AECOM

Central Coast Highway-Tumbi Road Intersection Upgrade
Transport for NSW
05-Aug-2021

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Biodiversity Assessment Report

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Client: Transport for NSW

ABN: 76 236 371 088

Prepared by

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Reviewed by	Jamie McMahon

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List of Acronyms

BC Act	Biodiversity Conservation Act 2016 (NSW)
DoEE	Department of the Environment and Energy
EEC	Endangered Ecological Community
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999* (Cth)
FM Act	*Fisheries Management Act 1994*
ha	Hectare
km	Kilometres
KTP	Key Threatening Process
LEP	Local Environmental Plan
LGA	Local Government Area
MNES	Matters of National Environmental Significance
NPWS	National Parks and Wildlife Service, NSW
NSW	New South Wales
OEH	Office of Environment and Heritage, NSW.
SEPP	State Environmental Planning Policy
TEC	Threatened Ecological Community
WoNS	Weeds of National Significance

1.0 Introduction

1.1 Background

Transport for NSW (TfNSW) propose to upgrade the intersection at Central Coast Highway and Tumbi Road located in Wamberal, NSW (the Proposal). The intersection is located on the Central Coast Highway, adjacent to Wamberal Lagoon Nature Reserve (Figure 1-1), and consists of a two lane roundabout merging into two lanes travelling northbound and southbound along the Central Coast Highway and a single lane into Tumbi Road. The Proposal is part of a broader commitment to improve travel on the Central Coast Highway between Tumbi Road, Wamberal and Bateau Bay Road, Bateau Bay which will see the highway widened to two lanes in both directions for 3.8 kilometres.

AECOM Australia Pty Ltd (AECOM) has been engaged by TfNSW to prepare a biodiversity assessment report to identify the potential for threatened species or communities to be affected by the Proposal.

1.2 Proposal description

TfNSW is proposing improvements to the intersection of the Central Coast Highway and Tumbi Road at Wamberal, NSW (the Proposal). The main scope of the Proposal would be to replace the existing roundabout at this intersection with traffic lights, including associated improvements such as new and upgraded shared paths.

TfNSW also proposes to upgrade the Central Coast Highway from single to dual lanes in each direction within the vicinity of the intersection, to the limits of the Proposal area. This would include provision of a raised central median and sealed shoulders north and south of the intersection.

The Proposal would also include associated drainage upgrades and utility relocations. Adjustments to public and private property boundaries, fences, parking and property accesses would also be undertaken as necessary to support construction of the Proposal. Construction of a replacement car park beside the Wamberal Grocer and Fruit Market may proceed if agreed to by TfNSW and the property owner.

The above works would be undertaken with the Proposal area. This extends to approximately 200 m south of the Tumbi Road intersection, adjacent to the Old Tumbi road cul-de-sac. The northern limit of the Proposal area is approximately 400 metres north of the Tumbi Road intersection. The western limit of works would be in proximity to the Tumbi Road/Dalpura Road intersection. The upgraded (widened) section of the Central Coast Highway would tie back into the existing single lane configuration near the southern and northern limit of the Proposal area.

The Proposal location is shown in Figure 1-1.

This Proposal would be the first stage of a larger ultimate Proposal to upgrade the Central Coast Highway from single to dual lanes in each direction up to Bateau Bay Road, Bateau Bay. However, this Proposal has a need that is stand-alone from the larger ultimate Proposal, as one of the objectives is to alleviate substantial congestion and road and pedestrian safety issues at the existing intersection of the Central Coast Highway with Tumbi Road.

Key features of the Proposal can be found in Figure 1-2, Figure 1-3 and Figure 1-4 and would include:

- Site preparation works, including establishment of ancillary facilities, vegetation clearing, site fencing, temporary drainage measures, and implementation of environmental management measures
- Relocation of the following bus stops to a common location on the western side of the Central Coast Highway, just the north of the intersection:
  - Bus stop 2260187 - Tumbi Road at Central Coast Highway
  - Bus stop 2260174 - Central Coast Highway opposite Ulamba Avenue.
- Minor relocation of bus stop 2260137 (Central Coast Highway at Ulamba Avenue) approximately 30 metres north

- All existing bus services would remain in operation during construction of the Proposal
- Localised demolition of existing footpaths to accommodate works. Alternative access would be provided for pedestrians throughout construction
- Temporary relocation of active traffic lanes, including the placement of temporary pavement, to maintain traffic flow during construction and local access
- Demolition of the existing roundabout and sections of pavement over each arm of the intersection
- Widening of the Central Coast Highway to the north of the intersection to dual lanes in both directions, with a transition back to single lanes prior to the northern limit of works
- Widening of Tumbi Road as it approaches the intersection. This would include dual left turn lanes and a single right turn lane for traffic approaching the intersection. Tumbi Road would remain single lane for traffic leaving the intersection (heading north)
- Installation of new traffic lights at the intersection of the Central Coast Highway and Tumbi Road, including the following road changes:
    - Construction of a slip lane for left turn onto Tumbi Road from the northbound lanes of the Central Coast Highway
    - Construction of a dedicated right turn lane onto Tumbi Road from the southbound lanes of the Central Coast Highway
    - Construction of a slip lane for left turn onto the northbound lanes of the Central Coast Highway from Tumbi Road
    - Construction of dedicated dual right turn lanes onto the southbound lanes of the Central Coast highway from Tumbi Road.
- Construction of concrete and vegetated medians on Tumbi Road and the Central Coast Highway to separate opposing lanes of traffic
- Earthworks, including excavation and the construction of retaining walls and batters to accommodate the widened road
- Construction of retaining walls and batters on both sides of the Central Coast Highway
- Changes to the existing culvert under the Central Coast Highway immediately north of the Tumbi Road intersection. This would include:
    - Extension of eastern side the culvert to accommodate the widened road
    - Addition of a new pipe under the road to increase capacity of the culvert
    - Construction of new inlet and outlet structures at both ends of the culvert
    - Construction of an energy dissipation device at the eastern end of the culvert to reduce the velocity of water entering the Wamberal Lagoon Nature Reserve.
- Provision of a new pedestrian footpath adjacent to the northbound lanes of the Central Coast Highway between Old Tumbi Road and Tumbi Road, including a pedestrian connection to the Old Tumbi Road cul-de-sac
- Provision of a new pedestrian footpath along the northern side of Tumbi Road from a point 20 metres north of the intersection with Dalpura Road towards the intersection with the Central Coast Highway intersection, and continuing north adjacent to the northbound lanes of Central Coast Highway to the Pacific Garden Hotel
- Provision of suitable temporary and permanent entry arrangements for private properties fronting the Central Coast Highway and Tumbi Road within the limit of works
- Provision of a u-turn facility adjacent to the Pacific Garden Hotel for southbound traffic to turn back northbound, including a new kerbside lane on the northbound side of the road to facilitate entry to the hotel

- Permanent and temporary acquisition of private property, both full and partial, to accommodate the widened road and associated construction activities. This would include the demolition of all structures within the property to be fully acquired (Lot 1 DP136311)
- Subject to landowner agreement, property adjustments to the Wamberal Grocer and Fruit Market, including removal of the existing parking area provision of a new replacement parking and loading facility immediately south of the existing shop
- Drainage upgrade works within the road corridor and adjacent private property
- Provision of formalised drainage along the Central Coast Highway at the north eastern limit of works, discharging into an existing waterway
- Provision of a new permanent maintenance vehicle access ramp on the eastern side of the Central Coast Highway, north of the intersection
- Street lighting upgrades within and approaching the upgraded intersection
- Provision of new pavements and upgrade of existing pavements throughout the Proposal area
- New and adjusted signage and line marking
- Construction of new and upgraded active transport connections, including the re-establishment of any footpaths or shared paths removed to facilitate construction
- Construction of a new permanent bus stop adjacent to the northbound lanes of the Central Coast Highway, just north of the intersection. This new bus stop would consolidate bus stops 2260187 and 2260174 with all services being transferred to the new permanent bus stop
- Landscaping, including the planting of trees, shrubs and grass within the Proposal area and the regeneration of bushland adjacent to the Wamberal Lagoon Nature Reserve boundary. Drainage channels would be planted with suitable mix of species aimed at improving water quality
- Relocation and adjustment of existing utilities including water, sewerage, electricity, gas and telecommunications as required to accommodate the Proposal. This includes adjustments to existing utility connections into private property where these are affected by the Proposal, and may include short adjustments outside the limit of works to allow for connection back to existing utility alignments
- Demobilisation of construction activities, including removal of ancillary facilities, remaining construction materials and stockpiles and temporary environmental management measures. All temporary sites occupied during construction would be rehabilitated upon completion to at least their condition prior to the start of works.

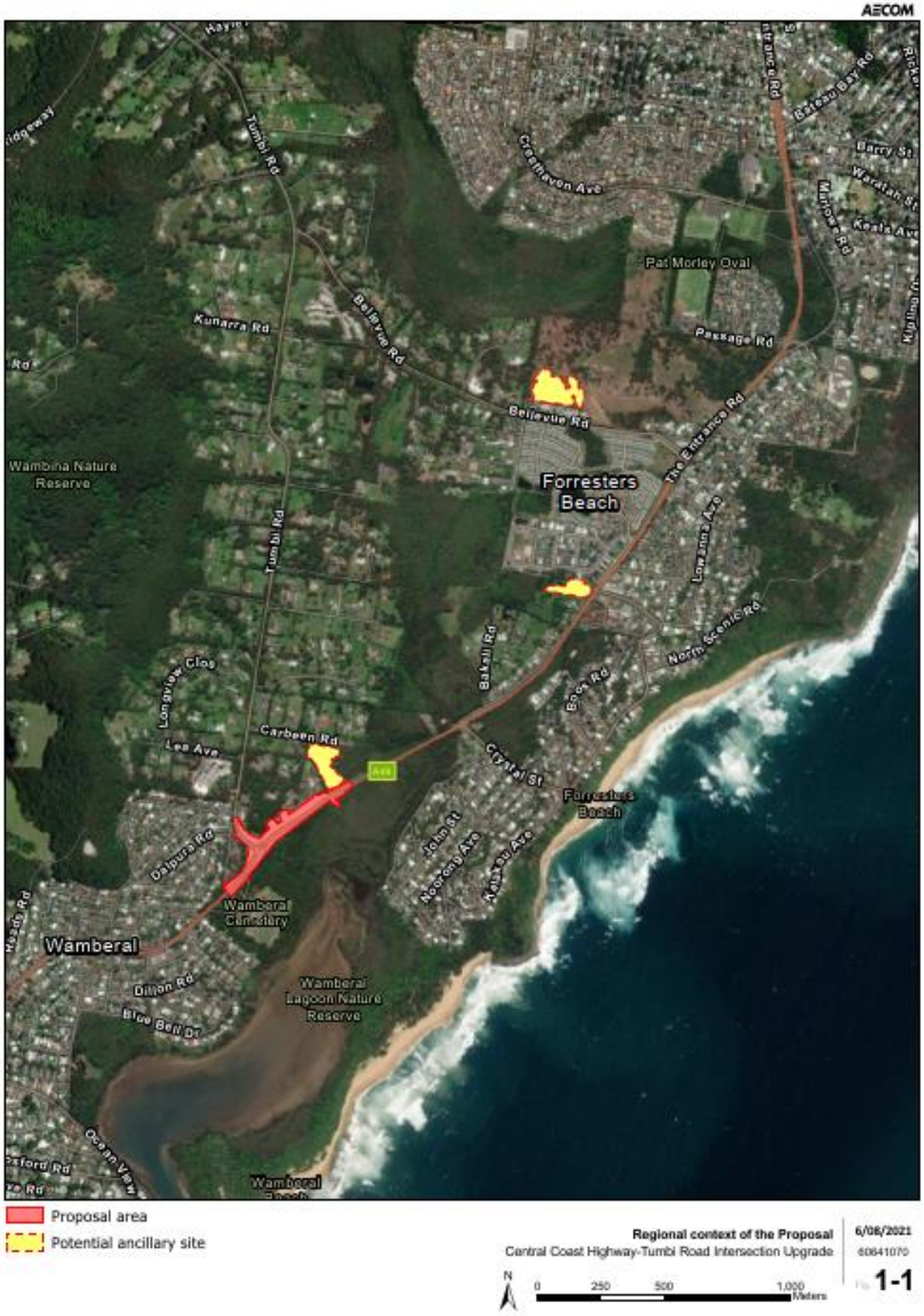
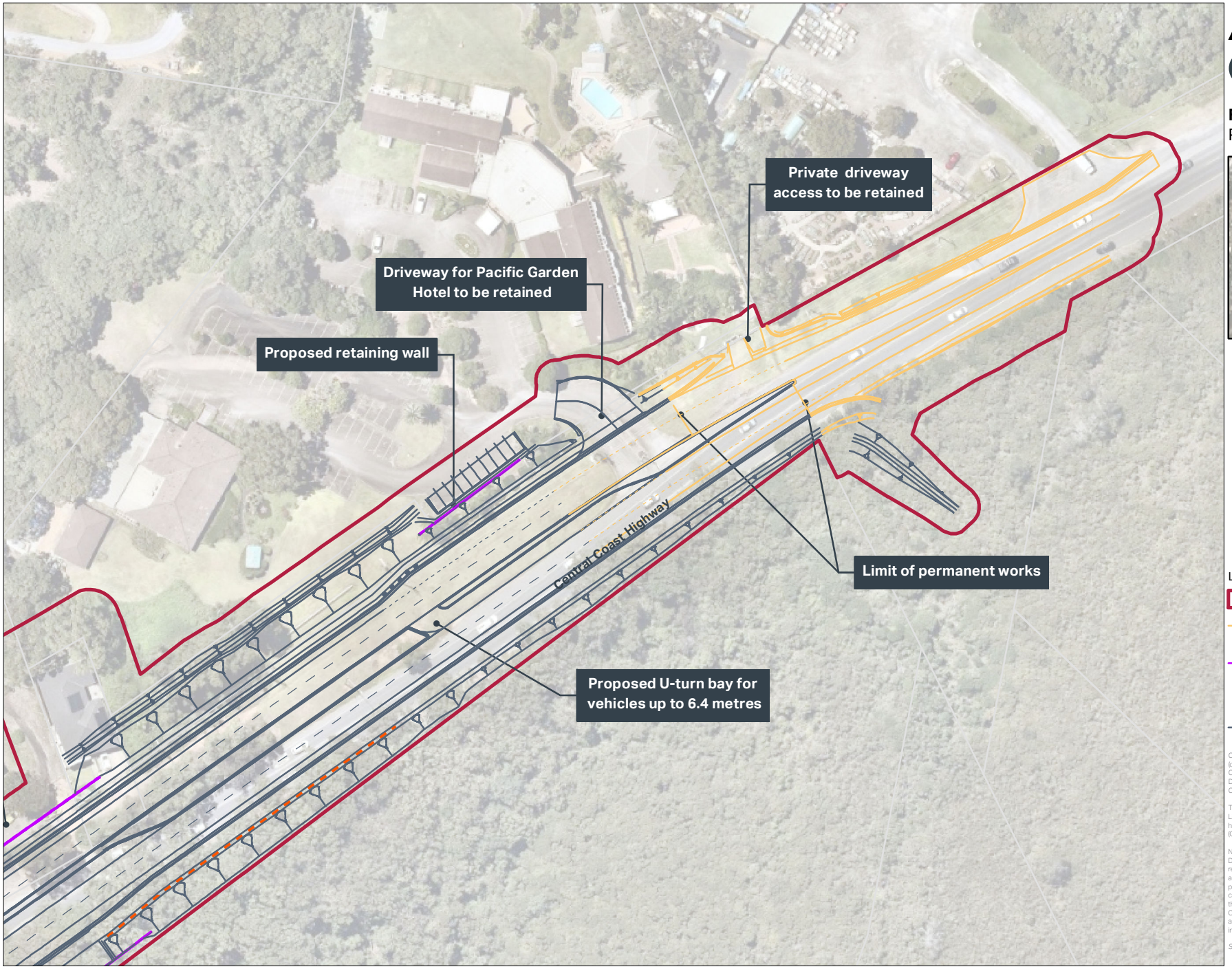


