed
Aves	<i>Artamus leucorhyn</i>	White-breasted Woodswallow	Observed	Not listed	Not listed
Aves	<i>Aythya australis</i>	Hardhead	Observed	Not listed	Not listed
Aves	<i>Bubulcus ibis</i>	Cattle Egret	Observed	Not listed	Not listed
Aves	<i>Cacatua sanguinea</i>	Little Corella	Heard call, Observed	Not listed	Not listed
Aves	<i>Caligavis chrysops</i>	Yellow-faced Honeyeater	Heard call	Not listed	Not listed
Aves	<i>Casmerodius modesta</i>	Eastern Great Egret	Observed	Not listed	Not listed
Aves	<i>Ceyx azureus</i>	Azure Kingfisher	Heard call, Observed	Not listed	Not listed
Aves	<i>Chalcites basalis</i>	Horsfield's Bronze-Cuckoo	Heard call	Not listed	Not listed

Class	Scientific name	Common name	Observation type	Status	
				BC Act	EPBC Act
Aves	<i>Chalcites lucidus</i>	Shining Bronze-Cuckoo	Heard call, Observed	Not listed	Not listed
Aves	<i>Chenonetta jubata</i>	Australian Wood Duck	Observed	Not listed	Not listed
Aves	<i>Cincloramphus timoriensis</i>	Tawny Grassbird	Heard call, Observed	Not listed	Not listed
Aves	<i>Cisticola exilis</i>	Golden-headed Cisticola	Heard call	Not listed	Not listed
Aves	<i>Colluricincla harmonica</i>	Grey Shrike-thrush	Heard call	Not listed	Not listed
Aves	<i>Corvus orru</i>	Torresian Crow	Heard call, Observed	Not listed	Not listed
Aves	<i>Cracticus nigrogularis</i>	Pied Butcherbird	Heard call, Observed	Not listed	Not listed
Aves	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	Heard call, Observed	Not listed	Not listed
Aves	<i>Egretta novaehollandiae</i>	White-faced Heron	Heard call, Observed	Not listed	Not listed
Aves	<i>Eolophus roseicapilla</i>	Galah	Heard call, Observed	Not listed	Not listed
Aves	<i>Geopelia humeralis</i>	Bar-shouldered Dove	Heard call, Observed	Not listed	Not listed
Aves	<i>Gerygone olivacea</i>	White-throated Gerygone	Heard call	Not listed	Not listed
Aves	<i>Grallina cyanoleuca</i>	Magpie-lark	Heard call, Observed	Not listed	Not listed
Aves	<i>Gymnorhina tibicen</i>	Australian Magpie	Observed	Not listed	Not listed
Aves	<i>Haliastur sphenurus</i>	Whistling Kite	Observed	Not listed	Not listed
Aves	<i>Hirundo neoxena</i>	Welcome Swallow	Heard call, Observed	Not listed	Not listed
Aves	<i>Lichmera indistincta</i>	Brown Honeyeater	Heard call	Not listed	Not listed
Aves	<i>Malurus cyaneus</i>	Superb Fairy-wren	Heard call, Observed	Not listed	Not listed
Aves	<i>Meliphaga lewinii</i>	Lewin's Honeyeater	Heard call	Not listed	Not listed
Aves	<i>Microcarbo melanoleucos</i>	Little Pied Cormorant	Observed	Not listed	Not listed

Transport  
for NSW

Class	Scientific name	Common name	Observation type	Status	
				BC Act	EPBC Act
Aves	<i>Myiagra inquieta</i>	Restless Flycatcher	Heard call, Observed	Not listed	Not listed
Aves	<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater	Heard call	Not listed	Not listed
Aves	<i>Neochmia temporalis</i>	Red-browed Finch	Heard call, Observed	Not listed	Not listed
Aves	<i>Pachycephala rufiventris</i>	Rufous Whistler	Heard call	Not listed	Not listed
Aves	<i>Pelecanus conspicillatus</i>	Australian Pelican	Observed	Not listed	Not listed
Aves	<i>Phalacrocorax varius</i>	Pied Cormorant	Observed	Not listed	Not listed
Aves	<i>Philemon corniculatus</i>	Noisy Friarbird	Heard call	Not listed	Not listed
Aves	<i>Porphyrio porphyrio</i>	Purple Swamphen	Heard call	Not listed	Not listed
Aves	<i>Rhipidura albiscapa</i>	Grey Fantail	Heard call, Observed	Not listed	Not listed
Aves	<i>Rhipidura leucophrys</i>	Willie Wagtail	Heard call, Observed	Not listed	Not listed
Aves	<i>Smicronis brevirostris</i>	Weebill	Heard call	Not listed	Not listed
Aves	<i>Todiramphus sanctus</i>	Sacred Kingfisher	Heard call, Observed	Not listed	Not listed
Aves	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	Heard call	Not listed	Not listed
Aves	<i>Vanellus miles</i>	Masked Lapwing	Heard call, Observed	Not listed	Not listed
Aves	<i>Zanda funereus</i>	Yellow-tailed Black-Cockatoo	Observed	Not listed	Not listed
Aves	<i>Zosterops lateralis</i>	Silvereye	Heard call	Not listed	Not listed
Reptilia	<i>Lampropholis delicata</i>	Dark-flecked Garden Sunskink	Observed	Not listed	Not listed
Reptilia	<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake	Observed	Not listed	Not listed



## Appendix B: Habitat suitability assessment

The below criteria have been used to determine the likelihood of threatened species occurring in the study area. Species considered for assessment include all species with recorded sightings within the assessment area within the past 20 years (obtained from BioNet Atlas, DPIE 2022a) and species identified with the potential to occur in the protected matters search tool (DAWE 2022a).

### 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	<p>A species is considered highly likely to occur in the study area if:</p> <ul style="list-style-type: none"> <li>• <i>There are previous credible records on BioNet within the study area from the last 10 years and suitable habitat is present.</i></li> </ul> <p><b>OR</b></p> <ul style="list-style-type: none"> <li>• <i>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.</i></li> </ul>
Moderate	<p>A species is considered moderately likely to occur in the study area if:</p> <ul style="list-style-type: none"> <li>• <i>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.</i></li> </ul> <p><b>OR</b></p> <ul style="list-style-type: none"> <li>• <i>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.</i></li> </ul> <p><b>OR</b></p> <ul style="list-style-type: none"> <li>• <i>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.</i></li> </ul>
Low	<p>A species is considered to have a low likelihood of occurring in the study area if:</p> <ul style="list-style-type: none"> <li>• <i>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.</i></li> </ul> <p><b>OR</b></p> <ul style="list-style-type: none"> <li>• <i>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.</i></li> </ul> <p><b>OR</b></p>

Likelihood	Criteria
	<ul style="list-style-type: none"> <li>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.</li> </ul>
Unlikely	Suitable habitat for the species is absent from the study area.

### Habitat suitability assessment table

Scientific name	Status		BAM credit type	Number of records	Likelihood of occurrence assessment	Likelihood of occurrence
	BC Act	EPBC Act				
Plants						
<i>Acacia courtii</i> (North Brother Wattle)	V	V	Species	1	This species is only known from the mountains of North Brother, Middle Brother and South Brother. The study area is not located within this geographic range (OEH 2022).	Unlikely
<i>Acronychia littoralis</i> (Scented Acronychia)	E	E	Species	0	The study area occurs in the southern extent of this species' range. It is known to occur between littoral rainforest and swamp sclerophyll forests, usually within 2 km of the coast. The study area does not provide suitable habitat for this species and no local records occur. Additionally, this species was not recorded during survey.	Unlikely
<i>Allocasuarina defungens</i> (Dwarf Heath Casuarina)	E	E	Species	0	In NSW this species is mostly found growing in tall heath on sand. No suitable habitat for this species occurs within the study area and not recorded during survey.	Unlikely
<i>Allocasuarina thalassoscopica</i>	-	E	Species	0	This species is restricted to the low closed heathland community of Mt Coolum on the Sunshine Coast and is not known to occur outside of this area (DCCEE 2022a). This species was not recorded during targeted survey.	Unlikely
<i>Arthraxon hispidus</i> (Hairy-joint Grass)	V	V	Species	0	A rainforest species favouring habitat with richer loams soils (OEH 2022). Suitable habitat for this species does not occur within the study area and not recorded during targeted survey.	Unlikely
<i>Asperula asthenes</i> (Trailing Woodruff)	V	V	Species	6	This species is known to occur in damp areas, often along riverbanks. Suitable habitat for this species may occur throughout the study area however this species was not recorded during targeted survey.	Low

Scientific name	Status		BAM credit type	Number of records	Likelihood of occurrence assessment	Likelihood of occurrence
	BC Act	EPBC Act				
<i>Corybas dowlingii</i> (Red Helmet Orchid)	E	-	Species	1	A tuberous orchid that prefers sheltered areas such as gullies and southerly slopes in tall open forest (OEH 2022). Usually found in well drained gravelly soil. Suitable habitat for this species does not occur within the study area.	Unlikely
<i>Cryptostylis hunteriana</i> (Leafless Tongue-orchid)	V	V	Species	0	This species is found in a range of environments however larger populations are typically recorded in woodland that is dominated by select eucalypts and Allocasuarina. This preferred habitat does not occur within the study area. No local records of this species occur.	Unlikely
<i>Cynanchum elegans</i> (White-flowered Wax Plant)	E	E	Species	3	This species is typically recorded on the edges of dry rainforest although other community associations have been recorded (OEH 2022). Preferred habitat for this species does not occur within the study area this species was not recorded during targeted survey.	Unlikely
<i>Eucalyptus glaucina</i> (Slaty Red Gum)	V	V	Species	0	This species grows in grassy woodland and dry eucalypt forest (OEH 2022). Suitable habitat for this species does not occur within the study area and no local records occur.	Unlikely
<i>Eucalyptus seeana</i> (Greater Taree LGA population)	E	-	Species	3	A large tree often occurring as scattered individuals in open forests and woodlands. Suitable habitat for this species occurs within the study area however this species was not recorded during targeted survey.	Low
<i>Euphrasia arguta</i>	CE	CE	Species	0	This species is historically known from the Bathurst area with plants from the Nundle area discovered in recent history. This re-discovery, north of its previously known range, was reported from eucalypt forests with a mixed grass and shrub understory (OEH 2022). Habitat of this type does not occur on within the study area and the location of the study area is not within the OEH mapped known or predicted geographic area (OEH 2022).	Unlikely
<i>Hakea archaeoides</i> (Big Nellie Hakea)	V	V	Species	0	A hinterland species which grows in deep gullies and on steep, sheltered, rocky slopes (DCCEEW 2022a). Habitat of this type does not occur on within the study area and no local records occur.	Unlikely
<i>Leichhardtia longiloba</i> (Slender Marsdenia)	E	V	Species	0	Typically recorded in wet sclerophyll forest and rainforest. Suitable habitat for this species does not occur within the study area and no local records occur.	Unlikely



Scientific name	Status		BAM credit type	Number of records	Likelihood of occurrence assessment	Likelihood of occurrence
	BC Act	EPBC Act				
<i>Lindernia alsinoides</i>	E	-	Species	296	An erect annual herb which grows in swamp forests and wetlands that are along coastal and hinterland creeks (OEH 2022). Suitable habitat for this species occurs within the study area however this species was not recorded during targeted survey.	Low
<i>Macadamia integrifolia</i> (Macadamia Nut)	-	V	Species	0	This species is generally found in Queensland with the study area occurring in the southern extent of this species' known distribution. Records in the Mid North Coast are planted trees.	Unlikely
<i>Maundia triglochinooides</i>	V	-	Species	2	This species requires shallow freshwater, creeks, dams or swamps to grow and is often associated with the wetland species <i>Triglochin procerum</i> . Habitats within the study area are suitable for this species and <i>Triglochin procerum</i> was recorded during the survey. Despite this however, <i>Maundia triglochinooides</i> was not recorded during targeted survey.	Low
<i>Melaleuca biconvexa</i> (Biconvex Paperbark)	V	V	Species	0	This species occurs in swamp margins or creek edges. Suitable habitat for this species occurs within the study area however this species was not recorded during survey and no local records occur.	Unlikely
<i>Parsonsia dorrigoensis</i> (Milky Silkpod)	V	E	Species	0	This species is found in dry eucalypt forests on sandstone and in moist shrubby eucalypt forests on metasediments. Waterlogged sites along creeks are where this species is most commonly found (OEH 2022). The study area does not provide suitable habitat for this species and no local records occur. Additionally, this species was not recorded during survey.	Unlikely
<i>Persicaria elatior</i> (Knotweed)	V	V	Species	0	This species is known to grow in moist areas with a particular preference for areas adjacent to streams and lakes. Occasionally this species is recorded in swamp forests (OEH 2022). Suitable habitat for this species occurs within the study area however this species was not recorded during survey and no local records occur.	Unlikely
<i>Phaius australis</i> (Lesser Swamp-orchid)	E	E	Species	0	This species is limited to areas of swampy grassland and swampy forest. Suitable habitat for this species occurs within the study area however this species was not recorded during survey and no local records occur.	Unlikely
<i>Rhizanthella slateri</i> (Eastern Underground Orchid)	V	E	Species	0	A highly cryptic species which almost completely grows underground. Flowers between September and November. Habitat associations are currently unknown however it is known to occur in sclerophyll forest (OEH 2022). This species is considered unlikely to occur as no local records occur and it was not recorded during survey conducted within the flowering season for the species.	Unlikely

Scientific name	Status		BAM credit type	Number of records	Likelihood of occurrence assessment	Likelihood of occurrence
	BC Act	EPBC Act				
<i>Rhodamnia rubescens</i> (Scrub Turpentine)	CE	CE	Species	114	A rainforest species which is also occasionally found in wet sclerophyll forest. Neither of these habitat communities occur on the study area and this species was not recorded during targeted survey.	Unlikely
<i>Rhodomyrtus psidioides</i> (Native Guava)	CE	CE	Species	1	A small tree or shrub often found near creeks and drainage lines within wet sclerophyll forest and subtropical, littoral and warm temperate rainforest communities. Although the study area contains wet areas required for this species, the vegetation communities this species is known to occur in, does not occur within the study area.	Unlikely
<i>Syzygium paniculatum</i> (Magenta Lilly Pilly)	E	V	Species	1	This species is restricted to specific soils of riverside rainforests and remnant littoral rainforests (OEH 2022). No suitable habitat for this species occurs within the study area and it was not recorded during the site surveys.	Unlikely
<i>Thesium austral</i> (Austral Toadflax)	V	V	Species	0	The study area contains areas of native groundcover, however the habitat in general is unlikely to be suitable for this species which is more often associated with grassland on coastal sea cliffs. No local records occur.	Unlikely
<i>Tylophora woollsii</i> (Cryptic Forest Twiner)	E	E	Species	3	This species is known to occur in moist eucalypt forests, rainforests and in moist areas of dry eucalypt forests (OEH 2022). Suitable habitat does not occur within the study area and this species was not recorded during the site surveys.	Unlikely
<b>Birds</b>						
<i>Anthochaera phrygia</i> (Regent Honeyeater)	CE	CE	Dual	0	Favoured winter flowering nectar sources for this species are very limited within the study area and no local records occur.	Unlikely
<i>Artamus cyanopterus cyanopterus</i> (Dusky Woodswallow)	V	-	Ecosystem	2	This species is known to primarily inhabit dry, open forests and woodlands with a preference for a groundcover of sedges and grasses and woody debris (OEH 2022). Preferred habitat for this species does not occur within the study area.	Unlikely
<i>Botaurus poiciloptilus</i> (Australasian Bittern)	E	E	Ecosystem	2	A wetland species found in areas of dense sedges, reeds and rushes (OEH 2022). Suitable habitat for this species occurs within the study area. The most recent record of this species occurs from 2014 in the Cattai Wetlands approximately 1.6 kilometres north-east of the study area (DPIE 2022a).	Moderate
<i>Burhinus grallarius</i> (Bush Stone-curlew)	E	-	Species	4	This species inhabits open woodlands and forests that have a sparse, grassy ground layer and fallen debris (OEH 2022). Very marginal suitable habitat for this species occurs within the study area and it is likely that the study area is too disturbed for this	Low

Scientific name	Status		BAM credit type	Number of records	Likelihood of occurrence assessment	Likelihood of occurrence
	BC Act	EPBC Act				
					species. All local records occur greater than six kilometres south-east of the study area around the Manning River mouth (all recorded greater than ten years ago). This species requires an abundance of leaf litter and fallen debris for breeding. Site has been extensively disturbed in the past by logging which would be a deterrent for this species. Not recorded by survey and not recorded within the assessment area within the past ten years. Unlikely to occur.	
<i>Calidris alba</i> (Sanderling)	V	-	Dual credit	43	A summer migrant often found on low coastal beaches that have firm sand. This species is rarely recorded in near-coastal wetlands (OEH 2022). Preferred habitat for this species does not occur within the study area and the wetlands within the study area are likely to be too disturbed and too far inland for this species. Very marginal potential habitat is therefore present within the study area. Recent local records of this species occur in the assessment area however all records are recorded within one kilometre of the coast (DPIE 2022a).	Low
<i>Calidris canutus</i> (Red Knot)	-	E	-	15	A marine species largely found in intertidal sandflats, mudflats, sandy beaches and estuaries. It has occasionally been recorded in saline wetlands near the coast however all local records of this species occur within 200 meters of the coastline. The study area is considered unlikely to provide suitable habitat for this species.	Unlikely
<i>Calidris ferruginea</i> (Curlew Sandpiper)	E	CE	Dual credit	4	A migratory shorebird which is generally found intertidal mudflats of sheltered coasts. This species forages at shallow water and roosts on beaches, spits and wetlands (OEH 2022a). Suitable habitat for this species does not occur within the study area.	Unlikely
<i>Calidris tenuirostris</i> (Great Knot)	V	CE	Dual credit	5	This species is known to occur in sheltered, coastal habitats containing large intertidal sandflats or mudflats. Suitable habitat for this species does not occur within the study area.	Unlikely
<i>Calyptorhynchus lathami</i> (Glossy Black Cockatoo)	V	-	Dual credit	46	This species requires large tree hollows to breed and <i>Allocasuarina littoralis</i> and <i>A. torulosa</i> to forage. The Riverina population, greater than 200 kilometres from the study area, also utilise Casuarina species to forage. Breeding habitat for this species does not occur within the study area and foraging resources within the study area are not suitable for the population which is likely to occur in the locality. Numerous recent local records of this species occur within the assessment area with the nearest occurring greater than five kilometres from the study area.	Low
<i>Callocephalon fimbriatum</i> (Gang-gang Cockatoo)	V	E	Dual credit	0	This species is known to favour old growth forests and woodlands and requires hollows of greater than 10cm in diameter at least 9m above the ground for nesting	Unlikely



Scientific name	Status		BAM credit type	Number of records	Likelihood of occurrence assessment	Likelihood of occurrence
	BC Act	EPBC Act				
					(DPIE 2020b). Suitable habitat for this species does not occur within the study area and no local records occur.	
<i>Carterornis leucotis</i> (White-eared Monarch)	V	-	Species	1	A rainforest species endemic to the areas between the Cape York Peninsula and Iluka, with occasional records south of this range. The study area is outside of the normal distribution for this species however a single record occurs in the assessment area. This record occurs from 2005 where an individual was recorded in the Crowdy Bat National Park.  Suitable habitat for this species does not occur within the study area and only a single record occurs from greater than ten years ago.	Unlikely
<i>Charadrius leschenaultia</i> (Greater Sand-plover)	V	V	Dual credit	1	A migratory shorebird which is found on large intertidal mudflats or sandbanks of sheltered beaches or estuaries. Suitable habitat for this species does not occur within the study area.	Unlikely
<i>Charadrius mongolus</i> (Lesser Sand-plover)	V	E	Dual credit	4	An almost entirely coastal species which favours beaches of sheltered harbours, estuaries and bays with large intertidal mudflats or sandbanks. Suitable habitat for this species does not occur within the study area.	Unlikely
<i>Circus assimilis</i> (Spotted Harrier)	V	-	Ecosystem	7	This species is mostly found in native grassland or foraging over open habitats. Multiple local records occur within the assessment area with one of these occurring within the study area in 2014.	High
<i>Daphoenositta chrysoptera</i> (Varied Sittella)	V	-	Ecosystem	22	This species forages in trees with rough bark or on dead trees. It is known to occur in a range of vegetation types excluding deserts and grassland. The study area does not contain preferred habitat for this species however habitats are considered to be marginally suitable. Local records occur as recent as 2019.	Low
<i>Ephippiorhynchus asiaticus</i> (Black-necked Stork)	E	-	Ecosystem	62	This species is found in wetlands of major coastal rivers in NSW. Suitable habitat for this species occurs within the study area and this species has been historically recorded. The record of this species within the study area occurs from 2012.	High
<i>Epthianura albifrons</i> (White-fronted Chat)	V	-	Ecosystem	1	In NSW, this species is largely found in damp open habitats along the coast (OEH 2022). Suitable habitat for this species occurs within the study area and this species was recorded within the study area in 2013.	High
<i>Esacus magnirostris</i> (Beach Stone-curlew)	E	-	Dual credit	14	A coastal species which forages in the intertidal zone of beaches and estuaries (OEH 2022). The study area is unlikely to be suitable for this species due to the distance	Low

Scientific name	Status		BAM credit type	Number of records	Likelihood of occurrence assessment	Likelihood of occurrence
	BC Act	EPBC Act				
					between the study area and the coast. Local records are all in very close proximity to the coast.	
<i>Glossopsitta pusilla</i> (Little Lorikeet)	V	-	Ecosystem	12	This species is mostly found in areas of profuse-flowering eucalypts where it feeds on nectar and pollen from the tree canopy. Has been recorded occurring in isolated roadside and paddock trees. Recent records of this species occur within the study area however the study area isn't considered to contain a suitable foraging resource for this species as no eucalypts were recorded during the survey.	Low
<i>Grantiella picta</i> (Painted Honeyeater)	V	V	Ecosystem	0	This species inhabits mistletoe-infested forest and woodland communities. This habitat does not occur on the study area and this species has not been recorded in the assessment area.	Unlikely
<i>Haematopus fuliginosus</i> (Sooty Oystercatcher)	V	-	Species	43	A coastal species which favours rocky headlands, rock pools, rocky shelves, beaches and muddy estuaries (OEH 2022). Suitable habitat for this species does not occur within the study area.	Unlikely
<i>Haematopus longirostris</i> (Pied Oystercatcher)	E	-	Species	182	A coastal species which favours intertidal flats of open beaches, bays and sandbanks (OEH 2022). Suitable habitat for this species does not occur within the study area.	Unlikely
<i>Haliaeetus leucogaster</i> (White-bellied Sea Eagle)	V	-	Dual credit	93	This species is found in areas containing large open water for foraging. Nests are often built in tall emergent eucalypts and often have dead branches or trees nearby to be used as 'guard roosts' (OEH 2022). Suitable habitat for this species occurs within the study area. Numerous local records of this species occur with one of these occurring within the study area in 2017 and another immediately outside the boundary in 2019.	Recorded
<i>Hieraaetus morphnoides</i> (Little Eagle)	V	-	Dual credit	6	This species forages in forest and woodland communities that contain an abundance of prey resources. The development site is unlikely to support a sufficient prey source for this species however there is a very marginal potential for it to forage over the site as part of a larger range. Recent records of this species occur in the assessment area.	Moderate
<i>Hirundapus caudacutus</i> (White-throated Needletail)	-	V	-	33	A migratory species which breeds in Asia over the winter months. When in Australia, this species is almost exclusively aerial where is also feeds aurally (DCCEEW 2022a). Numerous records of this species occur within the assessment area with two of these occurring within the study area from 2014.	High

Scientific name	Status		BAM credit type	Number of records	Likelihood of occurrence assessment	Likelihood of occurrence
	BC Act	EPBC Act				
<i>Irediparra gallinacea</i> (Comb-crested Jacana)	V	-	Ecosystem	89	This species is found in areas with a permanent water source and a good cover of surface vegetation. It is most commonly recorded in freshwater swamps, billabongs and ponds. Suitable habitat for this species occurs within the study area.  Numerous records of this species occur within the assessment area with the majority of these occurring from within the Cattai Wetlands approximately 1.5 kilometres north-east of the study area. Local records are as recent as 2018 however this species was personally observed in the Cattai Wetlands in 2022.	High
<i>Ixobrychus flavicollis</i> (Black Bittern)	V	-	Ecosystem	2	This species is found in freshwater and estuarine wetlands with dense vegetation. Suitable habitat for this species occurs within the study area.  Two local records of this species occur within the assessment area, both of which occur from the mouth of Cattai Creek in 2017 and 2018.	High
<i>Lathamus discolor</i> (Swift Parrot)	E	CE	Dual credit	2	Two recent, local records of this species occur within the assessment area however this species is generally recorded in areas of profuse, winter-flowering eucalypts which do not occur within the study area. Despite the absence of preferred foraging resources, there is a minor potential for this species to occur in the study area during passage to foraging resources.	Low
<i>Limosa lapponica baueri</i> (Bar-tailed Godwit)	-	V	Dual credit	0	A migratory wader found in large intertidal sandflats, banks, estuaries, lagoons and bays. This species forages along the water's edge and is known to roost on saltmarshes, beaches and sandbars (OEH 2022). Suitable habitat for this species does not occur within the study area.	Unlikely
<i>Limosa limosa</i> (Black-tailed Godwit)	V	-	Dual credit	2	A coastal species found in sheltered waterbodies with large intertidal sandflats/mudflats (OEH 2022). Suitable habitat for this species does not occur within the study area and local records all occur greater than eight kilometres from the study area, at the mouth of the Manning River.	Unlikely
<i>Lophoictinia isura</i> (Square-tailed Kite)	V	-	Dual credit	32	This species is commonly found in open forests and woodlands. Large stick nests are constructed in forks of living trees. Potential foraging habitat occurs within the study area however searches of the area did not detect any large stick nests; hence breeding is considered unlikely to occur within the study area.  Numerous recent records of this species occur in the assessment area; hence it is likely to occur as part of a larger foraging range.	High