Figure 1-1 Regional context of the Proposal



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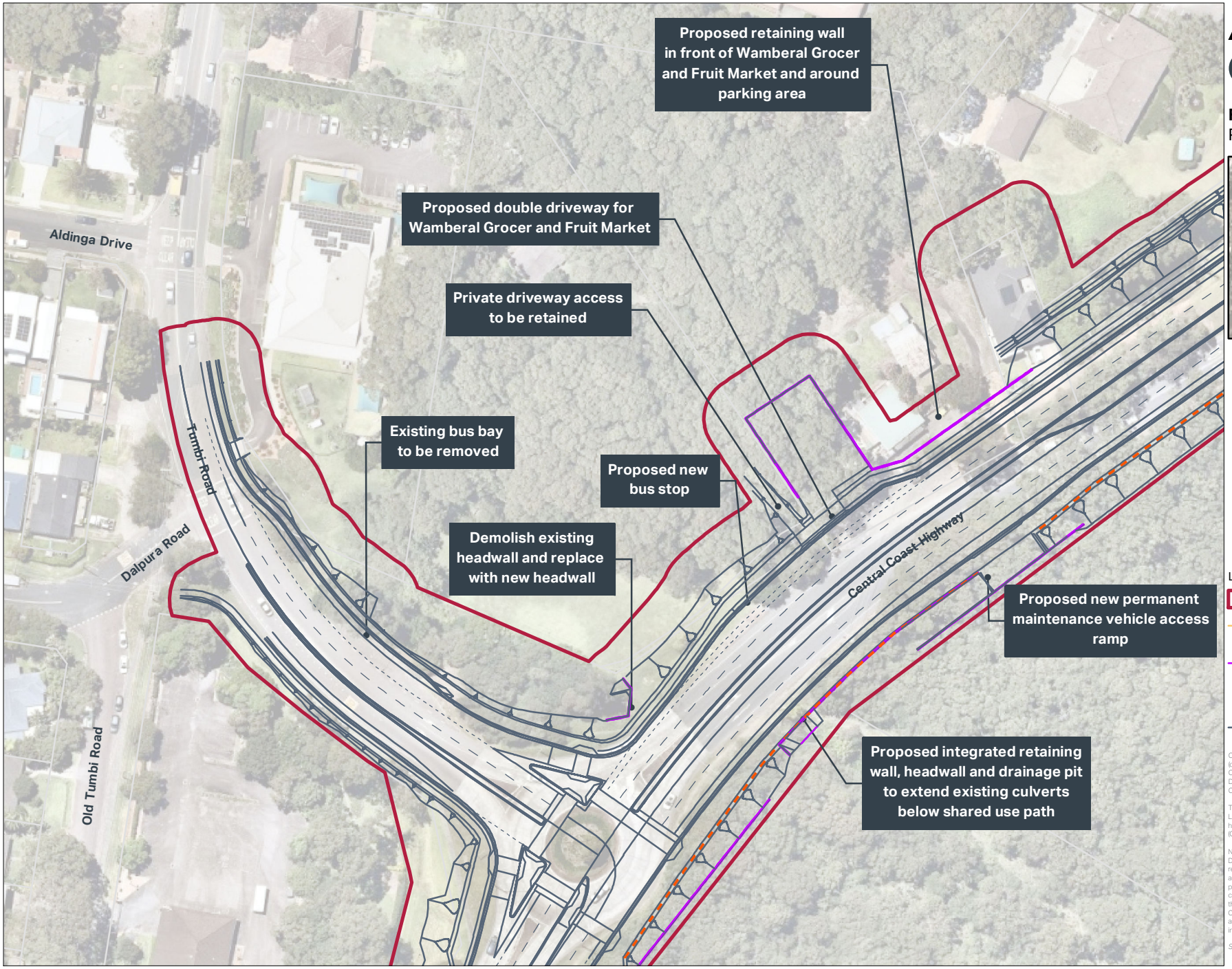
0 10 20 m

Figure 1-2:
PROJECT KEY FEATURES

Legend

- Proposal area
- Temporary works
- Proposed retaining wall
- Shared Path
- Permanent works

Source: Imagery © Nearmap, 2020.



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0 10 20 m

Figure 1-3:
PROJECT KEY FEATURES

Legend

- Proposal area
- Temporary works
- Proposed retaining wall
- Shared Path
- Permanent works

Source: Imagery © Nearmap, 2020.

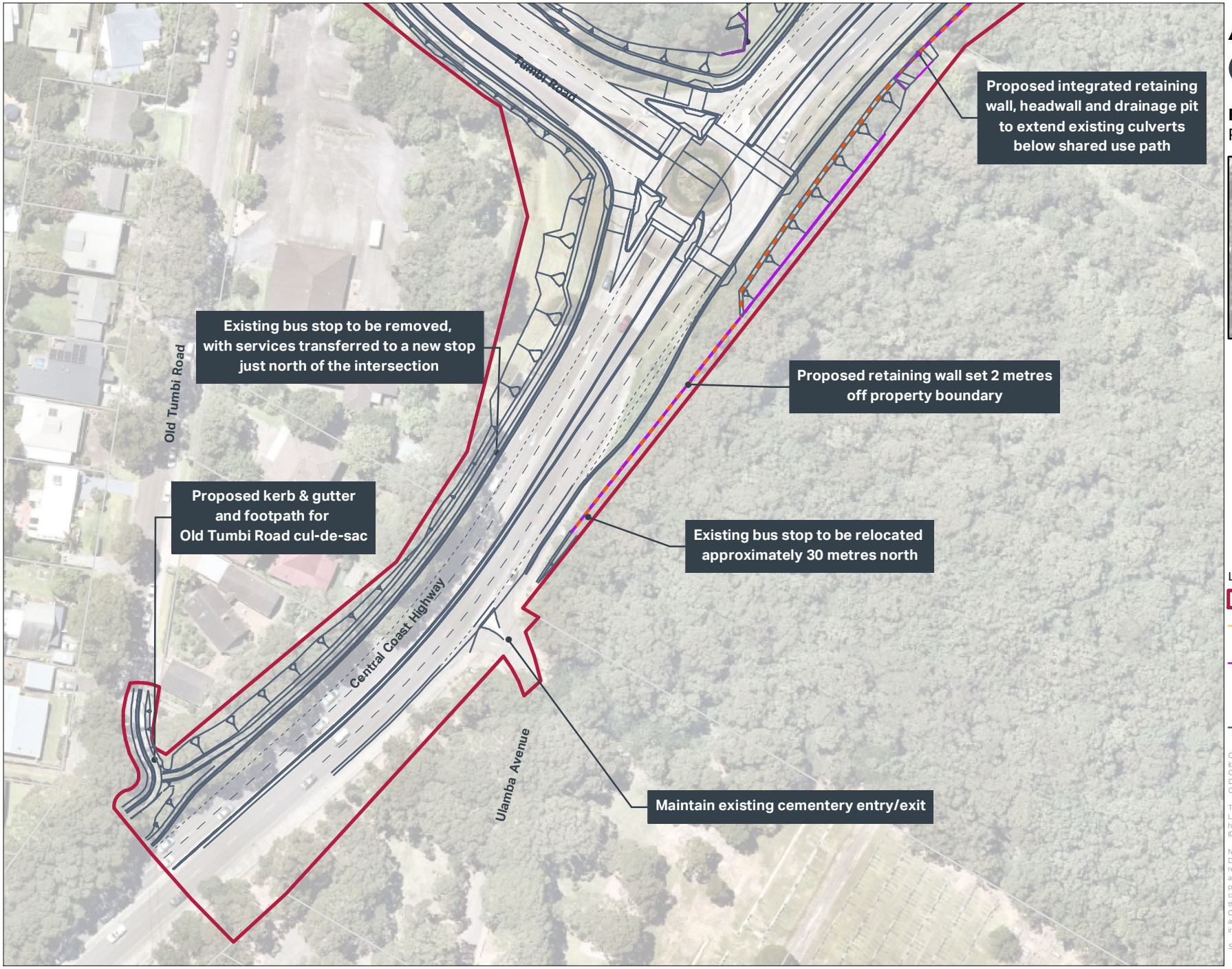

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Figure 1-4:
PROJECT KEY FEATURES

Legend

- Proposal area
- Temporary works
- Proposed retaining wall
- Shared Path
- Permanent works

Source: Imagery © Nearmap, 2020.

1.3 Study, Proposal and Ancillary areas

The Proposal is located with the Central Coast Council Local Government Area (LGA), in the suburb of Wamberal, NSW. The Proposal area refers to the area immediately affected by the proposed works. This includes the footprint of the new intersection and its approaches. It also takes in the footprint of the existing roundabout and its approaches, which will be removed prior to construction. Additionally, there are three potential ancillary sites which would consist of site compounds, stockpile areas and laydown areas. These potential ancillary sites have been listed through the report as Site 1 (893 The Entrance Road, Wamberal), Site 2 (987-991 The Entrance Road, Foresters Beach) and Site 3 (35 Bellevue Road, Bateau Bay).

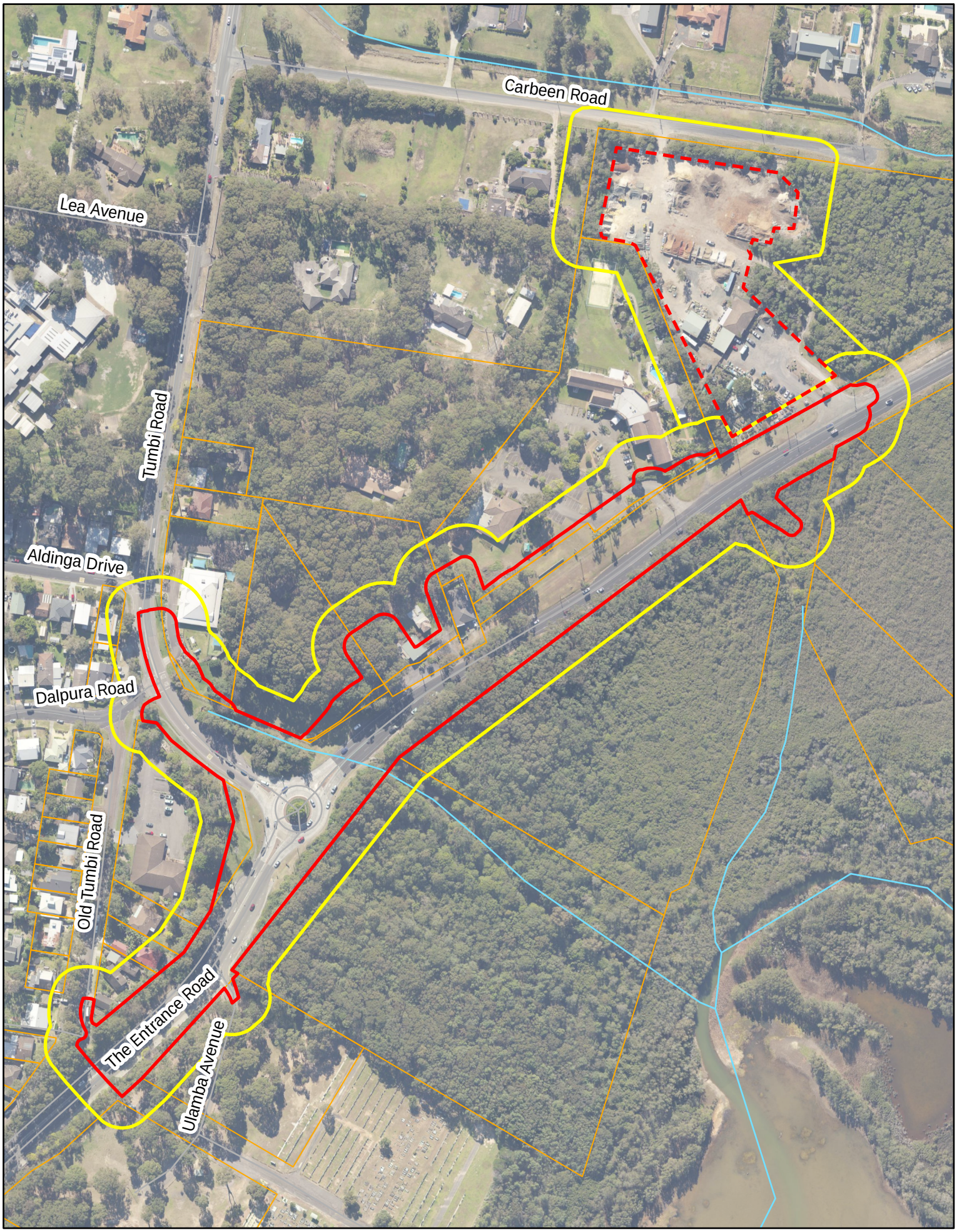
The study area refers to the broader area in which the Proposal area and potential ancillary sites are located which influences the nature of the existing ecology. For this assessment the study area includes an area with a 20 metre buffer of the Proposal area and potential ancillary sites.

The location of the Proposal area, potential ancillary sites and the study area are shown in Figure 1-5 and Figure 1-6.

TfNSW commissioned WSP (2020) to conduct a biodiversity assessment in May 2020 which included background searches, desktop assessment and field surveys. This report assesses the majority of the impacts associated with the Proposal, including assessment of impacts upon threatened species and ecological communities directly and indirectly affected by the intersection upgrade. As part of the development of the concept REF a gap analysis was prepared by AECOM to identify areas where the WSP assessment required updates to take into account the full scope of the updated Proposal. The results of this analysis are detailed in Table 1-1 and have been included throughout this report.

To fill gaps identified by the gap analysis supplementary field survey and technical specialist assessment was undertaken by AECOM and various specialist subconsultants. AECOM commissioned targeted threatened orchid surveys by Sclerophyll (2020, 2021) to account for surveys which were not able to be surveyed by WSP due to seasonal constraints (Appendix E and Appendix F). Additionally, EcoPlanning (2021) undertook targeted frog surveys within and adjacent to the Proposal area (Appendix G).

Further supplementary assessment carried out by AECOM included updated searches of both the BioNet and Protected Matters Search Tool databases (Appendix B and Appendix C). Both the BioNet and Protected Matters searches included threatened species and communities within a 10 kilometre x 10 kilometre area centred on the Proposal area and potential ancillary sites. A PlantNet database search was also undertaken for the area of the Central Coast Council LGA (Appendix D).