Scientific name	Status		BAM credit type	Number of records	Likelihood of occurrence assessment	Likelihood of occurrence
	BC Act	EPBC Act				
<i>Melithreptus gularis gularis</i> (Black-chinned Honeyeater)	V	-	Ecosystem	1	A locally nomadic species which occurs in dry, open forests or woodlands that are dominated by ironbark and box eucalypts (OEH 2022). Suitable habitat for this species does not occur within the study area.	Unlikely
<i>Ninox connivens</i> (Barking Owl)	V	-	Dual credit	1	This species hunts over large territories where it prefers open country. Tree hollows in well-forested hills, flats or riverine woodland are required for nesting. No nesting habitat occurs within the study area for this species however the study area may provide foraging habitat as a small part of a large hunting range. One recent local record of this species from within the nearby Cattai Wetlands.	Moderate
<i>Ninox strenua</i> (Powerful Owl)	V	-	Dual credit	3	This species occurs in sclerophyll forests and requires an abundance and diversity of prey species. Tree hollows are also required for nesting. Prey species are likely to be scarce however the site may form part of a larger foraging territory. All local records of this species occur from within the Lansdowne State Forest with the most recent recorded in 2017.	Moderate
<i>Numenius madagascariensis</i> (Eastern Curlew)	-	CE	-	131	A shorebird, not generally recorded as far inland as the study area. It requires large areas of coastal lakes, bays and estuaries with preference for habitats with extensive tidal flats (DAWE 2020a). Habitat of this type does not occur within the study area.	Unlikely
<i>Pachycephala olivacea</i> (Olive Whistler)	V	-	Ecosystem	2	A ground-foraging species which is usually found in wet forests above 500m in elevation (OEH 2022). Habitat suitable for this species does not occur within the study area which is low in elevation.	Unlikely
<i>Pandion cristatus</i> (Eastern Osprey)	V	-	Dual credit	151	A water-dependent species which favours river mouths and coastal lakes and lagoons. This species forages over large waterbodies and breeds in nests constructed in the dead branches high in the canopy (OEH 2022). Suitable habitat for this species occurs within the study area and a local record of this species (dated 2014) occurs within the study area.	Moderate
<i>Petroica boodang</i> (Scarlet Robin)	V	-	Ecosystem	1	Marginally suitable habitat for this species occurs within the study area however only a single local record of this species occurs from 2010.	Low
<i>Ptilinopus magnificus</i> (Wompoo Fruit-Dove)	V	-	Ecosystem	6	A rainforest species which also inhabits wet sclerophyll forests with a rainforest understory. No rainforest or wet sclerophyll forest habitat occurs within the study area.	Unlikely

Scientific name	Status		BAM credit type	Number of records	Likelihood of occurrence assessment	Likelihood of occurrence
	BC Act	EPBC Act				
<i>Ptilinopus regina</i> (Rose-crowned Fruit-Dove)	V	-	Ecosystem	7	This species inhabits dense rainforest communities with a density of fruiting-bearing trees. Habitat of this type does not occur within the study area.	Unlikely
<i>Rostratula australis</i> (Australian Painted Snipe)	E	E	Ecosystem	0	This species is known to forage on mudflats and in shallow water, where there is a cover of tall vegetation (DPIE 2020b). Suitable habitat for this species does not occur within the study area.	Unlikely
<i>Sternula albifrons</i> (Little Tern)	E	-	Dual credit	124	A coastal species which is unlikely to occur as far inland as the study area.	Unlikely
<i>Tyto longimembris</i> (Eastern Grass Owl)	V	-	Ecosystem	1	This species inhabits areas of tall grass, which is required for shelter and breeding. Some areas of potentially suitable habitat for this species occur in the study area however these areas are small in comparison to the extent of area required to fulfil the Eastern Grass Owl's lifecycle. The study site is likely to form part of a larger foraging territory for this species which was recently recorded less than 1.5 kilometres from the study area.	High
<i>Tyto novaehollandiae</i> (Masked Owl)	V	-	Dual credit	6	This species occurs in forests and woodlands with a sparse understory. It requires tree hollows for nesting and an abundance and diversity of prey species. No large tree hollows were recorded in the study area and prey species are likely scarce across the study area, however there is some potential to forage over the study area as part of a larger range. Local records of this species are greater than six kilometres from the study area with the most recent record occurring from 2017.	Moderate
<i>Tyto tenebricosa</i> (Sooty Owl)	V	-	Dual credit	8	A rainforest species which requires very large tree-hollows to roost/nest. The lack of large tree hollows and desirable vegetation within the study areas is a large constraint for this species.	Unlikely
<i>Xenus cinereus</i> (Terek Sandpiper)	V	-	Dual credit	2	Largely a coastal species favouring sandbanks and mudbanks near mangroves, however occasionally this species occurs up to ten kilometres inland around brackish pools (OEH 2022). Marginally suitable habitat for this species occurs within the study area however site habitats are not a preference for this species. Local records occur within 300 metres of the coast in Harrington.	Low
<b>Mammals</b>						

Scientific name	Status		BAM credit type	Number of records	Likelihood of occurrence assessment	Likelihood of occurrence
	BC Act	EPBC Act				
<i>Chalinolobus dwyeri</i> (Large-eared Pied Bat)	V	V	Species	0	The study area lacks preferred roosts such as caves, mines and Fairy Martin nests. Considered unlikely to occur on the study area due to the lack of breeding habitat and lack of records in the locality.	Unlikely
<i>Dasyurus maculatus</i> (Spotted-Tailed Quoll)	V	E	Ecosystem	8	This species prefers forest habitats with dense vegetation. For nesting, caves, large hollow logs or tree hollows are required. Although broadly suitable habitat for this species occurs within the study area, the study area unlikely to contain dense-enough vegetation and is likely to be too exposed to support this species.	Low
<i>Falsistrellus tasmaniensis</i> (Eastern False Pipistrelle)	V	-	Ecosystem	1	A winter-hibernating species with a preference for moist habitats containing trees taller than 20 metres in height (OEH 2022). Roosts in eucalypt hollows however has been found roosting in buildings or under loose bark. Very limited roosting habitat occurs within the study area however the study area may contain some potential habitat which may be used for foraging as part of a larger area.	Low
<i>Micronomus norfolkensis</i> (Eastern Coastal Free-tail Bat)	V	-	Ecosystem	2	This species is most commonly recorded in woodland habitats with available roosting habitat such as tree hollows, house eaves and roofs. There is a potential foraging habitat for this species however no roosting habitat occurs within the study area.	Low
<i>Miniopterus australis</i> (Little Bent-wing Bat)	V	-	Dual credit	32	This species is known to occur in well-forested areas and often found roosting in caves, old mines and old buildings. Suitable habitat for this species does not occur on within the study area.	Low
<i>Miniopterus orianae oceanensis</i> (Large Bent-winged Bat)	V	-	Dual credit	11	This species is known to occur in well-forested areas and often found roosting in caves, old mines and old buildings. Although ideal roosting habitat for this species does not occur on study area, the site may also form a small part of larger foraging range.	Low
<i>Myotis macropus</i> (Southern Myotis)	V	-	Species	2	This species requires tree hollows, caves, tunnels or dense foliage for roosting. Forages along creek lines and other water bodies and has a preference for riparian habitat. The study area contains a potential foraging resource however roosting habitat is not present.	Low
<i>Petauroides volans</i> (Greater Glider)	-	E	-	1	This species requires a high density of tree hollows for shelter. The study area does not contain any hollow-bearing trees and only a single local record exists which is dated from 2010.	Unlikely
<i>Petaurus australis</i> (Yellow-bellied Glider)	V	V	Ecosystem	1	This species occurs high rainfall areas of tall mature eucalypt forests (OEH 2022). The study area does not contain suitable habitat for this species.	Unlikely



Scientific name	Status		BAM credit type	Number of records	Likelihood of occurrence assessment	Likelihood of occurrence
	BC Act	EPBC Act				
<i>Petaurus norfolcensis</i> (Squirrel Glider)	V	-	Species	6	This species is commonly found in dry, open forests with an abundance of winter-flowering trees. The study area does not contain suitable foraging or nesting resources for this species.	Unlikely
<i>Petrogale penicillata</i> (Brush-tailed Rock-wallaby)	E	V	Species	0	This species requires areas of rocky escarpments, outcrops and cliffs as it seeks shelter in caves and rock crevices by day. By night, this species is forages on vegetation adjacent to these areas (OEH 2022). No habitat of this type occurs within close proximity to the study area.	Unlikely
<i>Phascogale tapoatafa</i> (Brush-tailed Phascogale)	V	-	Species	5	This species is generally found in areas of dry sclerophyll open forest containing sparse groundcover (DPIE 2020b). The study area does not contain suitable foraging habitat for this species. Most recent local record of this species occurs from 2014.	Unlikely
<i>Phascolarctos cinereus</i> (Koala)	E	E	Species	79	Field surveys identified small patches of a potential foraging resources for the Koala within the study area. Foraging resources recorded were isolated patches and no secondary evidence of the Koala was recorded.  Abundant local records of this species occur within the nearest approximately 1.5 kilometres from the study area in a sclerophyll forest.	Low
<i>Phoniscus papuensis</i> (Golden-tipped Bat)	V	-	Ecosystem	5	This species is found in rainforest and sclerophyll forest adjacent to rainforests (OEH 2022). Suitable habitat for this specie does not occur within the study area.	Unlikely
<i>Potorous tridactylus tridactylus</i> (Long-nosed Potoroo)	V	V	Species	0	This species requires a dense understory and groundcover for refuge whilst feeding. The study area does not contain suitable habitat for this species and no local records occur.	Unlikely
<i>Pseudomys novaehollandiae</i> (New Holland Mouse)	-	V	Ecosystem	0	This species requires heathlands with a dense understory. Suitable habitat for this species does not occur on the study area and no local records occur.	Unlikely
<i>Pseudomys oralis</i> (Hastings River Mouse)	E	E	Ecosystem	0	This species inhabits dry, open forest with a low, dense groundcover. The study area does not contain suitable habitat for this species and no local records occur.	Unlikely
<i>Pteropus poliocephalus</i> (Grey-headed Flying Fox)	V	V	Dual credit	54	A nomadic species which is dependent on winter flowering eucalypts. Very marginal to nil suitable foraging resources occur on the study area for this species and no breeding or roosting camps were located within the study area.	Low

Scientific name	Status		BAM credit type	Number of records	Likelihood of occurrence assessment	Likelihood of occurrence
	BC Act	EPBC Act				
<i>Saccolaimus flaviventris</i> (Yellow-bellied Sheath-tail-bat)	V	-	Ecosystem	0	A wide-spread species which has been recorded in a variety of habitats across the state. Potentially suitable habitat for this species may occur within the study area however no local records of this species occur.	Unlikely
<i>Scoteanax rueppellii</i> (Greater Broad-nosed Bat)	V	-	Ecosystem	3	This species utilises a range of habitats although generally roosts in tree hollows. The study area is unlikely to provide suitable habitat for this species with an absence of tree hollows and local records occur greater than eight kilometres from the study area.	Unlikely
<b>Amphibians</b>						
<i>Crinia tinnula</i> (Wallum Froglet)	V	-	Species	1	This species is generally found in coastal acidic paperbark swamps with potential to also occur in heathland and Melaleuca sedgelands. Marginally suitable habitat of this type does occur within the study area.  A single local record of this species occurs greater than seven kilometres from the study area (2008).	Low
<i>Litoria aurea</i> (Green & Golden Bell Frog)	E	V	Species	2	This species inhabits permanent waterbodies with a preference for those which are still. Waterbodies within the study area may provide potential habitat for this species and two local records of this species occur within the assessment area. Local records occur from within the Cattai Wetlands in 2014 and 2019.	High
<i>Litoria brevipalmata</i> (Green Thighed Frog)	V	-	Species	5	A generalist species found in a range of habitats containing a water source however preference is given to watered forests. Suitable habitat for this species occurs within the study area.  Local records of this species occur from within the Lansdowne State Forest with the most recent recorded dating back to 2007.	Low
<i>Mixophyes balbus</i> (Stuttering Frog)	E	V	Species	0	This species is found in wet, forested areas usually above 100 metres elevation and near mountain streams. Although wet areas occur within the study area, the site is situated at a low elevation and is not near mountainous streams. Suitable habitat for this species does not occur within the study area and no local records occur.	Unlikely
<i>Mixophyes iteratus</i> (Giant Barred Frog)	E	E	Species	28	This species is found in moist forests and rainforests. Although moist habitats are found within the study area, vegetation within the study area is not preferred for this species which is generally found along freshwater streams with permanent or semi-permanent water (OEH 2022).	Low
<b>Insects</b>						