Proposal area
Potential ancillary site
Study area
Roads
Waterway
Cadastre

Biodiversity assessment study area
Central Coast Highway-Tumbi Road Intersection Upgrade

0 25 50 100 Meters

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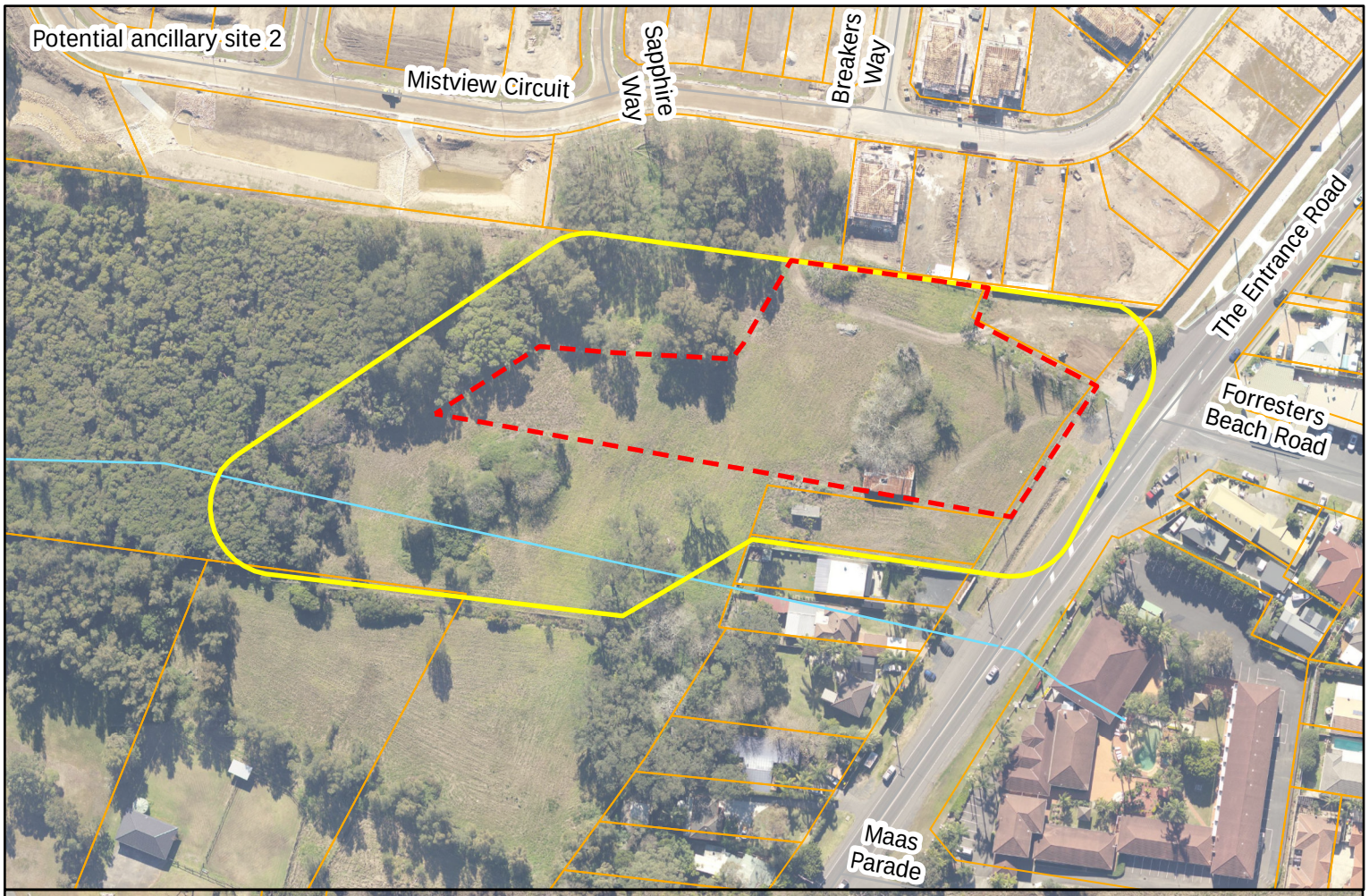
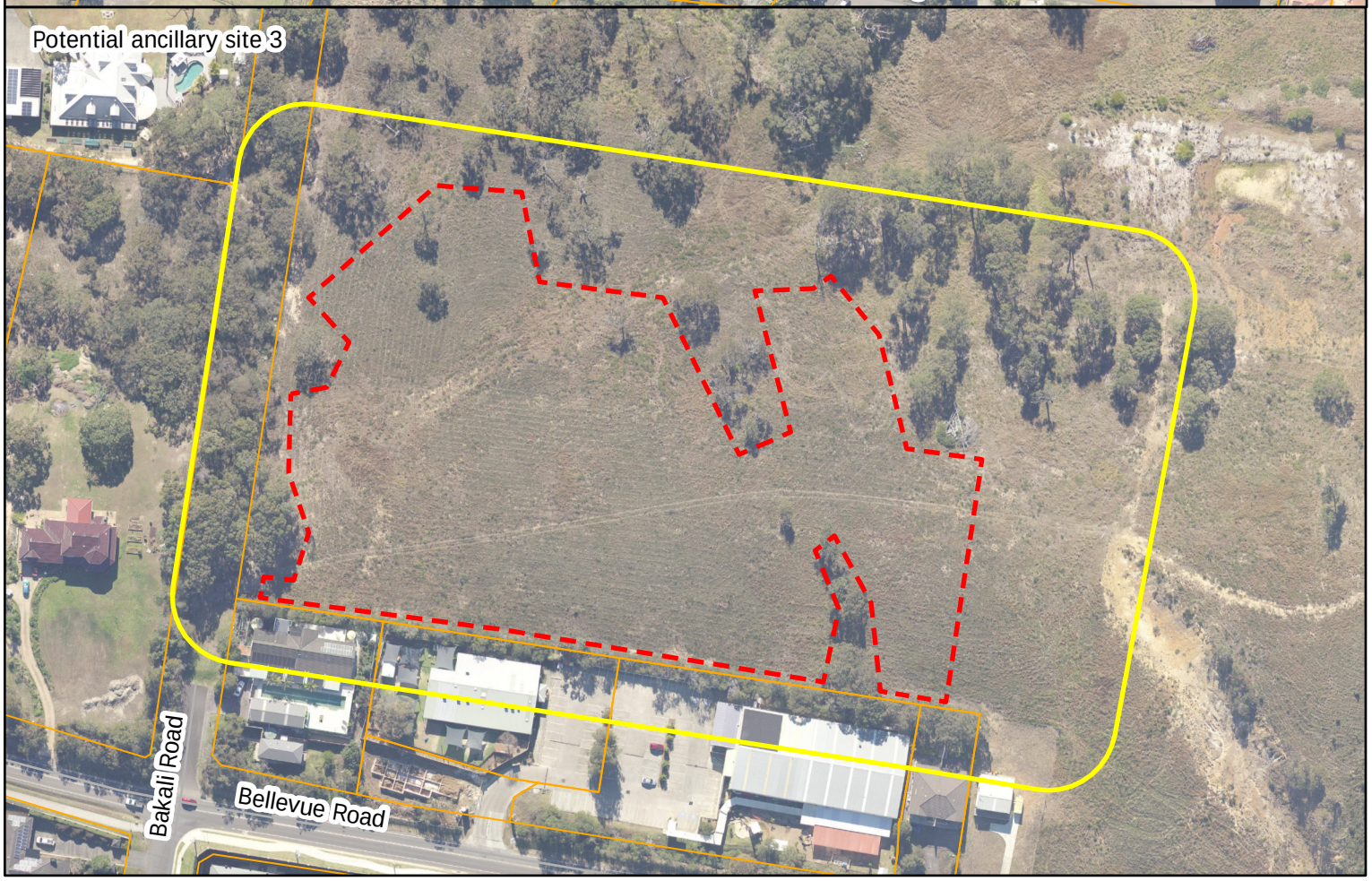
Fig. **1-5**





Proposal area
Potential ancillary site
Study area
Roads
Waterway
Cadastre

Biodiversity assessment study area
Central Coast Highway-Tumbi Road Intersection Upgrade

0 25 50 100 Meters

9/08/2021
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Fig. **1-6**

1.4 Legislative context

Environmental Planning and Assessment Act 1999

This assessment has been prepared to consider the potential environmental impacts of the Proposal, in keeping with the legislative requirements of Part 5 of *the Environmental Planning and Assessment Act 1979* (EP&A Act). The EP&A Act provides the statutory basis for planning and environmental assessment in New South Wales. This biodiversity assessment report is provided as part of the environmental assessment and technical considerations prepared in support of the Review of Environmental Factors (REF) for the Proposal. Further detail of the EP&A Act implications of the Proposal may be found within the REF.

Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires that Commonwealth approval be obtained for certain actions and establishes an assessment and approvals system for actions that have or are likely to have, a significant impact on Matters of National Environmental Significance (MNES). Matters of NES considered in this report include listed threatened species, populations and ecological communities as well as migratory species protected under international agreements. Particular consideration has been given to potential impacts on threatened biota that occur or are likely to occur within the study area. Potential impacts are discussed in Section 4.0 of this report.

In September 2015, a 'strategic assessment' was granted by the Commonwealth Minister for the Environment under Part 10 of the EPBC Act. The approval applies to TfNSW (Roads and Maritime) activities being assessed under Division 5.1 of the EP&A Act with respect to potential impacts on nationally listed threatened species, ecological communities and migratory species.

As a result, Roads and Maritime Proposals assessed via a REF:

- Must address and consider potential impacts on Commonwealth listed threatened species, populations, ecological communities and migratory species, including application of the "avoid, minimise, mitigate and offset" hierarchy
- Do not require referral to the Commonwealth Minister for the Environment for these matters, even if the activity is likely to have a significant impact.

TfNSW must consider impacts to Commonwealth listed threatened species, ecological communities and migratory species as part of the approval process under the strategic assessment. To assist with this, assessments are required in accordance with the *Matters of National Environmental Significance: Significant impact guidelines 1.1* (DoE 2013).

Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) protects threatened flora and fauna species and ecological communities and their habitats within NSW. Particular attention has been given to potential impacts on threatened biota that occur or are likely to occur within the study area. Potential impacts are discussed in Section 4.0 of this report.

Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) protects threatened species, populations and ecological communities of fish and marine vegetation, and other living resources of Australian waters. Species listed under this act are considered alongside those of the BC and EPBC Acts.

Under section 219 works within a waterway that may result in the temporary or permanent blockage of fish passage will require a permit from NSW DPI.

Section 199 of the Act requires a public authority provide the Minister for Primary Industries 21 days' notice dredging or reclamation works, though clause 227 of the Fisheries Management (General) Regulations 2019 provide an exemption from this requirement if the works are carried out in accordance with the Code of Practice for Minor Works in NSW Waterways.

Potential impacts to aquatic environment are discussed in Section 4.0 of this report.

Biosecurity Act 2015

Under the *Biosecurity Act 2015*, TfNSW as the landowner is required to prevent, eliminate or minimise the risk posed by a prohibited matter as outlined in Schedule 2 of the Act so far as is reasonably practicable. A priority weed is one that should be prevented, managed, controlled or eradicated in the region. Section 3.9 of this report considers weeds declared as priority weeds in the Central Coast Council LGA that occur within the Proposal area.

State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to assist in the effective delivery of public infrastructure across the State by improving certainty and regulatory efficiency through a consistent planning assessment and approvals regime for public infrastructure and services and through the clear definition of environmental assessment and approval processes for public infrastructure and services facilities.

As the Proposal is for a road or road infrastructure facility and is to be carried out by TfNSW, it can be assessed under Part 5 of the EP&A Act. As such, development consent from Central Coast Council is not required.

Clauses 13, 14, 15 (including 15AA and 15A) and 16 of the ISEPP require certain consultation with councils and other statutory agencies to be undertaken under certain circumstances. As per these requirements, Central-Coast Council was consulted about the Proposal. Other agencies that were consulted included the NSW State Emergency Service (SES) and the National Parks and Wildlife Service (NPWS). Issues raised through this consultation relating to biodiversity have been addressed through this report.

1.5 Study aims

The key aims of this study were to:

- Review previous studies undertaken on behalf of TfNSW for the Proposal or other related projects
- Conduct a gap analysis to identify elements of the Proposal that have not been previously assessed
- Undertake additional assessment to complement previous studies and fill relevant data gaps, including:
    - Undertaking a desktop study of flora and fauna relevant to the current study area, identifying species and communities that may be present
    - Conduct a field inspection of the study area, with particular attention to impacts on species, populations and ecological communities listed under the BC Act and the EPBC Act
    - Identify and assess likely direct impacts to flora and fauna occurring within the Proposal area
    - Undertake assessments of significance under the BC Act and the EPBC Act for threatened biota, where required.
- Summarise and discuss the results of these studies
- Based on previous studies and primary research, identify measures for managing impacts on threatened biota during design, construction and operation of the Proposal.

1.6 Gap analysis

A gap analysis has been undertaken to consider the scope of the Biodiversity Assessment Report undertaken by WSP (2020) and identify elements that would require further assessment to adequately assess the biodiversity impacts of the Proposal. These elements would then be further investigated as part of this assessment to ensure the full impacts of the Proposal are adequately assessed for potential impacts to biodiversity, and that appropriate mitigation measures are recommended. The results of this gap analysis are shown in Table 1-1.

Table 1-1 Gap analysis results

Area	Current assessment	Target assessment	Difference	Action	Where addressed
Proposal area	WSP assessment undertaken with 20% concept design	Complete current Proposal footprint from 100% concept design and potential ancillary sites including up to 3 metre construction works buffer	Wamberal Grocer and Fruit Market car park location, north eastern drainage line, potential ancillary sites	Update survey area and impact area through all assessments	Section 1.3
Vegetation impact	Vegetation impact encompassing WSP survey area	Vegetation impact encompassing updated survey area	Wamberal Grocer and Fruit Market car park location, north eastern drainage line, potential ancillary sites	Extension of PCT mapping to encompass updated study area. Additional desktop and on site assessment.	Section 3.3 and 4.1
Threatened species	Threatened species searches and habitat assessments for WSP survey area	Threatened species assessment encompassing updated survey area	Database records and habitat assessments for the Wamberal Grocer and Fruit Market car park location north eastern drainage line, potential ancillary sites	Undertake database searches for threatened species occurrence in updated study area. Assess likelihood of occurrence based on habitat in updated survey area	Section 3.5
Aquatic habitat	Unnamed first order stream north of roundabout	All potential watercourses occurring in the study area	Potential aquatic habitat occurring at the NE drainage channel	Additional desktop and on site assessment	Section 3.6 and 4.7
Biodiversity offsets	Assessment of WSP survey impact area against *Guideline for Biodiversity Offsets* (RMS, 2016)	Assessment of vegetation impact area against *Guideline for Biodiversity Offsets* (RMS, 2016)	Additional impact areas within updated study area	Assess updated vegetation impact against *Guideline for Biodiversity Offsets* (RMS, 2016)	Section 5.1
Wildlife connectivity	Assessment of impacts within WSP survey area	Potential connectivity occurring in updated study area	Addressing discrete connectivity elements, inclusion of the Wamberal Grocer and Fruit Market car park location area next to fruit shop, north eastern drainage line, potential ancillary sites	Detailed investigation of potential impacts addressing elements including roadkill, habitat proximity, likely fauna mobility, updated study area	Section 3.8 and 4.3
Specialist reports	Missing targeted and season-appropriate assessments for certain threatened species	Full assessment to ensure identification of all threatened species occurring in the study area	Targeted surveys for orchid and frog species not undertaken in original assessment	Targeted species surveys undertaken by Sclerophyll (2020,2021) and EcoPlanning (2021) with results presented in this report	Section 2.2 and 3.5

2.0 Methodology

2.1 Database searches and literature reviews

Desktop research was undertaken by WSP ecologists prior to the commencement of the site inspection (WSP, 2020). This included database searches and a review of relevant literature to determine if targeted surveys for specific species were required. Additionally, these searches helped to identify threatened biota known or likely to occur within the Proposal area.

The following databases and resources were investigated:

- NSW DPIE BioNet Database within a 10 kilometre x 10 kilometre area centred on the Proposal area (EES, 2020a)
- Protected Matters Report that documents all Matters of National Environmental Significance (MNES) within a 10 kilometre radius of the Proposal area. MNES include threatened species, communities and migratory species which are listed under the EPBC Act (DoEE, 2020)
- Royal Botanic Gardens PlantNet Database search of Central Coast Council LGA (RBG, 2020)
- NSW DPIE WeedWise Priority Weeds Weeds List for the Greater Sydney region (DPI 2020)
- Central Coast Highway improvements, between Wamberal and Bateau Bay preliminary environmental investigation (Roads & Maritime Services, 2019).
- 'Vegetation survey, classification and mapping – Lower Hunter and Central Coast Regional Environment Management Strategy' (Lower Hunter and Central Coast Regional Environmental Management Strategy, 2000) (LHCCREMs)
- 'The Natural Vegetation of the Gosford Local Government Area, Central Coast, New South Wales' (Bell, 2009)
- 'Hunter, Central and Lower North Coast Vegetation Classification and Mapping' (Somerville, 2009) (HCCREMs)
- Draft Biodiversity Strategy (Central Coast Council, 2019)
- Central Coast Flying-fox Management Strategy (Central Coast Council et al, 2017)
- Wamberal Lagoon Nature Reserve Plan of Management (NSW National Parks and Wildlife Service, 1993).

In addition to the above, targeted orchid surveys were undertaken by Sclerophyll Flora Surveys and Research. These assessments included background research and assessment of impact with a focus on the following threatened orchid species (Appendix E and Appendix F):

- Leafless Tongue Orchid *(Cryptostylis hunteriana) – BC* Act: vulnerable, EPBC Act: vulnerable
- Rough Doubletail *(Diuris praecox)* – BC Act: vulnerable, EPBC Act: vulnerable
- Thick Lip Spider Orchid *(Caladenia tessellata)* – BC Act: endangered, EPBC Act: vulnerable.

A targeted threatened frog survey was undertaken by EcoPlanning in November 2020. This included BioNet and Atlas of Living Australia database searches. Additionally, the following scientific literature was reviewed by EcoPlanning, which are listed in Appendix G, for identification and assessment of study areas for the following species:

- Green and Golden Bell Frog *Litoria aurea* (*Litoria aurea*)
- Green-thighed Frog (*Litoria brevipalmata*)
- Wallum Froglet (*Crinia tinnula*)
- Mahony's Froglet (*Uperoleia mahonyi*).

A survey of potential potential ancillary sites and other revisions to the Proposal design was undertaken by AECOM in May 2021. This included database searches and literature review. These included:

- NSW DPIE BioNet Database assessment within the compound areas (EES, 2021b)
- Protected Matters Report that documents all Matters of National Environmental Significance (MNES) within a 10 kilometre radius of the Proposal area. MNES include threatened species, communities and migratory species which are listed under the EPBC Act (DoEE 2020)
- Final determination to list Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions as an Endangered Ecological Community (NSC, 2011)
- Floristic variability, distribution and an extension of range for the endangered Pittwater Spotted Gum Forest, Central Coast, New South Wales. (Bell & Staples, 2012)
- Greater Hunter Native Vegetation Mapping v4.0. VIS ID 3855 (DPIE, 2019)
- Greater Glider Action Statement (DELWP, 2019)
- Gliding possums (DPIE,2018)
- NSW Department of Primary Industries WeedWise Priority Weeds Weeds List (DPI 2019b)
- Threatened Biodiversity Data Collection (EES, 2021a).
- The Natural Vegetation of the Gosford Local Government Area, Central Coast, New South Wales (Bell, 2009)

Other data and documents were reviewed as part of this study and are referenced throughout the report where relevant.

2.2 Field survey

2.2.1 Biodiversity assessment (WSP, 2020)

WSP undertook biodiversity assessment field surveys at the Site from the 9th to 13th of March 2020 by qualified and BAM accredited ecologists (WSP, 2020). This survey included assessment of flora and fauna present, verification of background research and habitat assessment, as well as opportunistic fauna sightings. Findings of these surveys have been used in this report and are available in Appendix D.

Targeted flora surveys included:

- Plot and transect surveys carried out in accordance with the BAM
- Rapid point assessment
- Parallel line transverses
- Random meander

Targeted fauna surveys included:

- Nocturnal surveys
- Spotlighting
- Call playback
- Diurnal bird surveys
- Koala spot assessments
- Elliot and cage trapping
- Deployment of ultrasonic bat recorders.

Weather conditions during the field survey are summarised in Table 2-1. Data was drawn from the Norah Head AWS (station 065103).

Table 2-1 WSP field survey weather conditions

Date	Minimum temperature (°C)	Maximum temperature (°C)	Wind direction (Km/hr)	Rainfall (mm)
9 March 2020	18.6	24.3	SSE 37	0.2
10 March 2020	17.3	23.4	SE 37	0
11 March 2020	16.4	24.8	SSE 33	0
12 March 2020	17.7	26.6	E 24	0
13 March 2020	16.5	25.3	NNE 33	0

2.2.2 Targeted orchid survey (Sclerophyll, 2020 and 2021)

A target orchid survey was undertaken at the Site by Sclerophyll Flora Research and Surveys on 7th September and 21 December 2020. The surveys were completed by a principal botanist experienced in specialist orchid surveys (Sclerophyll, 2021 and 2021). The target species for these surveys included:

- *Diuris praecox (Rough Doubletail)*
- *Caladenia tessellate* (Thick Lip Spider Orchid)
- *Cryptostylis hunteriana* (Leafless Tongue Orchid).

The surveys were conducted using parallel line transects in suitable habitat, namely Bloodwood-Peppermint dry sclerophyll habitat, within and adjoining the Study area. The survey on 7th September was undertaken over a three hour period in fine conditions while the survey on 21st December was undertaken over a three hour period in overcast conditions. Findings of these surveys have been included in this report and are available in Appendix E and F.

2.2.3 Targeted frog survey (EcoPlanning, 2020)

A targeted frog survey and aquatic habitat assessment was undertaken by Ecopanning from the 9th to the 12th November 2020 by a Principal Ecologist and qualified amphibian expert. These surveys were undertaken within potential aquatic habitat in the vicinity of the Proposal area with two additional reference sites at Avoca Lagoon and Chittaway. The target species for these surveys include:

- *Litoria aurea* (Green and Golden Bell Frog)
- *Litoria brevipalmata* (Green-thighed Frog)
- *Crinia tinnula* (Wallum Frog)
- *Uperoleia mahonyi* (Mahony's Froglet).

The extent of potential habitat was identified outside of the Proposal area, within Wamberal Lagoon Nature Reserve and adjacent to the Proposal area. Findings of these surveys have been included in this report and are available in Appendix G.

2.2.4 Supplementary site survey (AECOM, 2021)

The updated survey area was surveyed by AECOM ecologists on 5 May 2021, focussing on the potential ancillary sites and the areas of the Proposal not covered by the WSP survey. Survey at these locations was undertaken via rapid data plot methodology with view to characterising flora communities present. Targeted searches were undertaken for relevant threatened flora species. Habitat assessment for threatened fauna was also undertaken. Findings of these surveys have been included in this report.

2.3 Limitations

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

- AECOM is reliant on externally supplied reports and data including surveys, analyses and other information provided by other organisations including WSP and Sclerophyll. Except where stated, AECOM has not verified these findings. However, the methods reported in the documents provided indicate that these surveys and reports were undertaken to an adequate extent to assess the survey areas identified. As such, the findings of the reports have been accepted as accurately reporting on the condition of the survey area
- The AECOM 2021 survey focused on particular areas not covered by the WSP report, namely the potential ancillary sites, new Wamberal Grocer and Fruit Market car park location, updated design areas, and where ecological risks were deemed to be greater. This included areas of existing vegetation through which Proposal would pass, as well as locations where areas existed around the Proposal area that were deemed to be more sensitive to potential off site impacts
- While a fauna habitat assessment was undertaken during the AECOM 2021 survey, this technique is not an adequate substitute for full fauna surveys. Fauna are capable of inhabiting sub-optimal habitat, and fragmentation, isolation or species density can all influence the presence and distribution of a particular species. Species likelihood of occurrence was informed by considering habitat characteristics and opportunistic sightings. Where deemed appropriate, targeted surveys were undertaken to assess particular threatened species identified as being likely to inhabit the study area
- No aquatic survey was undertaken, although general assessment of minor aquatic habitats was undertaken by WSP (2020) and AECOM during site surveys. Aquatic habitat suitable for frog species was identified and assessed in the targeted frog survey (EcoPlanning, 2020).

3.0 Existing environment

3.1 Overview

Table 3-1 considers an overview of the site, including relevant environmental controls and sensitivities. Photographs of the site are included in Figure 3-1 to Figure 3-7.

Table 3-1 Environmental controls and sensitivities

Environmental Considerations	In the study area?
Is the Proposal located within a National Park?	No, though is adjacent to Wamberal Lagoon Nature Reserve
Is the Proposal located within land reserved or dedicated for preservation of other environmental protection purposes?	No, though is adjacent to Wamberal Lagoon Nature Reserve
Is the Proposal located within a World Heritage Area?	No
Is the Proposal located within an Environmental Protection Zone under an environmental planning instrument?	No, though is adjacent to land zoned as E1 Environmental Protection
Is the Proposal located within land identified as a wilderness area?	No
Is the Proposal located within a wetland area dedicated under the Ramsar Wetlands Convention?	No
Does the site contain critical habitat?	No
Is the area mapped as Key Fish habitat?	No
Is the area mapped on the Biodiversity Values map?	Partially
Is the area mapped on the Native Vegetation Regulatory Map?	No

Figure 3-1 PCT 1625 occurring along the south eastern side of The Central Coast Highway (left) and a smaller section of PCT 1625 in the road reserve (right)

Figure 3-2 View from cleared area north west of current roundabout

Figure 3-3 PCT 1589b western side of Tumbi Road

Figure 3-4 Culvert outflow into disturbed waterway within PCT 1716b south east of the roundabout

Figure 3-5 PCT 1564 at the proposed carpark area south of the fruit shop

Figure 3-6 Proposed compound 2 looking east toward house

Figure 3-7 Proposed compound 3 looking west, scattered trees with disturbed native invasive ground cover

3.2 Land use

The Proposal area is located within the road corridor and adjacent lands and is zoned as various land use zoned. These include:

- SP2 (Infrastructure – Road)
- E1 Environmental Protection
- E4 Environmental Living
- RE1 Recreation
- R2 Low density residential
- R1 Low density residential
- DM Deferred Matter.

The general landform of the Proposal area is flat, with a gentle slope downwards to the east. Further to the west however the land rises sharply with undulating to steep hills dominating the upper catchment.

One minor waterway, an unnamed tributary to Wamberal Lagoon, passes through the centre of the Proposal Area, just north the intersection. This waterway passes under the road in a triple pipe culvert and deposits in the Wamberal Lagoon Nature Reserve.

Land uses around the Proposal area varies substantially throughout the alignment. On the eastern side land use is dominated by the remnant vegetation of the Wamberal Lagoon Nature Reserve. To the south of this reserve is Wamberal Cemetery. On the western side, in the southern section, the Proposal area backs onto residential properties and a place of worship. Immediately north of the intersection is the above mentioned waterway, followed by open grazing land, remnant vegetation, residential properties and a small roadside fruit shop. Beyond this is a motel and restaurant.

Along Tumbi Road land use is predominantly residential development to the south, with a child care centre located to the north of the road at the limit of works.

The broader area around the Proposal area is a mixture of small and large lot residential intermixed with elements of social infrastructure and businesses. Some lands have been cleared and are currently used for grazing or horse agistment. A broad section of uncleared land is located to the north of the Proposal area.

The potential ancillary sites are generally located to the north east of the Proposal area. Site 1 is located immediately adjacent to the Proposal area and currently operates as a garden centre. To the east of the garden centre, outside of the potential ancillary site, is remnant bushland, with residential properties to the north and a landscape supply business to the west.

The lot accommodating site 2 is approximately half vegetated and half cleared with a derelict house situated close to the roadway. It fronts onto The Central Coast Highway, with a residential development site to the north and a vegetated area on the western side of the property connected to a larger bushland area of about 40 hectares to the west.

Site 3 is located on a ridge with some residential properties and an early learning centre and gym to the south and lifestyle properties and a place of worship to the west. The east of the property is woodland and some cleared areas with a larger contiguous vegetated area of about 100 hectares extending to the north of the property.

3.3 Vegetation communities and habitat

3.3.1 Terrestrial vegetation

A total of Four Plant Community Types (PCTs) were identified within the Proposal study area via reference to the BioNet Vegetation Classification Database, these include:

- PCT 1564: Blackbutt - Rough-barked Apple - Turpentine - ferny tall open forest of the Central Coast

- PCT 1589: Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast
- PCT 1625 - Red Bloodwood -Sydney Peppermint - Podocarpus spinulosus shrubby open forest of the southern Central Coast - Intact
- PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast

Four PCTs were identified within the potential ancillary sites study areas via reference to the BioNet Vegetation Classification Database. One of these, PCT 1589, was also present within the Proposal study area however presented as a modified variant when compared to the PCT 1589 vegetation found within the Proposal study area. Additional PCTs include:

- PCT 925: Melaleuca nodosa closed shrubland on alluvium of the Central Coast, Sydney Basin Bioregion
- PCT 1718: Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
- PCT 1795: Coastal flats Swamp Mahogany forest.

The Proposal study area also contained significant areas of non-native vegetation in which rapid point assessments were conducted to assess composition and abundance of non-native vegetation. These were allocated into two types, including:

- 0 - Miscellaneous ecosystem – highly disturbed areas with limited or no native vegetation
- 00 - Miscellaneous ecosystem – landscape plantings

An additional mixed native exotic modified vegetation type was identified within the ancillary site 3 study area:

- 000 - Miscellaneous ecosystem – maintained mixed native exotic ground cover

Two of the PCTs identified in the study area were assigned to discrete vegetation condition classes based on condition and variant. A summary of the total area of mapped vegetation identified within the study area is outlined in Table 3-2. Plant Community Types and potential Threatened Ecological Communities (TECs) mapped as being present within the study area are discussed below and shown in Figure 1-5.