Scientific name	Status		BAM credit type	Number of records	Likelihood of occurrence assessment	Likelihood of occurrence
	BC Act	EPBC Act				
<i>Argynnis hyperbius inconstans</i> (Australian Fritillary)	E	CE	Species	0	In NSW, this species is restricted to open, swampy coastal areas that contain the food plant, Arrowhead Violet ( <i>Viola betonicifolia</i> ) (DCCEEW 2022a). The Arrowhead Violet was not recorded during the vegetation surveys and no local records of this species occur.	Unlikely
Reptiles						
<i>Chelonia mydas</i> (Green Turtle)	V	V	Species	1	An ocean-dwelling species which generally only emerges from the sea to nest on coastal beaches. No suitable habitat for this species occurs within the study area.	Unlikely
<i>Coeranoscincus reticulatus</i> (Three-toed Snake-tooth Skink)	V	V	Species	0	This species is known to occur on sandy and loamy soils of rainforests and moist eucalypt forests (OEH 2022). Potential suitable habitat for this species does not occur within the study area and no local records occur.	Unlikely
<i>Hoplocephalus stephensii</i> (Stephens' Banded Snake)	V	-	Species	2	This species inhabits eucalypt forests, rainforests and rocky areas up to 950 in altitude (DPIE 2020b). This species requires loose bark, vines or hollow trunk limbs for shelter (OEH 2022). The lack of fallen logs, hollows, vines and eucalypts are a major limitation for this species.	Unlikely
Aquatic Species						
<i>Epinephelus daemeli</i> (Black Rockcod)	-	V	-	0	The study area is within the distribution of the Black Rock Cod, however it inhabits inshore and rocky reefs, of which do not occur within the study area.	Unlikely
<i>Hippocampus whitei</i> (White's Seahorse)	-	E	-	0	Known to occur in estuaries that have a habitat association with seagrass beds, soft corals, sponges and macroalgae. Suitable habitat for this species does not occur within the study area.	Unlikely
<i>Seriolella brama</i> (Blue Warehou)	-	CD	Species	0	This species largely occurs in offshore waters however juvenile schools have the potential to occur within estuarine systems. Suitable habitat for this species does not occur within the study area and no local records occur.	Unlikely
<i>Thunnus maccoyii</i> (Southern Bluefin Tuna)	-	CD	Species	0	An ocean-dependent species. Suitable habitat for this species does not occur within the study area.	Unlikely
Migratory species						



Scientific name	Status		BAM credit type	Number of records	Likelihood of occurrence assessment	Likelihood of occurrence
	BC Act	EPBC Act				
<i>Actitis hypoleucos</i> (Common Sandpiper)	-	-	-	0	Despite the development site representing a disturbed roadside area, it is considered to provide potential habitat for this species which frequent coastal wetlands. This species occurs in a wide range coastal wetlands however is known to prefer those around muddy margins or rocky shores (DCCEEW 2022a). It is unlikely that the wetlands within the study area provide suitable habitat for this species and no local records occur.	Unlikely
<i>Calidris acuminata</i> (Sharp-tailed Sandpiper)	-	-	-	0	This species is known to prefer the muddy edges of shallow fresh or brackish wetlands (DCCEEW 2022a). Habitat of this type does not occur within the study area and no local records of this species occur.	Unlikely
<i>Calidris canutus</i> (Red Knot)	-	E	-	15	See assessment in under Aves.	Unlikely
<i>Calidris ferruginea</i> (Curlew Sandpiper)	E	CE	Dual credit	4	See assessment in under Aves.	Unlikely
<i>Calidris melanotos</i> (Pectoral Sandpiper)	-	-	-	0	This species is known to prefer coastal wetlands with fringing mudflats and low, emergent or fringing vegetation (DCCEEW 2022a). Preferred habitat for this species does not occur within the study area however this species has occasionally been recorded in wetlands further inland from the coast. Marginally suitable habitat for this species occurs within the study area.	Low
<i>Calidris ruficollis</i> (Red-necked Stint)	-	-	-	0	A coastal species unlikely to occur within the study area.	Unlikely
<i>Charadrius bicinctus</i> (Double-banded Plover)	-	-	-	0	This species is found in a range of wetlands and is commonly recorded in open grassy areas further inland (DCCEEW 2022a). Suitable habitat for this species occurs within the study area although no local records occur.	Unlikely
<i>Charadrius leschenaultia</i> (Greater Sand Plover)	V	V	Dual credit	1	See assessment in under Aves.	Unlikely
<i>Charadrius mongolus</i> (Lesser Sand-plover)	V	E	Dual credit	4	See assessment in under Aves.	Unlikely

Scientific name	Status		BAM credit type	Number of records	Likelihood of occurrence assessment	Likelihood of occurrence
	BC Act	EPBC Act				
<i>Cuculus optatus</i> (Oriental Cuckoo)	-	-	-	0	This species is known to occur in rainforest margins, vine scrub, riverine thickets and monsoon forest. Suitable vegetation for this species does not occur within the study area.	Unlikely
<i>Gallinago hardwickii</i> (Latham's Snipe)	-	-	-	0	Suitable habitat for this species occurs within the study area. No local records occur.	Low
<i>Gallinago megala</i> (Swinhoe's Snipe)	-	-	-	0	Suitable habitat for this species occurs within the study area however no local records of this species occur.	Low
<i>Gallinago stenura</i> (Pin-tailed Snipe)	-	-	-	0	Suitable habitat for this species occurs within the study area however no local records of this species occur.	Low
<i>Hirundapus caudacutus</i> (White-throated Needletail)	-	V	-	33	See assessment in under Aves.	High
<i>Limosa lapponica</i> (Bar-tailed Godwit)	-	-	-	0	Suitable habitat for this species occurs within the study area however no local records of this species occur.	Unlikely
<i>Monarcha melanopsis</i> (Black-faced Monarch)	-	-	-	0	This species is mainly recorded in rainforest ecosystems including semi-deciduous vine-thickets and complex notophyll vine-forests (DCCEEW 2022a). Habitat of this type does not occur within the study area.	Unlikely
<i>Myiagra cyanoleuca</i> (Satin Flycatcher)	-	-	-	0	This species is largely recorded in heavily vegetated gullies of eucalypt-dominated forests and woodlands. On migration, it is known to occur in coastal forests, woodlands, mangroves and drier woodlands and open forests (DCCEEW 2022a). Preferred habitat for this species does not occur within the study area and no local records occur.	Low
<i>Numenius madagascariensis</i> (Eastern Curlew)	-	CE	-	131	See assessment in under Aves.	Unlikely
<i>Numenius minutus</i> (Little Curlew)	-	-	-	0	Suitable habitat for this species occurs within the study area however no local records of this species occur.	Low

Scientific name	Status		BAM credit type	Number of records	Likelihood of occurrence assessment	Likelihood of occurrence
	BC Act	EPBC Act				
<i>Numenius phaeopus</i> (Whimbrel)	-	-	-	0	This species is known to occur on intertidal mudflats of sheltered coasts, in harbours lagoons, estuaries and in river deltas (DCCEEW 2022a). Habitat suitable for this species does not occur within the study area. No local records of this species occur.	Unlikely
<i>Pandion haliaetus</i> (Osprey)	V	-	Dual credit	151	See assessment in under Aves.	Moderate
<i>Pluvialis fulva</i> (Pacific Golden Plover)	-	-	-	0	This species is found in a range of coastal habitats although is rarely recorded in terrestrial wetlands such as that which occur within and surrounding the study area (DCCEEW 2022a). Marginally suitable habitat for this species occurs within the study area. No local records of this species occur.	Low
<i>Rhipidura rufifrons</i> (Rufous Fantail)	-	-	-	0	In NSW, this species mainly inhabits wet sclerophyll forests, often in gullies (DCEEW 2022). Suitable habitat for this species does not occur within the study area and no local records occur.	Unlikely
<i>Symposiachrus trivirgatus</i> (Spectacled Monarch)	-	-	-	0	This species largely inhabits dense rainforests and wet sclerophyll forests. Habitat of this type does not occur within the study area. No local records occur.	Unlikely
<i>Tringa brevipes</i> (Grey-tailed Tattler)	-	-	-	0	This species inhabits sheltered coasts that have reefs and rock platforms or those with intertidal mudflats (DCCEEW 2022a). Suitable habitat for this species does not occur within the study area and no local records of this species occur.	Unlikely
<i>Tringa nebularia</i> (Common Greenshank)	-	-	-	0	This species is found in a range of sheltered coastal habitats and inland wetlands. Suitable habitat for this species occurs within the study area however no local records of this species occur.	Low

Key: Critically Endangered (CE), Conservation Dependent (CD), Endangered (E), Vulnerable (V), Not listed (-).



## Appendix C: Plot-based field data sheets

# BAM Plot - Field Survey Form

Page no. 1

Survey Name: <i>Harrington Overpass</i>	Date: <i>8/19/22</i>	Plot #: <i>1</i>
Surveyers: <i>Antony</i>	IBRA Region:	Plot Dimensions: <i>20 x 50</i>
Likely Vegetation Class		Zone ID
Plant Community Type <i>Swamp oak forest on coastal floodplain</i>		
EEC: <i>1 N</i>	Orientation of midline from the 0m point: <i>60</i>	north = 0, south = 180

Record easting and northing from the plot marker.

Dimensions (shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400m2 plot)	Sum values	
Count of Native Richness	Trees	1
	Shrubs	0
	Grasses etc.	3
	Forbs	0
	Ferns	0
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	10
	Shrubs	0
	Grasses etc.	0.3
	Forbs	0
	Ferns	0
	Other	0
High Threat Weed cover %	0.3	

The totals may be calculated after field component.

BAM Attribute (20 x 50 m plot)		Stem Classes and Hollows		Record living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately. Data needed is presence only (tick) unless a 'large tree' for that veg class.  * includes all species of Eucalyptus, Corymbia, Angophora, Lophostemon and Syncarpia  ^ For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.
dbh	Euc*	Non Euc	Hollows^	
80 + cm			0	Hollows 20cm+
50 - 79 cm				
30 - 49 cm	✓			
20 - 29 cm	✓			
10 - 19 cm	✓			
5 - 9 cm	✓			
< 5 cm	✓		This size class records tree regeneration	
Length of logs (m) (≥ 10cm diameter, > 50 cm in length)				total 0

Each size class is noted as present by the living tree stems only. Depending on the Vegetation Class, DBH values and counts may be needed for a size class. For a multi-stemmed tree, only the largest living stem is included in the count/estimate if it is required by the large tree category for that vegetation class.

Hollows at least 20cm across are recorded for the purposes of habitat of some threatened species

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	100 100 100 100 100			
Average of the 5 subplots	100			

The average percentage recorded from five 1m x 1m plots on alternate sides of midline at locations 5, 15, 25, 35 and 45 m along midline. Litter cover includes leaves, seeds, twigs, branchlets and branches <10cm diameter.