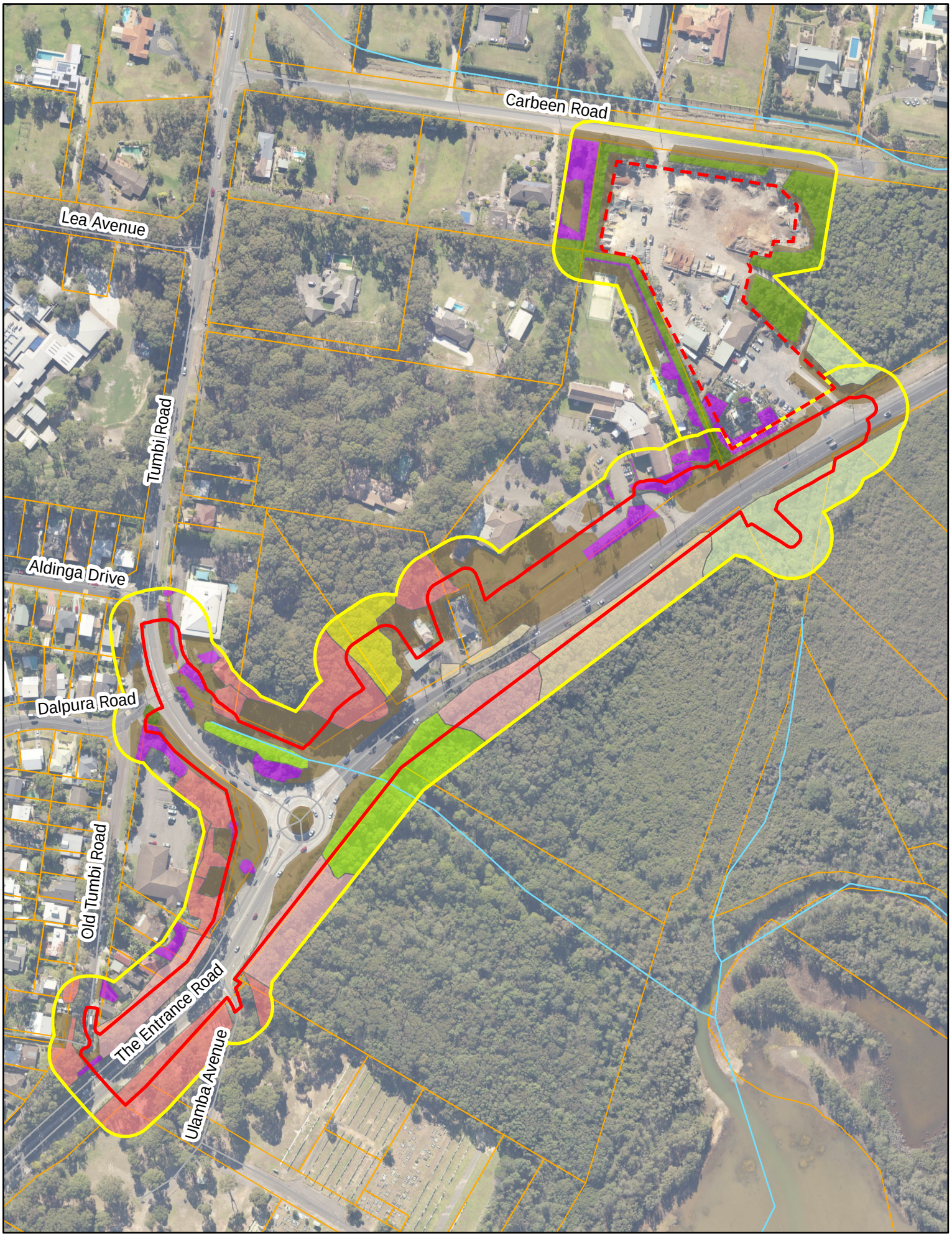
Table 3-2 Plant community types previously mapped within the Proposal study area

Plant Community Type	Plant Community Type Name	Condition Class	Vegetation within Proposal study areas (ha)
PCT 1564	Blackbutt - Rough-barked Apple - Turpentine - ferny tall open forest of the Central Coast	Modified	0.16
PCT 1589	Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast	Intact	0.57
		Modified - 1	0.90
PCT 1625	Red Bloodwood -Sydney Peppermint - Podocarpus spinulosus shrubby open forest of the southern Central Coast - Intact	Intact	0.38

Plant Community Type	Plant Community Type Name	Condition Class	Vegetation within Proposal study areas (ha)
PCT 1716	Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast	Intact	0.50
		Melaleuca nodosa variant – intact	0.42
		Modified	**0.03**
Total PCT vegetation			**2.96**
0		N/A	1.77
00		N/A	0.32
Total non-PCT vegetation			2.09
Total vegetation			**5.05**

Table 3-3 Plant community types previously mapped within the ancillary site study area

Plant Community Type	Plant Community Type Name	Condition Class	Vegetation within study areas (ha)		
			Ancillary site 1	Ancillary site 2	Ancillary site 3
PCT 925	Melaleuca nodosa closed shrubland on alluvium of the Central Coast, Sydney Basin Bioregion	Intact	-	0.14	-
PCT 1589	Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast	Modified - 2			0.61
PCT 1716	Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast	Intact	0.06		
		Modified	0.44		
PCT 1718	Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast	Modified	-	-	1.13
PCT 1795	Coastal flats Swamp Mahogany forest.	Modified	-	0.46	-
Total PCT vegetation			**0.50**	**0.60**	**1.74**
0		N/A	0.35	1.11	-
00		N/A	0.15	0.27	0.17
000		N/A	-	-	2.37
Total non-PCT vegetation			0.49	1.38	2.54
Total vegetation			**1.00**	**1.98**	**4.28**



Proposal area
Potential ancillary site
Study area
Roads
Waterway

Cadastre
0
00
1564
1589a
1589b
1625
1716a
1716b
1716c

Plant Community Types within the study area
Central Coast Highway-Tumbi Road Intersection Upgrade

0 25 50 100 Meters

9/08/2021
60641070
Fig. **3-8**

Proposal area
Potential ancillary site
Study area
Roads
Waterway

Cadastre
0
00
000
925

1589c
1718
1795

Biodiversity assessment study area
Central Coast Highway-Tumbi Road Intersection Upgrade

0 25 50 100 Meters

9/08/2021
60641070
Fig. **3-9**

PCT 925: Melaleuca nodosa closed shrubland on alluvium of the Central Coast, Sydney Basin Bioregion

This community occurs on swampy coastal alluvium plains of the central coast below 25 metres ASL. The canopy species consists of *Melaleuca nodosa, Melaleuca linariifolia* and *Melaleuca sieberi* **with** a mixed ground layer of sedges, rushes and grasses. The community is not well described with extent and post-1750 clearance not identified.

PCT 1564: Blackbutt - Rough-barked Apple - Turpentine - ferny tall open forest of the Central Coast

This community is generally characterised by open forests dominated by *Eucalyptus pilularis*. The mid-storey includes sparse small trees and numerous shrubs and climbers. The ground layer is typically dominated by ferns along with various graminoids and forbs. Mainly occuring on sandstone substrates on the hinterland of the Central Coast at elevations below 250 metres.

PCT 1589: Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast

This community is generally characterised by open forests with a canopy dominated by *Corymbia maculate*. The mid-storey is generally shrubby with various climbers with a ground layer dominated by a range of grasses along with other graminoid and forbs. The community occurs on coastal lowlands of the Central Coast mainly on sandstones, extending from Wyong to the Hunter. Approximately 71% of the pre-1750 extent of this PCT has been cleared.

Three distinct vegetation zones were assigned within this vegetation type based on broad condition state including:

1589a - Intact: This broad condition state occurs relatively undisturbed with all stratum present. Exotic weed incursions were recorded in both the ground and middle stratum although native species are dominant through all structural layers. This vegetation zone mostly occurs to the south and east of The Central Coast Highway and extends within the Wamberal Lagoon Nature Reserve.

1589b – Modified 1: Mostly occurs as intact canopy only or scattered trees with modified ground and middle stratum consisting mostly of maintained grasses, plantings or weeds. This vegetation zone is mostly associated with private lands and road verges.

1589c – Modified 2: This variant differentiated due to the complete lack of mid-storey vegetation and a largely intact native ground layer, albeit stressed due to soil erosion and apparent frequent disturbance by slashing supressing ground to mid-storey growth. This variant occurs up the hill east of Compound 3.

PCT 1625: Red Bloodwood -Sydney Peppermint -Podocarpus spinulosus shrubby open forest of the southern Central Coast

This community is generally characterised by open forests to woodlands with a mixed canopy typically including *Corymbia gummifera*, *Eucalyptus pipertia* along with a ground layer dominated by *Pteridium esculentum* along with various grasses. The community is often found on coastal plateaus and low coastal hills of the southern Central Coast on Quaternary sand and Triassic sandstones. Approximately 88% of the pre-1750 extent of this PCT has been cleared.

PCT 1716: Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast

This community is generally characterised by tall shrubland and low open forest with emergent *Eucalyptus resinifera* with a main canopy containing a variety of species in association with *Melaluca nodosa*. The ground stratum is relatively dense and is dominated by grasses. This community is found on poorly drained areas on the undulating coastal lowlands from Wamberal north to Yarratt State Forest. This community typically occurs on unconsolidated sediments or on fine-grained sedimentary geologies at elevations up to 100m. Approximately 66% of the pre-1750 extent of this PCT has been cleared.

Two distinct vegetation zones were assigned within this vegetation type based on broad condition state including:

1716a - Intact: This vegetation zone was dominated by a mixed paperbark canopy comprising of *Melaleuca styphelioides*, *Melaleuca nodosa*, *Callistemon salignus* and *Melaleuca linariifolia*. Scattered emergent eucalypts also occur in this vegetation zone along with a variety of mesic shrubs and ground stratum dominated by sedges and grasses.

1716b - Melaleuca nodosa variant – Intact: This vegetation zone occurs as a low dense thicket variant dominated by *Melaleuca nodosa.* This variant also exhibits a more wet heath shrub layer that includes species such as *Banksia oblongifolia*, *Hakea teretifolia* and *Monotoca elliptica*.

1716c – Modified: This vegetation zone is differentiated through a modified mid-storey and ground stratum, higher levels of disturbance and invasion of other native and exotic plants and at times intermingled with landscape plantings.

PCT 1718: Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast

This community type is characterised by Myrtaceous Swamp Open Forests with a Myrtaceous mid-storey comprising small trees and tall shrubs. The ground stratum is made up of grasses and graminoid species with some ferns and forbs. This community is distributed from the Central Coast area north to Karuah. It occurs typically on poorly drained unconsolidated sediments of the coastal lowlands at elevations are typically under 50 metres.

PCT 1795: Coastal flats Swamp Mahogany forest

This community is found in areas of impeded drainage near coastal swamps, lagoons and along low-lying drainage flats. This open forest is dominated by *Eucalyptus robusta* with a smaller tree layer of *Casuarina glauca*, *Melaleuca linariifolia* and *Melaleuca styphelioides*. A distinct mesic element is present in the understorey with *Glochidion ferdinandi* and *Livistona australis* most prominent. Climbers may be found winding around tree trunks and fallen branches. The ground cover is periodically wet with standing water rarely consistent throughout the year with some sedges occurring amongst ferns, grasses and herbs which are most abundant. Approximately 50% of this PCT has been cleared.

3.3.2 Fauna Habitat

The fauna habitat that occurs within the study site and within the locality varies substantially, with most habitat within the Proposal area being highly disturbed or absent. Higher quality terrestrial habitat is present immediately adjacent to the Proposal within the Wamberal Lagoon Nature Reserve and west of compound 2. Notable fauna habitat within the Proposal area includes the following:

- Upper stratum and canopy - mature trees likely used for foraging by arboreal mammals, birds, gliders, insects and reptiles. This habitat exists within the Proposal area predominantly along The Central Coast Highway adjacent to the Wamberal Lagoon Nature Reserve and is connected to the vegetation within the nature reserve. Due to the proximity to the road and the extensive connected habitat within the reserve, it is likely this would be used for foraging and movement. No tree hollows were identified within the Proposal area however several were identified within the adjacent nature reserve. Feed trees for some glider species are present on the northern side of The Central Coast Highway and may be used for foraging. However, ample alternative foraging area exists in adjacent land
- Shrubby open forest – Largely intact, albeit weed invaded, shrubby coastal swamp forest and dry sclerophyll forest is present within the Proposal area adjacent to the Wamberal Lagoon Nature Reserve, as well as within the nature reserve and immediately west of compound 2. These habitats vary from 10-30% shrub cover and include habitat features such as coarse woody debris, hollow logs and leaf litter. This habitat is typically used by native species including small to medium sized mammals such as mice, quolls, wallabies and echidnas as well as frogs, snakes, birds and lizards.

3.4 Threatened ecological communities

Two potential TECs were identified within the study area associated with PCT 1589 and PCT 1716 occurring within the Proposal area. These TECs include:

- *Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion*
- *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*

Vegetation characteristics of the PCTs occurring within the Proposal area were compared with the final determination listing criteria of the associated TECs. PCT 1716 was found to be consistent with the TEC *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*. PCT 1589 was not found to be consistent with *Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion*. These assessments are detailed below and comparisons listed Table 3-4 and Table 3-5. The extent of TEC occurrence within the Proposal area is shown in Figure 3-10.

Database investigation identified that the characteristics of PCT 1589 variant '1589a – intact' and '1589b – modified' were found to be similar to the final determination for the *Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion* (Table 3-5) which is listed as an Endangered Ecological Community under the BC Act. However, both PCT 1589 variants within the Proposal area are mapped as part of the Tumbi Spotted Gum – Ironbark Forest, which is not considered to form part of this EEC (Bell and Staples 2012, WSP 2020). As such, it was determined that the *Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion* EEC did not occur within the proposal area.

Table 3-4 Threatened ecological community comparison - Pittwater and Wagstaffe Spotted Gum Forest

Final determination listing criteria	Pittwater and Wagstaffe Spotted Gum Forest	PCT 1589
Area occupied by the EEC	Occurs in the Sydney Basin Bioregion	Yes, occurs in the Sydney Basin IBRA Bioregion
Soils	The community is known to occur on shale-derived soils from Narrabeen series geology	No, 1589a and 1589b occurs on periodically inundated alluvial flats of the Wamberal Lagoon catchment. PCT 1589c occurs on clay soils
Elevation	Does the PCT occur below 20 m	Yes, 1589a and 1589b occurs at elevations between 10 m and 20 m. 1589c occurs between 40-50 m
Floristic structure	The community is typically open-forest however, it now exists outside of reserves as woodland or remnant trees	Yes, 1589a forms shrub open forest while 1589b and 1589c occurs between 40-50 me
Assemblage of species	63 characteristic species of Pittwater and Wagstaffe Spotted Gum Forest are listed in the Scientific Determination	Yes, WSP plots Q2 and Q8 (1589a) recorded 23 species while Q5 and Q6 (1589b) recorded 22 and 15 species. AECOM assessment at compound 2 (1589c) recorded 7 species

Final determination listing criteria	Pittwater and Wagstaffe Spotted Gum Forest	PCT 1589
Location within LGA	Previously recorded from the local government areas of Gosford and Pittwater but may occur elsewhere in this bioregion	No, this PCT occurs within the Central Coast local government area (formerly Gosford) however is part of the Tumbi Spotted Gum – Ironbark Forest which is not considered to form part of this EEC (Bell and Staples, 2012)
Outcome		**No**

Field observation and subsequent comparison identified *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* which is listed as a TEC under the BC Act. The characteristics of PCT 1716a and PCT 1716b which occurred in the Proposal area is consistent with the final determination for the *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* (Table 3-5) (WSP, 2020).

Table 3-5 Threatened ecological community comparison - Swamp Sclerophyll Forest on Coastal Floodplains

Final determination listing criteria	Swamp Sclerophyll Forest on Coastal Floodplains	PCT 1716
Area occupied by the EEC	Occurs in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Yes, PCT 1716 occurs in the Sydney Basin IBRA Bioregion
Soils	The community is associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains	Yes, PCT 1716 occurs on periodically inundated alluvial flats of the Wamberal Lagoon catchment.
Elevation	Does the PCT occur below 20 m	Yes, the PCT occurs at elevations between 10m and 20m
Floristic structure	The community is typically open forest but can be reduced the canopy to scattered trees. In some areas, the tree stratum is low and dense, so the community takes on the structure of a scrub.	Yes, PCT 1716 Type variant is mostly an open forest structure while PCT 1716 Melaleuca nodosa variant exhibits a low and dense scrub structure
Assemblage of species	59 characteristic species of Swamp Sclerophyll Forest on Coastal Floodplains are listed in the Scientific Determination	Yes, Q1 recorded 16, Q4, 19 and Q7, 12 diagnostic species
Location within LGA	Previously recorded from the local government areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, Lake Macquarie, Wyong, Gosford, Hornsby, Pittwater, Warringah, Manly, Liverpool, Rockdale, Botany Bay, Randwick, Sutherland, Wollongong, Shellharbour, Kiama and Shoalhaven but may occur elsewhere in these bioregions.	Yes, this PCT occurs within the Central Coast local government area (formerly Wyong, Gosford).
Outcome		**Yes**

Proposal area
Potential ancillary site
Roads
Waterway
Cadastre

Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Threatened Ecological Communities within the study area
Central Coast Highway-Tumbi Road Intersection Upgrade

0 25 50 100 Meters

9/08/2021
60641070
Fig. **3-10**

3.5 Threatened species

Flora

For the Proposal area, a search and review of NSW BioNet threatened flora records and a habitat likelihood of occurrence assessment identified 27 threatened flora species known or predicted to occur in the vicinity of the study area. Twelve species were identified as having a moderate or higher likelihood of occurring within the study area. Additionally, an EPBC Matters of National Environmental Significance (MNES) database search identified 19 listed threatened species potentially occurring within the study area. Subsequent field and desktop habitat assessment identified 10 of these species having a moderate to high likelihood of occurrence in the study area (WSP, 2020).

Following desktop species searches and reviews and subsequent habitat assessment, WSP (2020) undertook targeted threatened flora surveys of the study area. These surveys only identified one threatened flora species within the study area, *Rhodamnia rubescens* (Scrub Turpentine), which was identified outside of the Proposal area. Due to seasonal flowering of the three potentially occurring threatened Orchid species, adequate survey of these species was not possible during the WSP survey. Subsequent targeted surveys were undertaken by Sclerophyll (2020 and 2021) at more suitable time of year for these species. No populations of any threatened orchid species were identified within the Proposal area during the Sclerophyll surveys.

Potentially occurring threatened species assessments are detailed in Appendix D and species listed in Table 3-6.

Table 3-6 Threatened flora species assessed at Proposal area

Scientific name	Common name	Status		Potential occurrence?	Affected Species?
		BC Act	EPBC Act		
Acacia bynoeana	Bynoes Wattle	E	V	Moderate	No - Surveyed
Caladenia tessellate	Thick Lip Spider Orchid	E	V	Moderate	No - Surveyed
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	Moderate	No - Surveyed
Diuris praecox	Rough Double Tail	V	V	Moderate	No - Surveyed
Eucalyptus camfieldii	Heart-leaved Stringybark	V	V	Moderate	No - Surveyed
Grevillea parviflora subsp. Parviflora	Small-flower Grevillea	V	V	Moderate	No - Surveyed
Melaleuca biconvexa	Biconvex Paperbark	V	V	Moderate	No - Surveyed
Persicaria elatior	Tall Knotweed	V	V	Moderate	No - Surveyed
Rhodamnia rubescens	Scrub Turpentine	CE	-	Recorded	No - outside of Proposal area, impact avoided
Rutidosis heterogama	Heath Wrinklewort	E	E	Moderate	No - Surveyed
Thesium australe	Austral toadflax	V	V	Moderate	No - Surveyed
Eucalyptus oblonga population at Bateau Bay, Forresters Beach and Tumbi Umbi in the Wyong local government area		EP	-	Moderate	No - Surveyed

V = Vulnerable, E = Endangered, EP = Endangered Population CE = Critically Endangered

For the three potential ancillary sites, AECOM undertook a search and review in May 2021 of NSW BioNet threatened flora records and the EPBC Matters of National Environmental Significance (MNES) database. The search identified 29 threatened flora species and one threatened population occurring or likely to occur within 10 kilometres of the potential ancillary sites. A likelihood of occurrence assessment, attached in Appendix A concluded however, that none of these species were likely to be present within the potential ancillary sites.

Several *Eucalyptus oblonga* (Narrow-leaved Stringybark) and *Eucalyptus camfieldii* (Camfield's Stringybark) were recorded on the BioNet Atlas as being adjacent to potential ancillary sites 3. A field assessment identified that neither of these species occurred within the vegetation bordering Site 3 and did not identify any other threatened flora species.

Fauna

Review of NSW BioNet threatened flora records and habitat likelihood of occurrence assessment identified 94 threatened fauna species known or predicted to occur in the vicinity of the study area with 13 identified as having a moderate or higher likelihood of occurring within the study area (Appendix D). EPBC Matters of National Environmental Significance (MNES) database search identified 57 threatened fauna species known or predicted to occur in the vicinity of the study area. Field and desktop habitat assessment identified two of these species as having a moderate to high likelihood of occurrence in the study area, see Table 3-7.

Table 3-7 Threatened fauna species assessed at Proposal area

Scientific name	Common name	Status		Potential occurrence?	Affected Species?
		BA Act	EPBC Act		
Crinia tinnula	Wallum Froglet	V	-	Moderate	Yes – habitat within Proposal area
Callocephalon fimbriatum	Gang-Gang Cockatoo	V	-	Moderate	Yes – habitat within Proposal area
Daphoenositta chrysoptera	Varied Sittella	V	-	Moderate	Yes – habitat within Proposal area
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Moderate	Yes – habitat within Proposal area
Glossopsitta pusilla	Little Lorikeet	V	-	Moderate	Yes – habitat within Proposal area
Lathamus discolor	Swift Parrot	E	CE	Moderate	Yes – habitat within Proposal area
Litoria aurea	Green and Golden Bell Frog	V	-	Recorded	Yes – habitat within Proposal area
Lophoictinia isura	Square-tailed Kite	V	-	Moderate	Yes – habitat within Proposal area
Micronomus norfolkensis	Eastern Freetail-bat	V	-	Moderate	Yes – habitat within Proposal area
Miniopterus australis	Little Bent-winged Bat	V	-	Recorded	Yes – habitat within Proposal area

Scientific name	Common name	Status		Potential occurrence?	Affected Species?
		BA Act	EPBC Act		
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	Moderate	Yes – habitat within Proposal area
Ninox strenua	Powerful Owl	V	-	Moderate	Yes – habitat within Proposal area
Petaurus norfolcensis	Squirrel Glider	V	-	Moderate	Yes – habitat within Proposal area
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Recorded	Yes – habitat within Proposal area

V = Vulnerable, E = Endangered, CE = Critically Endangered

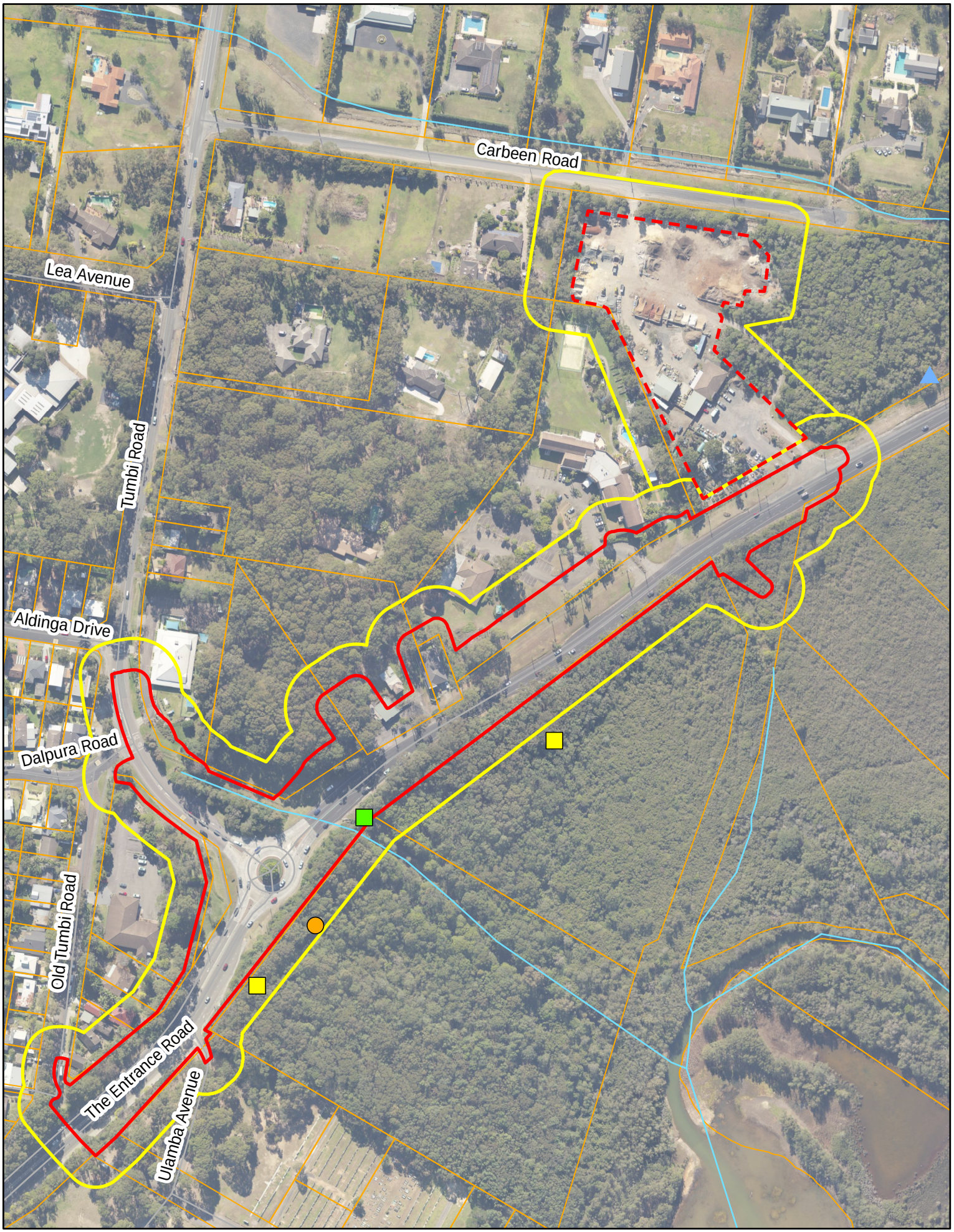
For the Proposal area, targeted fauna surveys by WSP in 2019 identified two Grey-headed Flying-fox sightings located outside of the Proposal area and within the Wamberal Lagoon Nature Reserve, while a Little Bent-winged Bat was sighted within the Proposal area immediately adjacent to the nature reserve. These species were all located within the contiguous vegetation which links the Wamberal Lagoon Nature Reserve to the vegetation east of The Central Coast Highway.

Field assessment by Ecoplanning in 2020, identified potential aquatic habitat for two threatened species, Green and Golden Bell Frog and Green-thighed Frog, immediately adjacent to the Proposal area. It was noted that the most recent record of the Green-thighed Frog in the locality was 5 km from the Proposal area and was recorded in 2011. As such it is unlikely that this species would occur within this habitat. A test of significance prepared by EcoPlanning deemed that the Proposal would not result in any significant impact on this species.

The targeted frog surveys undertaken by EcoPlanning in 2020 identified one threatened species, *Litoria aurea* (Green and Golden Bell Frog), about 60 metres north east of the proposal area (Figure 3-11). It was noted that the identified habitat for the Green and Golden Bell Frog was located outside of the Proposal area and would not be directly impacted.

For the potential ancillary sites, review of BioNet and MNES database searches undertaken by AECOM in 2021 identified 107 threatened fauna species recorded or likely to occur within 10 kilometres of the potential ancillary sites. Subsequent habitat assessment based on field survey, desktop analysis and targeted species survey reports concluded that none of these threatened fauna species had a moderate or high likelihood of occurring within the ancillary facility sites. The likelihood of occurrence of assessment can be found in Appendix A.

AECOM



Proposal area
Potential ancillary site
Study area
Roads
Waterway
Cadastre
Green and Golden Bell Frog
Grey-headed Flying-fox
Little Bent-winged Bat
Scrub Turpentine

Threatened Species near the study area
Central Coast Highway-Tumbi Road Intersection Upgrade

0 25 50 100 Meters

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60641070
Fig. **3-11**

3.6 Aquatic environment

One unnamed first order non-perennial stream occurs within the study area which raises on the north eastern side of the roundabout and travels south east via a three pipe culvert underneath The Central Coast Highway. This waterway then forms a small creek as it enters the vegetated area within the roadside reserve and continues south east into the Wamberal Lagoon Nature Reserve. No substantial pools or riffle areas were observed. This habitat was described as degraded with exotic weed infestation, containing rubbish and stormwater flows directly from nearby urban areas (Ecoplanning, 2021).

For the potential ancillary sites, an additional unnamed first order non-perennial stream occurs approximately 30 metres to the south of Site 2, which leads to a second order stream and associated waterbody approximately 500 metres south west. During the field survey, this upper section of the waterway was not flowing and is likely only an intermittent drainage line which only flows after rainfall. The area of this waterway adjacent to Site 2 was observed to be within highly disturbed modified grassland with no identifiable coherent aquatic habitat.

Potential Green and Golden Bell Frog habitat occurred 60 metres north east of potential ancillary site 1 and along both sides of The Central Coast Highway, outside of the Proposal area., with the The majority of this habitat occurringed on the southern side of the road within Wamberal Lagoon Nature Reserve, north of the Proposal area limit. These areas are shown in Appendix G.

No Key Fish Habitat occurs within the Proposal area. However, an area of Key Fish Habitat occurs about 150 metres to the south east of the Proposal area within the Wamberal Lagoon Nature Reserve.

3.7 Critical habitat

None of the land in or around the Proposal Area is listed as critical habitat for any species (WSP, 2020).

3.8 Wildlife connectivity corridors

Intersection area

An area of about 75 hectares of contiguous vegetation is present immediately to the east of the intersection area and an area of over 1,000 hectares present about 500 metres west of the intersection area. Between these areas there are patches of remnant vegetation within Wamberal Public School and a 4 hectare vegetated area located between Tumbi Road and The Central Coast Highway. There is also some vegetation within the roadside reserve on the western side of the highway, however this patch is narrow and fringes onto a suburban area with no immediate connections to any substantial habitat area, likely limiting connectivity utility for native fauna. Potential wildlife connectivity corridors are shown in Figure 3-12.

The vegetation on the western side of The Central Coast Highway is highly modified and varies in quality. Most of this vegetation contains minimal to no native mid-storey, and has a ground cover consisting of maintained exotic grasses due to this area being lifestyle residential property. This substantially reduces the utility of this area in terms of connectivity, particularly for ground-dwelling native fauna. Additionally, the vegetated areas further to the north are also modified and highly trafficked, requiring crossing of Tumbi Road and movement through a suburban area and school, all of which contain various barriers such as fencing. As such, it is unlikely the vegetation occurring either side of The Central Coast Highway would be used as a connectivity corridor for ground-dwelling fauna.

Vegetation on either side of the road is currently separated by about 20 metres at the closest distance for large sections of both Tumbi Road and The Central Coast Highway. This vegetation consists of mature trees and may be used by birds, bats and gliders to traverse the road. A patch of isolated vegetation is present in front of the fruit shop in which the canopy connects across the road. This connected canopy is separated by residential houses to the larger vegetation patch to the west and does not provide connectivity to any other vegetation.

The native vegetation occurring about 600 metres to the north east of the Proposal along the Central Coast Highway was observed to be intact on both sides of the highway and is distanced from the

residential areas within the Proposal area and to the north east. The highway bisects the vegetation to the east of the Proposal area, including the nature reserve, from an area of about 50 hectares of contiguous vegetation on the west side of the highway, north east of the Proposal area. The movement of fauna through this potential corridor is evidenced by a BioNet record of a vehicle strike of a Swamp Wallaby within this connectivity area. As such, potential wildlife connectivity surrounding the Proposal has been categorised as “Primary” and “Secondary”, see Figure 3-12.