### Physiography & site features

Morphological type		Soil colour	
Landform element	<i>Floodplain</i>	Soil depth	
Landform pattern		Slope	
Microrelief		Aspect	
Lithology		Site drainage	
Soil surface texture		Dist. to nearest water and type	

### Plot Disturbance

Plot Disturbance	Severity code	Age code		Severity code	Age code
Clearing (inc. logging)	<i>Mod</i>	<i>15-20</i>	Fire damage		
Cultivation (inc. pasture)			Storm damage		
Soil erosion			Weediness		
Firewood/CWD removal			Other		
Grazing (identify native/stock)			Other		

### Height range

Canopy		Shrub Layer	
Understorey		Ground Layer	

### Additional Notes:

*Inundated.*

Survey Name: Harrington express Date: 8/9/22  
 Surveyers: AVC, LS Plot: 1

Canopy,  
Understory  
Midstory  
Shrub layer  
Ground layer

#	GF Code	Species Name	N, E or HTE	Cover	Abund	Dominant (top 3 in each str.)	Stratum	Height range
1		<i>Casuarina glauca</i>		10	7/00			
2		<i>Ipomea cairica</i>		0.1	1			
3		<i>Juncus</i> sp (c)		0.1	3			
4		<i>Lantana camara</i>		0.2	1			
5		<i>Cynodon dactylon</i>		0.1	5			
6		<i>Carex appressa</i>		0.1	3			
7		<i>Asteracea</i> sp (c) <i>Cotula</i> sp		0.1	1			
8		<i>Coronopifolia</i>						
9								
10								
11								
12								
13								
14								
15								
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38								
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40								
41								
42								
43								
44								
45								
46								
47								
48								

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ... 100% (foliage cover). Note: 0.1% cover represents an area of approx. 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approx. 1.4 x 1.4 m, and 1% = 2 x 2 m, 5% = 4 x 5 m, 25% = 10 x 10 m. Abundance: 1, 2, 3, ..., 10, 20, 30, ..., 100, 200, ..., 1000, ...



# BAM Plot - Field Survey Form

Page no. 1

Survey Name: <i>Harrington overpass</i>	Date: <i>8/9/22</i>	Plot #: <i>2</i>
Surveyors: <i>Auc LS</i>	IBRA Region:	Plot Dimensions: <i>20 x 50</i>
Likely Vegetation Class		Zone ID
Plant Community Type <i>Swamp oak swamp forest (Disturbed)</i>		
EEC: <i>1 N</i>	Orientation of midline from the 0m point: <i>20</i> <span style="float: right;">north = 0, south=180</span>	

Record easting and northing from the plot marker.  
 Dimensions (shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400m2 plot)	Sum values	
Count of Native Richness	Trees	1
	Shrubs	0
	Grasses etc.	3
	Forbs	2
	Ferns	1
	Other	0
	Sum of Cover of native vascular plants by growth form group	Trees
Shrubs		0
Grasses etc.		95.2
Forbs		0.2
Ferns		0.2
Other		0
High Threat Weed cover %	0	

BAM Attribute (20 x 50 m plot)		Stem Classes and Hollows			Record living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately. Data needed is presence only (tick) unless a 'large tree' for that veg class.
dbh	Euc*	Non Euc	Hollows^		
80 + cm			0		* includes all species of Eucalyptus, Corymbia, Angophora, Lophostemon and Syncarpia  ^ For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.
50 - 79 cm					
30 - 49 cm			Hollows 20cm+		
20 - 29 cm					
10 - 19 cm		✓			
5 - 9 cm					
< 5 cm			This size class records tree regeneration		
Length of logs (m) (≥ 10cm diameter, > 50 cm in length)		0			total 0

Each size class is noted as present by the living tree stems only. Depending on the Vegetation Class, DBH values and counts may be needed for a size class. For a multi-stemmed tree, only the largest living stem is included in the count/estimate if it is required by the large tree category for that vegetation class.

Hollows at least 20cm across are recorded for the purposes of habitat of some threatened species

The totals may be calculated after field component.

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	5   5   10   8   5			
Average of the 5 subplots	6.6			

The average percentage recorded from five 1m x 1m plots on alternate sides of midline at locations 5, 15, 25, 35 and 45 m along midline. Litter cover includes leaves, seeds, twigs, branchlets and branches <10cm diameter.

### Physiography & site features

Morphological type		Soil colour	
Landform element	<i>Flood plain</i>	Soil depth	
Landform pattern		Slope	
Microrelief		Aspect	
Lithology		Site drainage	
Soil surface texture		Dist. to nearest water and type	

### Plot Disturbance

Plot Disturbance	Severity code	Age code		Severity code	Age code
Clearing (inc. logging)	Sev.	<del>22</del>	Fire damage		
Cultivation (inc. pasture)			Storm damage		
Soil erosion			Weediness		
Firewood/CWD removal			Other		
Grazing (identify native/stock)			Other		

### Height range

Canopy		Shrub Layer	
Understorey		Ground Layer	

Additional Notes:

Survey Name: Harrington	Date: 8/9/22
Surveyers: AVC & S.	Plot: 2

Canopy,  
Understory  
Midstory  
Shrub layer  
Ground layer

#	GF Code	Species Name	N, E or HTE	Cover	Abund	Dominant <small>top 3 in each str.</small>	Stratum	Height range
1		Casuarina glauca		53	2		C	6-8m
2		Carex appressa		95	1000	✓	G	0-1.8
3		Pteridium esculentum		0.2	5		G	0-1
4		Panicum strigosum		0.1	5		G	0-0.8
5		Rumex brownii		0.1	3		G	0-5
6		Imperata cylindrica		0.1	1		G	0-5
7		Paspalum sp.		0.1	3		G	0-5
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9								
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15								
16								
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44								
45								
46								
47								
48								

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ... 100% (foliage cover). Note: 0.1% cover represents an area of approx. 83 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approx. 1.4 x 1.4 m, and 1% = 2 x 2 m, 5% = 4 x 5 m, 25% = 10 x 10 m. Abundance: 1, 2, 3, ..., 10, 20, 30, ..., 100, 200, ..., 1000, ...

# BAM Plot - Field Survey Form

Page no. 1

Survey Name: <i>Hawthorn Interchange</i>		Date: <i>13.9.22</i>	Plot #: <i>3</i>
Surveyers: <i>Will, Leanne</i>		IBRA Region:	Plot Dimensions:
Likely Vegetation Class			Zone ID
Plant Community Type			
EEC: <i>Y / N</i>		Orientation of midline from the 0m point: <i>68°</i> <span style="float: right;">north = 0, south = 180</span>	

Record easting and northing from the plot marker.

Dimensions (shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400m2 plot)	Sum values	
Count of Native Richness	Trees	<i>1</i>
	Shrubs	<i>0</i>
	Grasses etc.	<i>2</i>
	Forbs	<i>0</i>
	Ferns	<i>0</i>
	Other	<i>0</i>
Sum of Cover of native vascular plants by growth form group	Trees	<i>0.5</i>
	Shrubs	<i>0</i>
	Grasses etc.	<i>92</i>
	Forbs	<i>0</i>
	Ferns	<i>0</i>
	Other	<i>0</i>
High Threat Weed cover %	<i>0</i>	

BAM Attribute (20 x 50 m plot)		Stem Classes and Hollows		Record living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately. Data needed is presence only (tick) unless a 'large tree' for that veg class.
dbh	Euc*	Non Euc	Hollows^	
80 + cm	<input checked="" type="checkbox"/>			* includes all species of Eucalyptus, Corymbia, Angophora, Lophostemon and Syncarpia  ^ For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.
50 - 79 cm	<input checked="" type="checkbox"/>			
30 - 49 cm	<input checked="" type="checkbox"/>		Hollows 20cm+	
20 - 29 cm	<input checked="" type="checkbox"/>			
10 - 19 cm	<input checked="" type="checkbox"/>			
5 - 9 cm	<input checked="" type="checkbox"/>			
< 5 cm	<input checked="" type="checkbox"/>		This size class records tree regeneration	
Length of logs (m) (≥ 10cm diameter, > 50 cm in length)		<i>0</i>		total

Each size class is noted as present by the living tree stems only. Depending on the Vegetation Class, DBH values and counts may be needed for a size class. For a multi-stemmed tree, only the largest living stem is included in the count/estimate if it is required by the large tree category for that vegetation class.

Hollows at least 20cm across are recorded for the purposes of habitat of some threatened species

The totals may be calculated after field component.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				Bare ground cover (%)				Cryptogam cover (%)				Rock cover (%)			
Subplot score (% in each)																
Average of the 5 subplots																

The average percentage recorded from five 1m x 1m plots on alternate sides of midline at locations 5, 15, 25, 35 and 45 m along midline. Litter cover includes leaves, seeds, twigs, branchlets and branches <10cm diameter.

### Physiography & site features

Morphological type	Soil colour	<i>Black</i>
Landform element	Soil depth	
Landform pattern	Slope	<i>0</i>
Microrelief	Aspect	
Lithology	Site drainage	<i>poor</i>
Soil surface texture	Dist. to nearest water and type	

### Plot Disturbance

	Severity code	Age code		Severity code	Age code
Clearing (inc. logging)			Fire damage		
Cultivation (inc. pasture)			Storm damage		
Soil erosion			Weediness		
Firewood/CWD removal			Other		
Grazing (identify native/stock)			Other		

### Height range

Canopy	-	Shrub Layer	-
Understory	-	Ground Layer	<i>0 - 1.5m</i>

Additional Notes:



Survey Name: <i>Hampton Interchange</i>	Date: <i>13.9.22</i>
Surveyers: <i>Will, Lorie</i>	Plot: <i>3</i>

Canopy,  
Understory  
Midstory  
Shrub layer  
Ground layer

#	GF Code	Species Name	N, E or HTE	Cover	Abund	Dominant <small>top 3 in each str.</small>	Stratum	Height range
1	T	<i>Casuarina glauca</i>		0.5				
2	G	<i>Juncus kraussii</i>		90				
3	G	Water couch - <i>Sporobolus virginicus</i>		2				
4								
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48								

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ... 100% (foliage cover). Note: 0.1% cover represents an area of approx. 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approx. 1.4 x 1.4 m, and 1% = 2 x 2 m, 5% = 4 x 5 m, 25% = 10 x 10 m. Abundance: 1, 2, 3, ..., 10, 20, 30, ..., 100, 200, ..., 1000, ...

# BAM Plot - Field Survey Form

Page no. /

Survey Name: <i>Harrington Interchange</i>		Date: <i>13.9.22</i>	Plot #: <i>4</i>
Surveyers: <i>Will, Leonie</i>		IBRA Region:	Plot Dimensions:
Likely Vegetation Class			Zone ID
Plant Community Type			
EEC: <i>D / N</i>		Orientation of midline from the 0m point: <i>310</i>	north = 0, south = 180

Record easting and northing from the plot marker.

Dimensions (shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400m2 plot)	Sum values
Count of Native Richness	
Trees	0
Shrubs	0
Grasses etc.	9
Forbs	3
Ferns	0
Other	0
Sum of Cover of native vascular plants by growth form group	
Trees	0
Shrubs	0
Grasses etc.	22.9
Forbs	1.3
Ferns	0
Other	0
High Threat Weed cover %	0

BAM Attribute (20 x 50 m plot)		Stem Classes and Hollows		Record living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately. Data needed is presence only (tick) unless a 'large tree' for that veg class.
dbh	Euc*	Non Euc	Hollows^	
80 + cm	/		0	* includes all species of Eucalyptus, Corymbia, Angophora, Lophostemon and Syncarpia
50 - 79 cm	/		0	
30 - 49 cm	/		Hollows 20cm+	^ For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.
20 - 29 cm	/		0	
10 - 19 cm	/		0	
5 - 9 cm	/			
< 5 cm	/		This size class records tree regeneration	
Length of logs (m) (≥ 10cm diameter, > 50 cm in length)	0			total

Each size class is noted as present by the living tree stems only. Depending on the Vegetation Class, DBH values and counts may be needed for a size class. For a multi-stemmed tree, only the largest living stem is included in the count/estimate if it is required by the large tree category for that vegetation class.

Hollows at least 20cm across are recorded for the purposes of habitat of some threatened species

The totals may be calculated after field component.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				Bare ground cover (%)				Cryptogam cover (%)				Rock cover (%)			
Subplot score (% in each)																
Average of the 5 subplots																

The average percentage recorded from five 1m x 1m plots on alternate sides of midline at locations 5, 15, 25, 35 and 45 m along midline. Litter cover includes leaves, seeds, twigs, branchlets and branches <10cm diameter.