Potential connectivity for aquatic habitat to the north of the roundabout and the lagoon to the east exists via the culvert running underneath The Central Coast Highway. Given the northern areas of these waterways are disturbed, modified and in peri-urban settings, it is assumed this would be of lower quality in comparison to aquatic habitat within Wamberal Lagoon, which is a protected nature reserve. This area was also determined to be of marginal quality during the targeted frog surveys, which inspected the aquatic environment of the Proposal area, reducing the likelihood of the Proposal being a critical wildlife corridor for species movement.

There is little connective value within the potential /ancillary sites, as they consist of cleared and disturbed grassland which would not require significant clearing. Additionally, any ancillary sites constructed would be temporary and not creating permanent obstructions to movement. These sites are also all adjacent to intact vegetation which would be preferable for the majority of species movement, further reducing the potential connectivity value of the areas to wildlife.

Proposal area
Potential ancillary site
Study area
Waterway

Connectivity corridors

Primary
Secondary
Vehichle strike

Wildlife connectivity in the vicinity of the Proposal area
Central Coast Highway - Tumbi Road Intersection Upgrade

N 0 125 250 500 Meters

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Fig. **3-12**

3.9 Priority weeds

Priority weeds are plants classified under the *Biosecurity Act 2015* as presenting a biosecurity risk to the State or a particular region. Of those listed for the Greater Sydney Local Land Services area, six species were recorded at the study area (WSP, 2020), including:

- *Asparagus aethiopicus* (Asparagus Fern)
- *Asparagus plumosus* (Climbing Asparagus Fern)
- *Chrysanthemoides monilifera* subsp*. Rotundata* (Bitou bush)
- *Lantana camara* (Lantana)
- *Opuntia sp.* (Prickly pear)
- *Senecio madagascariensis* (Fireweed).

All six weeds identified within the study area hold a Priority weed duty of Prohibition on dealings, which requires the species must not be imported into the state or sold. All six weeds are listed as Weeds of National Significance.

Under the Act, any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

No additional priority weed species were identified by AECOM within the Proposal area or potential ancillary sites

3.10 Groundwater dependent ecosystems

Two PCTs occurring within the Proposal study area are considered likely to be classified as terrestrial Groundwater dependent ecosystems (GDEs). These include:

- PCT 1625 - Red Bloodwood -Sydney Peppermint - Podocarpus spinulosus shrubby open forest of the southern Central Coast
- PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast

For the potential ancillary site study areas, one PCT was are considered likely to be classified as terrestrial Groundwater dependent ecosystems (GDEs).

- PCT 925 - Melaleuca nodosa closed shrubland on alluvium of the Central Coast, Sydney Basin Bioregion

It is noted that this PCT occurred adjacent to ancillary site 2 and was not within the impact area of the ancillary site**.**

3.11 EPBC Matters of National Environmental Significance

The PMST identified the following TECs as potentially occurring within the Proposal area:

- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community
- Coastal Upland Swamps in the Sydney Basin Bioregion
- Posidonia australis seagrass meadows of the Manning-Hawkesbury ecoregion
- River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria
- Subtropical and Temperate Coastal Saltmarsh.

Field surveys conducted by WSP in 2019 confirmed that no PCT's associated with these TEC's were present within the Proposal area, see Table 3-2.

During the frog survey a Green and Golden Bell Frog, which is listed as vulnerable under the EPBC Act, was identified outside of the Proposal area, in wetland vegetation about 60 metres north east of ancillary site 1, see Figure 3-11. No other threatened or migratory species listed under the EPBC Act were recorded during the surveys. Some threatened and/or migratory species may utilise habitat within the study area for foraging or movement on occasion, however, it is noted abundant and better quality habitat is located both adjacent to the Proposal area and within the broader locality as described in Section 3.8.

3.12 *State Environmental Planning Policy (Coastal Management) 2018*

State Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP) applies to mapped coastal wetland and proximity coastal wetlands across New South Wales in respect of development applications for land which may impact mapped coastal wetlands. The proposal does not directly impact on mapped coastal wetlands so does not trigger the designated development provisions under Division 4.1 of the EP&A Act. However, the Proposal does impact on areas shown as being in proximity to coastal wetlands and consideration of impacts on this is discussed in the REF, under Division 5.1 of the EP&A Act.

3.13 State Environmental Planning Policy (Koala Habitat Protection) 2021

State Environmental Planning Policy (Koala Habitat Protection) 2021 applies to a number of local government areas across New South Wales in respect of development applications for land on which koalas may inhabit. The policy applies only to development that requires consent under Division 4.1of the EP&A Act. This Proposal will be carried out under Division 5.1 of the Act and hence the policy does not apply.

Fauna surveys did not identify any Koalas or evidence of Koala presence in the study area. A likelihood of occurrence assessment was undertaken by WSP and concluded there was a low likelihood of occurrence of Koala within the Proposal area due to no suitable habitat existing in the vicinity (Appendix D).

4.0 Potential impacts

Potential impacts associated with the Proposal are detailed below have been assessed on the basis of consideration of both direct and indirect effects, and the resulting change to the biophysical and ecological processes that establish and support the biodiversity values of the Proposal area. For this Proposal, these direct and indirect impacts are a result of changes to the biophysical environment that ultimately result in changes to biodiversity, i.e. vegetation, landform and soils.

The potential impacts identified in this chapter consider:

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

4.1 Vegetation removal

Construction of the intersection and updated road alignment would require the removal of 2.17 hectares of vegetation within the Proposal area.

The total area of native vegetation to be potentially removed for the construction stage of the Proposal is approximately 0.89 hectares and consisting of PCT 1546, PCT 1589, PCT 1625 and PCT 1716 and is shown Table 4-1. An additional 1.28 hectares of miscellaneous ecosystems including highly disturbed area, landscape plantings and disturbed mixed native exotic ground cover would be removed.

Table 4-1 Vegetation to be affected by the Proposal

Plant Community Type	Plant Community Type Name	Condition Class	Impacted vegetation within Proposal study areas (ha)
PCT 1564	Blackbutt - Rough-barked Apple - Turpentine - ferny tall open forest of the Central Coast	Modified	0.08
PCT 1589	Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast	Intact	0.24
		Modified - 1	0.18
PCT 1625	Red Bloodwood -Sydney Peppermint - Podocarpus spinulosus shrubby open forest of the southern Central Coast - Intact	Intact	0.11
PCT 1716	**Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast**	**Intact**	0.09
		***Melaleuca nodosa* variant – intact**	0.17
		Modified	**0.01**
Total PCT vegetation			**0.89**
0		N/A	1.13
00		N/A	0.16

Total non-PCT vegetation	1.28
Total vegetation	**2.17**

Table 4-2 Vegetation to be affected by the potential ancillary sites

Plant Community Type	Plant Community Type Name	Condition Class	Impacted vegetation within ancillary sites (ha)		
			Ancillary site 1	Ancillary site 2	Ancillary site 3
Total PCT vegetation			**0**	**0**	**0**
0		N/A	0.11	0.60	-
00		N/A	0.05	0.11	-
000		N/A	-	-	2.37
Total non-PCT vegetation			0.16	0.71	2.37
Total vegetation			**0.16**	**0.71**	**2.37**

Native vegetation to be removed within the Proposal area east of The Central Coast Highway and north of Tumbi Road is adjacent to large areas of intact native vegetation in which fauna within these areas of the Proposal area would likely utilise, including Wamberal Lagoon Nature Reserve. The Vegetation to the south of Tumbi Road and west of The Central Coast Highway is limited to the road corridor and remnant vegetation within an urban environment.

The removal of vegetation adjacent to the Wamberal Lagoon Nature Reserve would move existing edge effects further inward relative to their current location. Edge effects in this case would include the potential for localised alterations to species assemblages, including through weed invasion. It is difficult to determine the extent to which these effects would intrude into the reserve, though it is noted that the edge effect observed within the existing vegetation was highly localised, being approximately 2-3 m on average. The impact of edge effects would be managed as part of the construction of the Proposal through the application of a planting regime of native vegetation reflective of the affected PCT and a weed control and bush regeneration program for disturbed roadside areas adjacent to the Wamberal Lagoon Nature Reserve.

Vegetation to be removed for establishment of the potential ancillary sites consists of disturbed native and exotic ground cover devoid of mid-storey and canopy, as well as planted/maintained mixed vegetation patches which do not form a coherent native plant community. Areas used for ancillary sites would be removed and sites restored to their existing condition once construction is complete, unless some components (eg. hardstands and access roads) are retained based on lease agreement with the landholder and where covered by relevant planning approvals.

Based on the degree of vegetation removal required, the context of the surrounding lands, and the safeguards proposed, the overall impact associated with vegetation loss within the Proposal area would be minor.

4.2 Threatened species and ecological communities

Fourteen threatened species were determined to have potential habitat present within the Proposal area and may be directly affected as part of the Proposal (WSP, 2020).

Tests of Significance (ToS) have been prepared in accordance with the *Threatened Species Test of Significance Guidelines: The Assessment of Significance* (Office of Environment & Heritage, 2018) for these species to determine if a significant impact is likely given the potential impacts of the Proposal and are shown in Table 4-3. These tests can also be found in Appendix D.

Table 4-3 Impacts on BC Act threatened species

Species	Potential of Occurrence	Impacted habitat area (ha)	Likely significant effect?
Crinia tinnula (Wallum Froglet)	Moderate	0.09	**No**
Callocephalon fimbriatum (Gang-Gang Cockatoo)	Moderate	0.89	**No**
Daphoenositta chrysoptera (Varied Sittella)	Moderate	0.89	**No**
Falsistrellus tasmaniensis (Eastern False Pipistrelle)	Moderate	0.89	**No**
Glossopsitta pusilla (Little Lorikeet)	Moderate	0.89	**No**
Lathamus discolor (Swift Parrot)	Moderate	0.89	**No**
Lophoictinia isura (Square-tailed Kite)	Moderate	0.89	**No**
Micronomus norfolkensis (Eastern Freetail-bat)	Moderate	0.89	**No**
Miniopterus australis (Little Bent-winged Bat)	Recorded	0.89	**No**
Miniopterus orianae oceanensis (Large Bent-winged Bat)	Moderate	0.89	**No**
Ninox strenua (Powerful Owl)	Moderate	0.89	**No**
Petaurus norfolcensis (Squirrel Glider)	Moderate	0.89	**No**
Pteropus poliocephalus (Grey-headed Flying-fox)	Recorded	0.89	**No**
Rhodamnia rubescens (Scrub turpentine)	Recorded	0.00	**No**

As shown in Table 4-4, 0.26 hectares of *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* TEC may be removed as part of the Proposal. However, this was assessed through a ToS, to not have a significant effect on this TEC (WSP, 2020).

Table 4-4 Threatened Ecological Community within the Proposal area

PCT	Community name	Condition Class	TEC Present?	TEC impacted (ha)
PCT 1589	Spotted Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast	Intact	No	-
		Modified - a	No	-
PCT 1716	Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast	Intact	**Yes - Swamp Sclerophyll Forest on Coastal Floodplain**	**0.09**
		Melaleuca nodosa variant - intact		**0.17**
Total extent of TEC impacted				**0.26**

All ToS concluded the Proposal would not have a significant impact on these species or ecological communities as the Proposal is unlikely to place a local occurrence of any of these species or ecological communities at risk of extinction (WSP, 2020).

Two threatened species also listed under the EPBC Act, , were assessed for significant impact in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Department of Environment, 2013). As outlined in Table 9, the assessment has determined the proposal will not have a significant impact on these species.

Table 4-5 Impacts of EPBC Act threatened species

Species	Potential of Occurrence	Important population?	Likely significant effect?
Pteropus poliocephalus (Grey-headed Flying-fox)	Recorded	No	**Unlikely**
Lathamus discolor (Swift Parrot)	Moderate	No	**Unlikely**

4.3 Wildlife connectivity and habitat fragmentation

The Proposal would result in the potential removal of approximately 0.89 hectares of native vegetation. The quality of this vegetation, and associated habitat, varies throughout the Proposal area and its surrounds. Despite this connectivity for mobile species, particularly birds, bats and gliders may still exist within the Proposal area.

Depending on the requirements of individual species, reduction in habitat connectivity can result in isolation of populations, loss of access to habitat resources, loss of genetic interchange and ultimately impacts upon overall population viability in certain cases.

The Proposal would increase the width of the existing road, increasing the separation between adjacent areas of native vegetation on opposite sides of the Central Coast Highway. This has the potential to reduce connectivity for some species, particularly certain gliders. The removal of roadside vegetation, particularly mature trees immediately adjacent to the roadway, may restrict the ability for gliders to traverse the widened road. This increase would be from around 20 metres to 35 metres at the closer points along The Central Coast Highway and Tumbi Road.

The gliders that have the potential to be present within the area, namely Squirrel Glider and Yellow-bellied Glider, are known to be able to glide up to 50 metres. However, this distance of travel is based on adequate leap and landing height, which is dependent on the height of available leap and landing points and gradient between these points. This would be of particular importance for individuals traversing to the vegetated area south west of the proposed Wamberal Grocer and Fruit Market car park location, as the vegetation within the reserve is positioned lower in the landscape, which may result in the glide gradient not reaching the base of the target landing trees.

Given the current level of separation between mature vegetation on opposing sides of the highway, aerial connectivity for other arboreal mammals such as possums is considered to be negligible. Any such movement of these species would be at ground level and hence equivalent to other ground-dwelling native fauna.

The potential for future connectivity across the highway for ground-dwelling fauna would be affected by several factors. These include:

- The existing attractiveness of vegetation and other resources on both sides of the road. It is noted that the only area of partially connected vegetation on the western side of the road is to the south of the fruit shop. Whilst the canopy layer in this area is reasonably intact, the midstorey and ground layer is highly modified by the presence of weeds and ongoing mowing associated with the adjacent private property. This area is also partially obstructed by the busy Wamberal Grocer and Fruit Market car park location and the associated fence. These factors would substantially limit the attractiveness of this area for ground-dwelling fauna.

- The presence of barriers associated with the Proposal, including safety fencing, would further discourage the movement of larger ground-dwelling fauna. This includes fencing proposed along the side of the eastern shared-use path.
- The degree of human activity within the road corridor. Whilst the Proposal is not expected to induce additional traffic the design will provide for active transport users on both sides of the road, where no facility currently exists. This would also discourage the movement of ground-dwelling fauna.
- The degree of light, noise and vehicle movement within the road corridor. Whilst the Proposal is not expected to induce additional traffic, and hence not affect overall noise or vehicle movements the design will provide for additional street lighting. This has the potential to the movement of discourage nocturnal species such as owls, possums, gliders and bats.

Despite these factors it is likely that ground-dwelling fauna would still attempt occasional crossings of the operational road. In such case there is the potential for an increase in fauna injury or mortality arising from the operation of the Proposal. Given the above factors the likely frequency of such crossings is expected to be low, particularly with the presence of pedestrian safety fencing along much of the eastern shared path. As such the overall significance of this impact on native fauna is considered to be low.