### Physiography & site features

Morphological type		Soil colour	
Landform element		Soil depth	
Landform pattern		Slope	0
Microrelief		Aspect	
Lithology		Site drainage	poor
Soil surface texture		Dist. to nearest water and type	

Plot Disturbance	Severity code	Age code		Severity code	Age code
Clearing (inc. logging)	3	0	Fire damage	-	
Cultivation (inc. pasture)	-		Storm damage	-	
Soil erosion	-		Weediness	1	R
Firewood/CWD removal	-		Other		
Grazing (identify native/stock)	-		Other		

### Height range

Canopy	-	Shrub Layer	-
Understorey	-	Ground Layer	0 - 1.9m

### Additional Notes:

*Shallow basin with ponded water, drainage line running through. Moderately dense cover of reeds + sedges with areas of open water. Approx 20cm deep to exotic grassland to south & east.*

Survey Name: <i>Harington Interchange</i>	Date: <i>13.9.22</i>
Surveyers: <i>Will, Leonie</i>	Plot: <i>4</i>

Canopy,  
Understory  
Midstory  
Shrub layer  
Ground layer

#	GF Code	Species Name	N, E or HTE	Cover	Abund	Dominant top 3 in each str.	Stratum	Height range
1		<i>Typha domingensis</i>		10		✓		
2		<i>Juncus kraussii</i>		1				
3		<i>Carex appressa</i>		0.5				
4		<i>Schaenoplectiella mucronata</i>		10		✓		
5		<del><i>Alternanthera denticulata</i></del> <i>Panicum decipiens</i>		0.2				
6		<i>Ludwigia peploides</i>		0.1				
7	-	<i>Setaria sphacelata</i>		2		✓		
8		<i>Nymphaea</i>		0.2				
9		<i>Sporobolus virginicus</i>		0.2				
10		Sedge sp. 1 - <i>Bolboschoenus fluviatilis</i>		0.1				
11		<i>Machaerina articulata</i>		0.5				
12		<i>Eleocharis equisetina</i>		0.3				
13		<i>Cladium procerum</i> - water ribbons		0.1				
14		<i>Isolepis inundata</i>		0.3				
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
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44								
45								
46								
47								
48								

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ... 100% (foliage cover). Note: 0.1% cover represents an area of approx. 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approx. 1.4 x 1.4 m, and 1% = 2 x 2 m, 5% = 4 x 5 m, 25% = 10 x 10 m. Abundance: 1, 2, 3, ..., 10, 20, 30, ..., 100, 200, ..., 1000, ...



# BAM Plot - Field Survey Form

Page no. 1

Survey Name: <i>Harrington Interchange</i>	Date: <i>13.9.22</i>	Plot #: <i>5</i>
Surveyers: <i>Will, Leonie</i>	IBRA Region:	Plot Dimensions:
Likely Vegetation Class <i>Forested Wetlands</i>		Zone ID
Plant Community Type		
EEC: <i>(Y) N</i>	Orientation of midline from the 0m point: <i>132</i> <span style="float: right;">north = 0, south = 180</span>	

Record easting and northing from the plot marker.

Dimensions (shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400m <sup>2</sup> plot)	Sum values	
Count of Native Richness	Trees	1
	Shrubs	1
	Grasses etc.	5
	Forbs	6
	Ferns	0
	Other	1
Sum of Cover of native vascular plants by growth form group	Trees	60
	Shrubs	0.1
	Grasses etc.	7.8
	Forbs	1.1
	Ferns	0
	Other	0.5
High Threat Weed cover %	0.2	

BAM Attribute (20 x 50 m plot)		Stem Classes and Hollows		Record living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately. Data needed is presence only (tick) unless a 'large tree' for that veg class.  * includes all species of Eucalyptus, Corymbia, Angophora, Lophostemon and Syncarpia  ^ For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.
dbh	Euc*	Non Euc	Hollows^	
80 + cm	/			Hollows 20cm+
50 - 79 cm	/			
30 - 49 cm	✓			
20 - 29 cm	✓			
10 - 19 cm	✓			
5 - 9 cm	✓			
< 5 cm	✓			This size class records tree regeneration
Length of logs (m) (≥ 10cm diameter, > 50 cm in length)				total <i>0</i>

Each size class is noted as present by the living tree stems only. Depending on the Vegetation Class, DBH values and counts may be needed for a size class. For a multi-stemmed tree, only the largest living stem is included in the count/estimate if it is required by the large tree category for that vegetation class.

The totals may be calculated after field component.

Hollows at least 20cm across are recorded for the purposes of habitat of some threatened species

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	98	98	100	95	100	2	2	0	5	0										
Average of the 5 subplots	98.2					1.8														

The average percentage recorded from five 1m x 1m plots on alternate sides of midline at locations 5, 15, 25, 35 and 45 m along midline. Litter cover includes leaves, seeds, twigs, branchlets and branches <10cm diameter.

### Physiography & site features

Morphological type	Soil colour	<i>Dark brown</i>
Landform element	Soil depth	
Landform pattern	Slope	-
Microrelief	Aspect	-
Lithology	Site drainage	<i>Poor</i>
Soil surface texture	Dist. to nearest water and type	

Plot Disturbance	Severity code	Age code		Severity code	Age code
Clearing (inc. logging)	<i>Y</i>	<i>0</i>	Fire damage	-	
Cultivation (inc. pasture)	-		Storm damage	-	
Soil erosion	-		Weediness	-	
Firewood/CWD removal	-		Other		
Grazing (identify native/stock)	<i>Y</i>	<i>R</i>	Other		

### Height range

Canopy	<i>15-20</i>	Shrub Layer	-
Understorey	<i>6-8</i>	Ground Layer	<i>0-0.8m</i>

### Additional Notes:

*Mature regrowth Swamp Oak forest, sparse ground cover, some areas of standing water.*

Survey Name: <i>Harrington Interchange</i>	Date: <i>13-9-22</i>
Surveyers: <i>Will, Lesmie</i>	Plot: <i>5</i>

Canopy,  
Understory  
Midstory  
Shrub layer  
Ground layer

#	GF Code	Species Name	N, E or HTE	Cover	Abund	Dominant top 3 in each str.	Stratum	Height range
1		<i>Casuarina glauca</i>		60		✓		
2		<i>Parsonsia straminea</i>		0.5				
3	-	<i>Ipomoea carnea</i>		0.2				
4		<i>Melaleuca linariifolia</i>		0.1				
5		<i>Cladium pterocarpum</i>		0.1				
6		<i>Carex appressa</i>		2				
7		<i>Commelina cyanea</i>		0.2				
8		<i>Centella asiatica</i>		0.3				
9		<i>Cynodon dactylon</i>		5				
10		<i>Sedge sp. 1</i>		0.5				
11		<i>Juncus usitatus</i>		0.2				
12		<i>Cyperus sp.</i>		0.2				
13	-	<i>Setaria sphacelata</i>		0.1				
14		<i>Rumex brownii</i>		0.1				
15		<i>Persicaria deciprens</i>		0.2				
16		<i>Alternanthera denticulata</i>		0.1				
17		<i>Sea celery</i>		0.2				
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
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Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ... 100% (foliage cover). Note: 0.1% cover represents an area of approx. 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approx. 1.4 x 1.4 m, and 1% = 2 x 2 m, 5% = 4 x 5 m, 25% = 10 x 10 m. Abundance: 1, 2, 3, ..., 10, 20, 30, ..., 100, 200, ..., 1000, ...

# BAM Plot - Field Survey Form

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Survey Name: <i>Harrington Interchange</i>	Date: <i>13.9.22</i>	Plot #: <i>6</i>
Surveyers: <i>Will, Leonie</i>	IBRA Region:	Plot Dimensions:
Likely Vegetation Class		Zone ID
Plant Community Type		
EEC: <i>Y1</i>	Orientation of midline from the 0m point: <i>245</i> <span style="float: right;">north = 0, south = 180</span>	

Record easting and northing from the plot marker.

Dimensions (shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400m <sup>2</sup> plot)	Sum values	
Count of Native Richness	Trees	<i>0</i>
	Shrubs	<i>0</i>
	Grasses etc.	<i>0</i>
	Forbs	<i>0</i>
	Ferns	<i>0</i>
	Other	<i>0</i>
Sum of Cover of native vascular plants by growth form group	Trees	<i>0</i>
	Shrubs	<i>0</i>
	Grasses etc.	<i>0</i>
	Forbs	<i>0</i>
	Ferns	<i>0</i>
	Other	<i>0</i>
High Threat Weed cover %	<i>0</i>	

The totals may be calculated after field component.

BAM Attribute (20 x 50 m plot)		Stem Classes and Hollows			Record living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately. Data needed is presence only (tick) unless a 'large tree' for that veg class.  * includes all species of Eucalyptus, Corymbia, Angophora, Lophostemon and Syncarpia  ^ For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.
dbh	Euc*	Non Euc	Hollows^		
80 + cm	/				
50 - 79 cm	/				
30 - 49 cm	/		Hollows 20cm+		
20 - 29 cm	/				
10 - 19 cm	/				
5 - 9 cm	/				
< 5 cm	/		This size class records tree regeneration		
Length of logs (m) (≥ 10cm diameter, > 50 cm in length)	<i>0</i>			total	<i>0</i>

Each size class is noted as present by the living tree stems only. Depending on the Vegetation Class, DBH values and counts may be needed for a size class. For a multi-stemmed tree, only the largest living stem is included in the count/estimate if it is required by the large tree category for that vegetation class.

Hollows at least 20cm across are recorded for the purposes of habitat of some threatened species

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)				
Average of the 5 subplots	<i>60</i>			

The average percentage recorded from five 1m x 1m plots on alternate sides of midline at locations 5, 15, 25, 35 and 45 m along midline. Litter cover includes leaves, seeds, twigs, branchlets and branches <10cm diameter.

### Physiography & site features

Morphological type		Soil colour	
Landform element		Soil depth	
Landform pattern		Slope	<i>-</i>
Microrelief		Aspect	<i>-</i>
Lithology		Site drainage	<i>Good</i>
Soil surface texture		Dist. to nearest water and type	

### Plot Disturbance

	Severity code	Age code		Severity code	Age code
Cultivation (inc. pasture)	<i>-</i>		Storm damage	<i>-</i>	
Soil erosion	<i>-</i>		Weediness	<i>3</i>	<i>R</i>
Firewood/CWD removal	<i>-</i>		Other		
Grazing (identify native/stock)	<i>-</i>		Other		

### Height range

Canopy	<i>-</i>	Shrub Layer	<i>-</i>
Understory	<i>-</i>	Ground Layer	<i>0-1.5m</i>

### Additional Notes:

*Rank exotic grassland, no native species*



Survey Name: Harrington Interchange	Date: 13.9.22
Surveyers: WS, LS	Plot: 6

Canopy,  
Understory  
Midstory  
Shrub layer  
Ground layer

#	GF Code	Species Name	N, E or HTE	Cover	Abund	Dominant <small>top 3 in each str.</small>	Stratum	Height range
1	-	Setaria sphacelata		98				
2		Rumex crispus		0.1				
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
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14								
15								
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46								
47								
48								

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ... 100% (foliage cover). Note: 0.1% cover represents an area of approx. 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approx. 1.4 x 1.4 m, and 1% = 2 x 2 m, 5% = 4 x 5 m, 25% = 10 x 10 m. Abundance: 1, 2, 3, ..., 10, 20, 30, ..., 100, 200, ..., 1000, ...

# BAM Plot - Field Survey Form

Page no. 1

Survey Name: <i>Harrington Interchange</i>	Date: <i>13.9.22</i>	Plot #: <i>7</i>
Surveyers: <i>Will, Leonie</i>	IBRA Region:	Plot Dimensions:
Likely Vegetation Class		Zone ID
Plant Community Type		
EEC: <i>Y / (N)</i>	Orientation of midline from the 0m point: <i>310</i>	north = 0, south = 180

Record easting and northing from the plot marker.

Dimensions (shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400m2 plot)	Sum values	
Count of Native Richness	Trees	1
	Shrubs	1
	Grasses etc.	2
	Forbs	0
	Ferns	0
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	0.1
	Shrubs	0.1
	Grasses etc.	10.3
	Forbs	0
	Ferns	0
	Other	0
High Threat Weed cover %	23.1	

The totals may be calculated after field component.

BAM Attribute (20 x 50 m plot)		Stem Classes and Hollows		Record living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately. Data needed is presence only (tick) unless a 'large tree' for that veg class.  * includes all species of Eucalyptus, Corymbia, Angophora, Lophostemon and Syncarpia  ^ For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.
dbh	Euc*	Non Euc	Hollows^	
80 + cm	/		○	Hollows 20cm+
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
< 5 cm		✓		This size class records tree regeneration
Length of logs (m) (≥ 10cm diameter, > 50 cm in length)		0		total

Each size class is noted as present by the living tree stems only. Depending on the Vegetation Class, DBH values and counts may be needed for a size class. For a multi-stemmed tree, only the largest living stem is included in the count/estimate if it is required by the large tree category for that vegetation class.

Hollows at least 20cm across are recorded for the purposes of habitat of some threatened species

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	5	60	80	90	100															
Average of the 5 subplots	67																			

The average percentage recorded from five 1m x 1m plots on alternate sides of midline at locations 5, 15, 25, 35 and 45 m along midline. Litter cover includes leaves, seeds, twigs, branchlets and branches <10cm diameter.

### Physiography & site features

Morphological type		Soil colour	
Landform element		Soil depth	
Landform pattern		Slope	2
Microrelief		Aspect	E
Lithology		Site drainage	Good
Soil surface texture		Dist. to nearest water and type	

### Plot Disturbance

	Severity code	Age code		Severity code	Age code
Clearing (inc. logging)	3	NR	Fire damage	-	
Cultivation (inc. pasture)	-		Storm damage	-	
Soil erosion	-		Weediness	3	R
Firewood/CWD removal	-		Other		
Grazing (identify native/stock)	-		Other		

### Height range

Canopy	-	Shrub Layer	
Understorey	-	Ground Layer	0-12m

### Additional Notes:

On previously constructed ramp. Mainly exotic grasses with some herbs + shrubs.

Survey Name: <i>Hanington Interchange</i>	Date: <i>13.9.22</i>
Surveyers: <i>Will, Leonie</i>	Plot: <i>7</i>

Canopy,  
Understory  
Midstory  
Shrub layer  
Ground layer

#	GF Code	Species Name	N, E or HTE	Cover	Abund	Dominant top 3 in each str.	Stratum	Height range
1	-	<i>Setaria sphacelata</i>		<del>10</del> 15				
2	<	<i>Eragrostis</i>		2				
3		<i>Acacia falcata</i>		0.1				
4	-	<i>Plantago lanceolata</i>		0.7				
5	-	<i>Bidens pilosa</i>		0.5				
6		<i>Casuarina glauca</i>		0.1				
7	-	<i>Paspalum mandiocanum</i>		15				
8	-	<i>Tagetes minuta</i>		1				
9	-	<i>Ipomoea carnea</i>		0.2				
10	-	Celery weed <i>Cyclophyllum</i>		0.2				
11	-	Scented-top grass		0.3				
12	-	Hares foot clover		0.5				
13	-	Burr medic		0.5				
14	-	<i>Chloris gayana</i>		20				
15	-	<i>Senecio madagascariensis</i>		0.1				
16	-	<i>Conyza bonariensis</i>		0.2				
17		<i>Gynodon dactylon</i>		10				
18	-	<i>Cinnamomum camphora</i>		0.2				
19	-	Rattlepod		0.2				
20	-	<i>Verbena bonariensis</i>		0.1				
21	-	<i>Sonchus asper</i>		0.1				
22								
23								
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Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ... 100% (foliage cover). Note: 0.1% cover represents an area of approx., 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approx. 1.4 x 1.4 m, and 1% = 2 x 2 m, 5% = 4 x 5 m, 25% = 10 x 10 m. Abundance: 1, 2, 3, ..., 10, 20, 30, ..., 100, 200, ..., 1000, ...

# Appendix D: Tests of Significance (BC Act)

## Threatened Ecological Communities

Significant Impact Assessment - Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Significant Impact Criteria	Details
<p>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.</p>	<p>Not Applicable to this Endangered Ecological Community.</p>
<p>b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:</p> <ul style="list-style-type: none"> <li>(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</li> <li>(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.</li> </ul>	<p>The proposal will require the removal of approximately 2.87 hectares of this EEC in the form of moderate and disturbed condition vegetation, as well as a portion occurring in the reedland form. Vegetation to be removed consists of the outer edges of habitat fringing existing road infrastructure and historically cleared areas. The community also extends further offsite where larger patches of moderate condition vegetation occur.</p> <p>The removal of any area of this community will impact and reduce the extent of the community. However, the works are unlikely to place the local occurrence at risk of extinction given the area to be removed is a relatively small proportion of that which remains further afield. In addition, the proposal is unlikely to introduce new threats or impacts further than what currently exists. Recommendations are provided to assist in minimising potential indirect impacts on this EEC.</p>
<p>c) In relation to the habitat of a threatened species or ecological community:</p> <ul style="list-style-type: none"> <li>(i) The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and</li> <li>(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</li> <li>(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.</li> </ul>	<p>The proposal will result in the removal up to 2.87 hectares of this community. The areas marked for removal comprise vegetation fringing existing road infrastructure and historically cleared areas. These are already subject to local fragmentation with road infrastructure interspersing and large cleared areas occurring in the broader area. The removal of these outer fringes of vegetation will marginally increase local fragmentation however this is considered to be unlikely to impact the long-term survival of the community.</p>
<p>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).</p>	<p>The proposed activity will not directly or indirectly affect an area of outstanding biodiversity value for the Gould's Petrel, Little Penguin population, Mitchell's Rainforest Snail or the Wollemi Pine.</p>



Significant Impact Criteria	Details
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.	As per assessed in Section 5.3.
<b>Conclusion</b>	<b>No significant impact</b>

Significant Impact Assessment - Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Significant Impact Criteria	Details
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 to this Endangered Ecological Community.
b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: <ul style="list-style-type: none"> <li>(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</li> <li>(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.</li> </ul>	<p>The extent of this community within the study area forms a modified patch of Typha rushland interspersing with exotic grassland and the outer edges of a freshwater wetland extending further offsite. Both forms of this community occur in a modified state, evidently altered from the historical development of the Pacific Highway, Harrington Road and Cooperbrook Road.</p> <p>The project may require the remove a total of 0.28 hectares of the outer edges of this vegetation community.</p> <p>In consideration of this limited extent of vegetation requiring removal and the already altered state that the community occurs in, the removal of this vegetation is unlikely to place this community at risk of extinction.</p>
c) In relation to the habitat of a threatened species or ecological community: <ul style="list-style-type: none"> <li>(i) The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and</li> <li>(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</li> <li>(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.</li> </ul>	<p>The project will result in the removal of 0.28 hectares of this community. The extent of the community occurring within the study area is evidently already modified as a result of the historical development of road infrastructure. The removal of this minute area of habitat will only marginally increase local fragmentation and will not result in the isolation of any area of this community (other than what currently exists). Therefore, the project is unlikely to impact the long-term survival of this EEC within the locality.</p>

Significant Impact Criteria	Details
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 project will not directly or indirectly affect an area of outstanding biodiversity value for the Gould’s Petrel, Little Penguin population, Mitchell’s Rainforest Snail or the Wollemi Pine.
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.	As per assessed in Section 5.3.
<b>Conclusion</b>	<b>No significant impact</b>

## Threatened Species

### Significant Impact Assessment – Waterbirds (Australasian Bittern, Black-necked Stork, Comb-crested Jacana, Black Bittern)

Significant Impact Criteria	Details
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 study area is considered to provide potential foraging habitat for these species. Habitats adjacent to the study area would largely be relied upon, with the study area only likely to provide the outer fringes of available habitat. Given the proximity of desirable higher-value habitat adjoining the study area, a viable population of the subject birds is not 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: <ul style="list-style-type: none"> <li>(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</li> <li>(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.</li> </ul>	Not Applicable to these threatened species.
c) In relation to the habitat of a threatened species or ecological community: <ul style="list-style-type: none"> <li>(i) The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and</li> <li>(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the</li> </ul>	<p>The project will result in the removal of up to 4.19 hectares of vegetation from a modified road edge. No other habitat features such as tree hollows, large emergent trees, nests dreys or hollow logs are proposed to be removed. The vegetation within the construction site is currently situated in a highly fragmented landscape with high-use roads and large areas of cleared agricultural land surrounding. The removal of the vegetation within the construction site is only likely to slightly increase local fragmentation and will not lead to the isolation of habitats.</p> <p>The habitat proposed to be removed represents a very minute proportion of the habitat available to the subject species in the assessment area. Given this, and that the proposed vegetation removal will only marginally increase gaps in</p>

Significant Impact Criteria	Details
<p>proposed development or activity, and</p> <p>(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.</p>	<p>habitat for this species, the proposal is unlikely to impact the long-term survival of a population of this species within the assessment area.</p>
<p>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).</p>	<p>The project will not directly or indirectly affect an area of outstanding biodiversity value for the Gould's Petrel, Little Penguin population, Mitchell's Rainforest Snail or the Wollemi Pine.</p>
<p>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.</p>	<p>As per assessed in Section 5.3.</p>
<p><b>Conclusion</b></p>	<p><b>No significant impact</b></p>

Significant Impact Assessment – White-fronted Chat

Significant Impact Criteria	Details
<p>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.</p>	<p>The study area is considered to provide a foraging and potential roosting resource for this species. This species is largely found in low vegetation/grasses foraging on insects. Foraging habitat for this species is locally abundant with the extent of available habitat within the construction footprint and ancillary areas considered to be minimal. In consideration that the habitat proposed to be removed would only form a very minute fraction of this species wider foraging range, that suitable habitat is widely available within the assessment area and that mitigation measures have been proposed to ensure that no nesting habitat is removed, it is considered unlikely that the project will adversely impact on the life cycle of the species and is therefore unlikely to place it at risk of extinction.</p>
<p>b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:</p> <p>(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</p> <p>(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.</p>	<p>Not Applicable to this threatened species.</p>
<p>c) In relation to the habitat of a threatened species or ecological community:</p>	<p>The project will result in the removal of up to 4.19 hectares of vegetation from a modified road edge. No other habitat features such as tree hollows, large emergent trees, nests dreys or hollow logs are proposed to be removed.</p>

Significant Impact Criteria	Details
<p>(i) The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and</p> <p>(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</p> <p>(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.</p>	<p>The vegetation within the construction site is currently situated in a highly fragmented landscape with high-use roads and large areas of cleared agricultural land surrounding. The removal of the vegetation within the construction site is only likely to slightly increase local fragmentation and will not lead to the isolation of habitats.</p> <p>The habitat proposed to be removed represents a very minute proportion of the habitat available to the subject species in the assessment area. Given this, and that the proposed vegetation removal will only marginally increase gaps in habitat for this species, the proposal is unlikely to impact the long-term survival of a population of this species within the assessment area.</p>
<p>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).</p>	<p>The project will not directly or indirectly affect an area of outstanding biodiversity value for the Gould’s Petrel, Little Penguin population, Mitchell’s Rainforest Snail or the Wollemi Pine.</p>
<p>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.</p>	<p>As per assessed in Section 5.3.</p>
<p><b>Conclusion</b></p>	<p><b>No significant impact</b></p>

Significant Impact Assessment – Forest owls and raptors (Spotted Harrier, White-bellied Sea Eagle, Little Eagle, Square-tailed Kite, Barking Owl, Powerful Owl, Eastern Osprey, Eastern Grass Owl, Masked Owl)

Significant Impact Criteria	Details
<p>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.</p>	<p>The study area is considered to provide potential foraging habitat for these threatened forest owl and raptor species. Habitats adjacent to the study area would largely be relied upon for foraging with the study area only likely to provide an extremely small foraging resource for the population relative to their ecological requirements and local extent of potential habitat. While in very strict terms a negative effect, this loss will have a very minor impact on the local potential populations as the site in total would only form a very minute fraction of these species wider foraging range.</p> <p>No potential breeding habitat is present given the absence of large emergent trees and tree hollows.</p>
<p>b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:</p> <p>(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</p>	<p>Not Applicable to these threatened species.</p>



Significant Impact Criteria	Details
(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.	
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.	<p>The proposal will result in the removal of up to 4.19 hectares of vegetation from a modified road edge. No other habitat features such as tree hollows, large emergent trees or nests are proposed to be removed.</p> <p>The vegetation within the construction site is currently situated in a highly fragmented landscape with high-use roads and large areas of cleared agricultural land surrounding. The removal of the vegetation within the construction site is only likely to slightly increase local fragmentation and will not lead to the isolation of habitats.</p> <p>The habitat proposed to be removed represents a very minute proportion of the habitat available to the subject species in the assessment area. Given this, and that the subject species are highly mobile species that will readily traverse gaps in vegetation for foraging and roosting habitats, the project is unlikely to impact the long-term survival of these species within the assessment area.</p>
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 project will not directly or indirectly affect an area of outstanding biodiversity value for the Gould’s Petrel, Little Penguin population, Mitchell’s Rainforest Snail or the Wollemi Pine.
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.	As per assessed in Section 5.3.
<b>Conclusion</b>	<b>No significant impact</b>

Significant Impact Assessment – Green and Golden Bell Frog

Significant Impact Criteria	Details
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.	<p>Habitat within the study area comprises waterlogged areas that are frequently inundated with water. These areas are considered marginally suitable for this species however are still considered likely to provide suitable habitat.</p> <p>The proposed works are anticipated to largely entail disturbances to the edges of suitable habitat which also fringe the existing road infrastructure, however, the deeper wet area to the north of the proposed overpass ramp, west of the highway, is also earmarked for direct disturbance. Although this larger wet area is encompassed within the construction footprint, it is anticipated that any works in this area will comprise of drainage works only.</p> <p>Given the mitigation measures proposed, that this species has not been recorded on site and the extent of available habitat directly adjoining the study area, the project is not likely to adversely affect the life cycle of this species such that a potential viable local population of the species is likely to be placed at risk of extinction.</p>

Significant Impact Criteria	Details
<p>b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:</p> <p>(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</p> <p>(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.</p>	<p>Not Applicable to this threatened species.</p>
<p>c) In relation to the habitat of a threatened species or ecological community:</p> <p>(i) The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and</p> <p>(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</p> <p>(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.</p>	<p>The project will result in the removal of up to 4.19 hectares of vegetation from a modified road edge. There may be a risk of decreased water quality and sedimentation to adjoining aquatic habitat during construction, however this would be temporary and would only affect the edges of potential habitat for this species.</p> <p>The vegetation within the construction site is currently situated in a highly fragmented landscape with high-use roads and large areas of cleared agricultural land surrounding. The removal of the vegetation within the construction site is only likely to slightly increase local fragmentation and will not lead to the isolation of habitats.</p> <p>The habitat proposed to be removed represents a minute proportion of the habitat available to the subject species in the assessment area. Given this, and that the proposed vegetation removal will only marginally increase gaps in habitat for this species, the proposal is unlikely to impact the long-term survival of a potential population of this species within the assessment area.</p>
<p>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).</p>	<p>The proposal will not directly or indirectly affect an area of outstanding biodiversity value for the Gould's Petrel, Little Penguin population, Mitchell's Rainforest Snail or the Wollemi Pine.</p>
<p>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.</p>	<p>As per assessed in Section 5.3.</p>
<p><b>Conclusion</b></p>	<p><b>No significant impact</b></p>

# Appendix E: Assessments of significance (EPBC Act)

## Threatened Ecological Communities

An action is likely to have a significant impact on a *Critically Endangered* or *Endangered* ecological community, if it will:

- Reduce the extent of an ecological community.
- Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines.
- Adversely affect habitat critical to the survival of an ecological community.
- 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.
- 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.
- Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
  - assisting invasive species, that are harmful to the listed ecological community, to become established, or
  - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or
- Interfere with the recovery of an ecological community.

*Critical habitat* refers to areas critical to the survival of an ecological community and may include areas that are necessary for:

- Activities such as foraging, breeding, roosting or dispersal.
- The long-term maintenance of the ecological community (including the maintenance of species essential to the survival of the ecological community)
- Maintain genetic diversity and long-term evolutionary development.
- Reintroduction of populations or recovery of the community.

### Significant Impact Assessment - Coastal Swamp Forest TEC

Significant Impact Criteria	Details
Reduce the extent of an ecological community.	The project will result in the removal of 2.87 hectares of vegetation from this community. This will reduce a fraction of its local extent.
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines.	The Swamp Forest community in the construction footprint and ancillary areas is currently in a modified state with this area comprising the previously disturbed roadside edges of the community. Removal of this swamp forest vegetation will not lead to further fragmentation as only a marginal amount of vegetation is to be disturbed.  Vegetation removal may increase the occurrence of edge effects into the adjoining vegetation however due to the extent of existing disturbance, this increase in edge effects is considered to be minute and is unlikely to lead to a significant increase in edge effects.
Adversely affect habitat critical to the survival of an ecological community.	The project does not affect any habitat critical to the survival of the community.
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of	The project has some potential to incrementally and cumulatively change the hydrology and stormwater patterns in the study area, however the extent of the community has historically been subject to substantial alterations due to road works and historical clearing and currently represents regrowth

Significant Impact Criteria	Details
groundwater levels, or substantial alteration of surface water drainage patterns.	vegetation. Mitigation measures to manage sedimentation and runoff have been proposed and this risk is considered to be minimal.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting.	The project is not anticipated to change the species composition of the ecological community as the works will see the alteration of road infrastructure only, which has already altered the surrounding environment with the introduction of roadside weeds.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: <ul style="list-style-type: none"> <li>– assisting invasive species, that are harmful to the listed ecological community, to become established, or</li> <li>– 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.</li> </ul>	<p>The extent of the vegetation community within the construction footprint and ancillary areas is already highly modified with the development of the existing road infrastructure and historical clearing.</p> <p>Mitigation measures have been proposed to manage weeds within the study area so as to ensure weeds, already highly abundant on the site, do not further encroach into the vegetation community.</p> <p>Erosion and sedimentation controls will also be established to ensure sediment laden runoff does not flow into the community.</p> <p>No other impacts are likely to result in the reduction or integrity of the TEC.</p>
Interfere with the recovery of an ecological community.	The minor impact on the TEC is unlikely to interfere with its recovery.
<b>Resulting Impact</b>	<b>No significant impact</b>

## Threatened Species

An action is likely to have a significant impact on a *Critically Endangered* or *Endangered* species, if it will:

- Lead to a long-term decrease in the size of a population.
- Reduce the area of occupancy of this species.
- Fragment an existing population into two or more populations.
- Adversely affect habitat critical to the survival of a species.
- Disrupt the breeding cycle of a population.
- Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
- Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat.
- Introduce disease that may cause the species to decline.
- Interfere with the recovery of the species.

An action is likely to have a significant impact on a *Vulnerable* species, if it will:

- Lead to a long-term decrease in the size of an important population of a species.
- Reduce the area of occupancy of an important population.
- Fragment an existing important population into two or more populations.



- Adversely affect habitat critical to the survival of a species.
- Disrupt the breeding cycle of an important population.
- Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
- Result in invasive species that are harmful to a *Vulnerable* species becoming established in the vulnerable species' habitat.
- Introduce disease that may cause the species to decline.
- Interfere substantially with the recovery of the species.

An *important population* is defined under the MNES Significant Impact Guidelines (Department of the Environment 2013) as one that is necessary for a species' long-term survival and recovery. This includes such populations as:

- Key populations either for breeding or dispersal.
- Populations that are necessary for maintaining genetic diversity.
- Populations that are near the limit of the species range.

*Critical habitat* refers to areas critical to the survival of a species and may include areas that are necessary for:

- Activities such as foraging, breeding, roosting or dispersal.
- The long-term maintenance of the species (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators).
- Maintain genetic diversity and long-term evolutionary development.
- Reintroduction of populations or recovery of the species/community.

#### Significant Impact Assessment – White-throated Needletail

Significant Impact Criteria	Details
Lead to a long-term decrease in the size of a population	The proposal will require the removal of up to 4.19 hectares of native vegetation from an area of marginal potential roosting habitat. The removal of this vegetation is unlikely to lead to a long-term decrease in the size of a population as, when in Australia, this species is almost exclusively aerial, breeding does not occur within Australia and as alternative roosting habitat will remain in the study area and surrounds.
Reduce the area of occupancy of this species	In Australia, this species is almost exclusively aerial where is also feeds aerially (DCCEEW 2022a). As such, the removal of vegetation for the proposal is not anticipated to reduce the area of occupancy of this species.
Fragment an existing population into two or more populations	The White-throated Needletail is highly mobile and known to be capable of crossing human-modified habitat. The proposal will offer no barrier to movement. Thus, it will not fragment an existing population.
Adversely affect habitat critical to the survival of a species	This species is migratory with breeding occurring in Asia. The study area is only likely to represent aerial foraging habitat and marginal potential roosting habitat for this species. Alternate roosting habitat will remain within the study area and in adjacent habitats during and post-construction. As such, the proposal is unlikely to affect habitats considered to be critical to the survival of this species.
Disrupt the breeding cycle of a population	This species breeds in eastern Siberia, north-eastern China and in Japan, hence the development site does not represent potential breeding habitat (DCCEEW 2022a). The removal of habitat within the study area would hence not be capable of disrupting the breeding cycle of the White-throated Needletail.

Significant Impact Criteria	Details
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The degree of possible vegetation loss imposed by the proposal is not significant enough to affect a local population of this species, to the point that it could cause a decline of the species.
Result in invasive species that are harmful to a critically endangered species becoming established in the critically endangered species' habitat	No new species that affects the White-throated Needletail is likely to be introduced as a direct result of the proposal.
Introduce a disease that may cause the species to decline	No disease that poses a potential risk to the White-throated Needletail is likely to be introduced to the study area.
Interferes substantially with the recovery of the species	The proposal will result in the removal of a relatively minute area of habitat for the White-throated Needletail, that is not significant enough to interfere with their recovery.
<b>Resulting Impact</b>	<b>No significant impact</b>

#### Significant Impact Assessment – Green and Golden Bell Frog

Significant Impact Criteria	Details
Lead to a long-term decrease in the size of a population	It is estimated that approximately 4.19 hectares of native vegetation, fringing larger areas of more desirable habitat for this species, will be removed as a result of the project. Given the minor loss of potential habitat for this species, that this species has not been recorded on site and the extent of available habitat directly adjoining the study area, the project is not likely to reduce the area of occupancy of a potential population of the Green and Golden Bell Frog. The proposal will thus not lead to a long-term decrease in the size of a potential population for this threatened amphibian.
Reduce the area of occupancy of this species	Given the minor loss of potential habitat in the construction footprint, the project is unlikely to reduce the area of occupancy of a potential population of this species.
Fragment an existing population into two or more populations	The construction footprint is currently in a modified state with this area comprising the previously disturbed roadside edges of high-use roads. Removal of site habitats will not lead to further fragmentation as habitat to be removed is already fragmented and only the outer edges of potential habitat will be removed.
Adversely affect habitat critical to the survival of a species	The vegetation within the construction footprint is not considered critical habitat for this species. Post-construction, the remainder of the site and other habitats in the study area will retain the potential to support this species, hence helping support the viability of potential local populations.
Disrupt the breeding cycle of a population	The habitats adjoining the study area may represent marginal potential breeding habitat for the Green and Golden Bell Frog. The extent of habitat that is proposed to be removed represents the minute outer fringes of this habitat which is unlikely to be preferred by this species. As such, it is unlikely that the project will disrupt the breeding cycle of this species.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The degree of possible vegetation loss is not significant enough to affect a potential local population of this species to the point that it could cause a decline of the species.

Significant Impact Criteria	Details
Result in invasive species that are harmful to a critically endangered species becoming established in the critically endangered species' habitat	No new species that affects this threatened amphibian is likely to be introduced as a result of the proposal given that mitigation measures for construction hygiene are followed.
Introduce a disease that may cause the species to decline	Amphibians, including the Green and Golden Bell Frog are known to carry chronic infections of the fungal pathogen Chytrid fungus that causes chytridiomycosis. This pathogen is a threat as it is a known cause of decline in frog species and may potentially be introduced to the study area during construction. Mitigation measures have been recommended around construction hygiene protocols. Given these measures are followed, the proposal is not expected to introduce a disease that may cause a decline to the species.
Interferes substantially with the recovery of the species	The proposal will result in the removal of a relatively minute area of habitat for the Green and Golden Bell Frog, that is not significant enough to interfere with their recovery.
<b>Resulting Impact</b>	<b>No significant impact</b>

### Migratory species

The guidelines to assessment of significance to this Matter, define an action as likely to have a significant impact on a migratory species, if it will:

- Substantially modify (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species, or;
- Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat of the migratory species, or;
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.

An important area of habitat is defined under the Matters of National Environmental Significance Significant Impact Guidelines 1.1 (Department of the Environment, Water, Heritage and the Arts (2013) as:

- Habitat used by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, or;
- Habitat utilised by a migratory species which is at the limit of the species range, or;
- Habitat within an area where the species is declining.

The study area is considered to constitute an important area of habitat for the subject species on the basis of the following:

- Subject species have historically been recorded within the study area.
- Habitats within the study area form the outer fringes of a larger area of habitat that would be important for these species.

### Significant Impact Assessment – Migratory birds (Eastern Osprey, White-throated Needletail)

Significant Impact Criteria	Details
Substantially modify (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species	Although the proposed development would remove a small portion of potential habitat for these species, habitat to be removed consists of the outer fringes of a larger areas of habitat. The project is not considered likely to substantially alter, destroy or isolate adjoining habitat which may be important for these species.

Significant Impact Criteria	Details
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat of the migratory species	An invasive species is one that may become established in the habitat, and harm the migratory species by direct competition, modification of habitat, or predation. The proposal will not introduce any such invasive species.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species	No disruption of the lifecycle of these migratory birds is likely, as the no breeding habitat is located within the construction footprint and ancillary areas; and the construction footprint and ancillary areas only represents the outer fringes of a larger area of habitat suitable for these species. Additionally, vegetation requiring removal does not comprise a significant extent of potential foraging habitat.
<b>Resulting Impact</b>	<b>No significant impact</b>





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