Despite this, mitigation measures are recommended to limit the potential for fauna injury or mortality whilst still encouraging connectivity and access to resources. This includes:

- Connectivity bridges and/or glide poles are to be investigated in detailed design for viability and benefit of an aerial crossing structure.
- Diligent selection of species for revegetation with regard to overall structure and refuge value, as well as for species diversity and ornamental value as part of the landscaping strategy This includes planting of taller canopy species near the roadway to facilitate future glider movement across the roadway.
- Monitoring of roadkill or wildlife rescues reported to WIRES for this stretch of the Central Coast Highway.
- Further assessment of wildlife connectivity to the north of the Proposal area in the identified potential wildlife crossing and connectivity corridor.

4.4 Injury and mortality

During construction the Proposal would involve the movement of plant and machinery. Although the existing road already poses a threat to native fauna for injury and mortality, it is likely that the risk would be higher during construction, particularly during any required vegetation clearing when fauna would be forced to move. This would be somewhat mitigated by the generally slow speed of construction vehicles and machinery.

During construction it will be necessary to remove trees and other roadside vegetation which has the potential to displace native animals utilising nest hollows and other habitat features within the trees, such as flaking bark. However, with the implementation of the mitigation measures in Section 5.0, the potential impacts are considered manageable.

During operation the risk of vehicle strike expected to be similar to current operation. Evidence from surrounding roadways indicates the majority of vehicle strikes involve common mammals, birds and pest species. As such, the impact of the Proposal on injury and mortality is not expected to be significant, however measures outlined in Section 5.0 should be sufficient to reduce this impact (WSP, 2020).

4.5 Spread of weeds

The movement of vehicles and personnel into and throughout the Proposal area as a result of construction and operation has the potential to facilitate the spread of weeds (WSP, 2020). All habitat within the Proposal area has significant weed infestation. The risk for spread of weed species would be highest during construction phases with weed dispersal and importation associated with

earthworks, movement of soil, attachment of propagules to vehicle and machinery. Although weed occurrence in the proposal area is extensive, measures outlined in Section 5.2 would be sufficient in minimising spread of weeds and associated impacts. As such, the overall weed impact associated with the construction phase of this Proposal is considered to be minimal.

4.6 Pests and pathogens

The Proposal area is likely to be utilised by a range of vertebrate pest species including European Fox and potentially rabbits (WSP, 2020). Feral cats and dogs have also been recorded within the locality including Wamberal Lagoon Nature Reserve. The Proposal is unlikely to alter the occurrence of pest species in and around the site, either positively or negatively, due to the localised nature of the works. As such the overall impact in this regard is considered to be neutral with respect to the baseline scenario.

Three plant pathogens identified within the Sydney Basin Bioregion have potential to occur within the Proposal area. These pathogens have potential to affect the biodiversity within the Proposal area and are the subject of Key Threatening Process listings:

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

Myrtle rust was observed within the study area on an individual *Rhodamnia rubescens* (Scrub Turpentine). This exotic rust is highly mobile and widely dispersed in coastal NSW and no cost-effective control measure is currently available.

Exotic Rust Fungi and Phytophthora Root Rot Fungus primarily spread through the movement of infected plant material and/or soil. Amphibian chytrid fungus can be spread through the movement of infected animals or water (including mud or moist soil) from infected areas. The construction and operation of the Proposal may increase the risk of disturbing and spreading these pathogens.

Implementation of appropriate hygiene procedures for construction plant entering and exiting the Proposal, moving between the Proposal and ancillary sites imported materials, in addition to investigating and where available prioritising use of plant materials sourced on-site for vegetation restoration, would adequately mitigate this risk.

Pathogens would be managed at the Proposal site according to the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (NSW Roads and Traffic Authority, 2011) (see Section 5.2).

4.7 Aquatic impacts

Construction of the Proposal has the potential to affect the first order drainage line which runs from the northern side of Tumbi Road, traversing The Central Coast Highway via culverts and continues into Wamberal Lagoon Nature Reserve to the east (WSP, 2020). This stream is in poor condition, highly disturbed and highly modified and unlikely to be utilised by any threatened species listed under the FM Act.

Additional aquatic habitat would also be affected in the area of the north eastern drainage channel. This is not part of a discrete waterway and currently acts as a drainage line for the road area. While the construction of the open drainage channel within this existing drainage line would remove some aquatic habitat, ample comparative and higher quality habitat exists immediately beyond the Proposal area and impacts to this habitat are anticipated to be minor.

Potential impacts to aquatic habitat as a result of the Proposal would be able to be limited and suitably managed by the implementation of mitigation measures detailed in Section 5.2. These include soil and water management measures aimed at reducing construction and operational off-site water quality impacts.

4.8 Noise, light and vibration

The existing environment in the Proposal area is subject to noise and vibration impacts associated with the surrounding urban development and vehicle use of The Central Coast Highway and Tumbi Road. Whilst there would be localised increased impacts to habitat within and adjacent to the Proposal area associated with construction, existing traffic light, noise and vibration are likely to deter most fauna from using areas close to the existing alignment.

The use of lighting associated with construction activities would affect nocturnal species such as possums and microbats which would likely avoid the area during this time. These impacts would be temporary and not likely impact biodiversity of the area beyond the construction phase. Given appropriate mitigation measures, construction impacts relating to light on the surrounding habitat would be low.

Given the Proposal is not expected to induce additional traffic, impacts relating to additional noise and vibration on the surrounding habitat during operation are expected to be only marginally greater than at present. Additional mitigation measures for these elements are not required.

The Proposal would introduce additional lighting to the area as part of the redesigned operational road. This would increase the potential for light spill into the adjacent nature reserve, with the potential to disrupt the localised activities of nocturnal fauna such as owls, possums and gliders. To mitigate this impact the design of street lighting would be reviewed to minimise the amount of lighting required and to ensure lighting is directed appropriately towards the road and away from the nature reserve. Additionally, during revegetation and rehabilitation, the growth habit of vegetation should be considered when selecting species for planting adjacent to the nature reserve so as to reduce light entering the nature reserve, where possible.

4.9 Groundwater dependant ecosystems

Two PCTs within the Proposal area, PCT 1625 and PCT 1716, are identified as likely GDEs and at points would be dependent on presence of subsurface groundwater. A Premilitary Groundwater Impact Assessment was undertaken by AECOM (2021) which identified that construction activities would result in minimal impacts to groundwater.

4.10 Cumulative impacts

A continuation of Central Coast Highway upgrades at Bateau Bay Road is currently in planning to the north of the Proposal area. That project may result in an impact to a section of the Wamberal Lagoon Nature Reserve to the north. This future project is not currently confirmed to be proceeding and is therefore not assessed in relation to biodiversity impacts within this report. Impacts associated with the future project will need to account for impacts already incurred by this Proposal. No other substantial projects, road or otherwise, are known to be planned for this area. (As such there would be no known cumulative development impacts arising from this Proposal.

The removal of vegetation, and subsequent habitat, associated with the Proposal would contribute to the overall and ongoing reduction in available habitat and resources available for native species generally. This impact is however considered to be negligible given the scale of the proposed works, and the relatively minor amount of vegetation and aquatic habitat affected.

4.11 Key threatening processes

4.11.1 BC Act

The following key threatening processes listed under the BC Act are considered relevant to the Proposal:

- *Clearing of native vegetation*

The Proposal would result in the clearing of a native vegetation to facilitate the construction of the widened road and associated infrastructure. The vegetation in this area ranges in quality from very low to good. Highly modified areas in areas in low condition are weed dominated or have been previously cleared for urban development.

- *Invasion of native plant communities by exotic perennial grasses*

Exotic perennial grasses and other environmental weeds exist within the Proposal Area and can benefit from disturbance to natural vegetation. Weed management at the site would help prevent these species from spreading within or between sites.

- *Invasion and establishment of exotic vines and scramblers*

A weed management plan for the Proposal would prevent invasion and whilst maintaining the habitat. This and other relevant measures are proposed to manage this KTP.

- *Infection of frogs by amphibian chytrid causing the disease chytridiomycosis*

Chytridiomycosis is a fatal disease of amphibians and is caused by the chytrid *Batrachochytrium dendrobatids*. Management measures are recommended to address contributing to this KTP.

4.11.2 EPBC Act

Relevant key threatening processes listed under the EPBC Act are:

- Land clearance
- Novel biota and their impact on biodiversity
- Infection of amphibians with chytrid fungus resulting in chytridiomycosis.

The impact of clearing of vegetation is outlined within this document. The scale of the proposed clearing is considered minor, with measures to reduce this impact further including revegetation and rehabilitation of disturbed areas and provision of wildlife connectivity features.

The other two KTPs are considered minor based on the limited physical scale of the Proposal and would be managed during construction and operation through the application of relevant measures.

4.12 Biodiversity Offsets

The *Guidelines for Biodiversity Offsets* (RMS, 2016) outlines the requirement for TfNSW Proposals to assess and consider biodiversity offsets or supplementary measures associated with removal of vegetation and habitat. Section 4.2 of this guideline details the thresholds associated with clearing for Proposals that are assessed by a REF. Items that are applicable to the Proposal include impacts on TECs. As the total area of TEC affected by the Proposal is 0.26 hectares, the 1 hectares threshold for considering offsets or supplementary measures was not exceeded and therefore this guideline has not been applied further for this Proposal.

5.0 Management measures

5.1 Avoidance and minimisation

Priority must always be given to the implementation of principles according to the following the following management hierarchy. That is:

1. Avoid:
    - The potential ancillary sites are to be located within disturbed and maintained areas with limited native ground cover
    - The Proposal would not encroach into the boundary of the Wamberal Lagoon Nature Reserve and as such would reduce the impact of edge effects, including future landscape maintenance activities.
2. Minimise:
    - The widening of Tumbi Road is restricted primarily to the north-east to minimise potential utility works and the overall impact area

- No access, work or storage would take place on any land within the boundaries of the Wamberal Lagoon Nature Reserve, with appropriate safeguards in place to minimise any potential off-site impacts to this land
- The Proposal follows the existing alignment of The Central Coast Highway and Tumbi Road and seeks to minimise impacts on surrounding land.

3. Mitigate:
   - A comprehensive suite of mitigation measures are proposed for the Proposal (Table 5-1).
4. Offset:
   - Offsetting thresholds have not been met for this Proposal and therefore have not been applied (RMS, 2016).

5.2 Mitigation measures

Within the context of ongoing use of the Proposal area as an active road, and to the extent that is safe and practicable, consideration should be given to implementing the management measures described in Table 5-1 to protect and enhance existing ecological assets and values.

The management measures provided are broadly listed in order of priority for managing ecological values.

Table 5-1 Proposed mitigation measures

Impact	Ref	Management measure
Aquatic impacts	A1	Aquatic habitat, specifically the unnamed watercourse within the Proposal area and additional drainage line to the north east of the Proposal, will be protected in accordance with Guide 10: Aquatic habitats and riparian zones of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011)
Vegetation removal	B1	Pre-clearing surveys will be undertaken in accordance with Guide 1: Pre-clearing process of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).
	B2	Vegetation and habitat removal removal will be undertaken in accordance with Guide 4: Clearing of vegetation and removal of bushrock of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).
	B3	Native vegetation will be re-established in accordance with Guide 3: Re-establishment of native vegetation of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).
	B4	The unexpected species find procedure is to be applied according to *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) if threatened ecological communities, not addressed in the biodiversity assessment, are identified in the Proposal area.
	B5	A revegetation and regeneration plan would be compiled which would aim to rehabilitate and manage native vegetation along the eastern extent of the Proposal fronting the Wamberal Lagoon Nature Reserve. This would include planting of vegetation consistent with the identified PCT in that area. Rehabilitation of disturbed vegetation, specifically through weed control, would be undertaken to aid in the recovery of native vegetation and reduce colonisation by weeds and exotic species.

Impact	Ref	Management measure
Wildlife Connectivity	C1	Landscaping species selection in areas more likely to support existing or future connectivity, such as adjacent to the fruit shop, should be investigated in design with regard to their overall structure and refuge value. This includes planting of taller canopy species next to the road to facilitate for future glider movement across the roadway
	C2	Connectivity measures will be implemented in accordance with the *Wildlife Connectivity Guidelines for Road Projects* (RTA 2011). The feasibility, long term viability and benefit of an aerial fauna crossing structure should be considered in the detailed design phase with respect to connectivity across the Central Coast Highway between the Wamberal Lagoon Nature Reserve and vegetation on the western side of the road.
Edge effects on adjacent native vegetation and habitat	D1	Exclusion zones will be set up at the limit of clearing in accordance with *Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011). In particular temporary exclusion fencing will be provided along the Nature Reserve boundary and a strict no entry procedure for vehicles, plant and equipment implemented during construction.
Injury and mortality of fauna	E1	Fauna will be managed in accordance with Guide 9: Fauna handling of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).
Invasion and spread of weeds	F1	Weed species will be managed in accordance with Guide 6: Weed management of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).
	F2	To minimise spread of weeds and disease; • All vehicles would be inspected for soil and plant materials before their first entry to the Proposal area Any non-complying equipment will be refused entry until cleaned. • All materials imported to the site for landscaping and environmental controls such as mulch, topsoil and plat materials will be certified as weed free and inspected before entry to the site.
Invasion and spread of pests	G1	The contractor will undertake a pre-construction weed survey and undertake preliminary removal or control of weed species within the construction zone and clearing limits. Pest species will be inspected and managed periodically within the Proposal site during construction and a procedure will be developed in the CEMP.
Invasion and spread of pathogens and disease	H1	Pathogens will be managed in accordance with Guide 2: Exclusion zones of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).
Noise, light and vibration	I1	Artificial light impacts will be minimised where practicable taking into account minimum luminescence requirements for an urban road as outlined in the Australian Standards through detailed design. Light will be directed away from natural areas, particularly adjacent to the Wamberal Lagoon Nature Reserve, as far as practicable. Vegetation selected for planting adjacent to the nature reserve should consider growth habit and its ability to reduce light entering the nature reserve.

6.0 Conclusion

6.1 Overview of key findings

The Proposal would lead to the potential loss of up to 0.89 hectares of native vegetation including:

- 0.08 hectares of PCT 1564 - Blackbutt - Rough-barked Apple - Turpentine - ferny tall open forest of the Central Coast
- 0.42 hectares of PCT 1589 - Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast
- 0.11 hectares of PCT 1625 - Red Bloodwood -Sydney Peppermint - Podocarpus spinulosus shrubby open forest of the southern Central Coast
- 0.27 hectares of PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast

Only 0.26 hectares of PCT 1716 within the Proposal area is classified as a Threatened Ecological Community (TEC) under the BC Act, corresponding to *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*. This TEC is not listed under the EPBC Act. Management measures in Section 5, including exclusion zones, would be applied to minimise avoid unnecessary impact to this TEC.

On ground vegetation surveys identified one threatened flora species (Scrub turpentine) within the broader study area listed as Critically Endangered under the BC Act. However, this record is outside of the Proposal area and is unlikely to be affected by the Proposal. Two threatened ground orchid surveys were also undertaken during known flowering seasons and identified no threatened orchid species within the Proposal area.

Fauna surveys identified two listed threatened fauna species (Grey-headed Flying-fox and Little Bent-winged Bat) occurring within the study area. As a result of Assessments of Significance the impacts on these two species and were assessed as not significant under the BC Act. Similarly, impacts to the Grey-headed Flying-fox were assessed also as unlikely to be significant under the EPBC Act.

A further eleven threatened fauna species were assessed as having a moderate or higher likelihood of occurring within the study area based on potential habitat presence. However, the impacts of the proposal on these species and their habitat were assessed in more detail and found to be not significant under the respective BA Act and EPBC Act tests of significance.

A frog survey was undertaken which found only one record of the Green and Golden Bell frog in wetland vegetation 60m away from the northern end of the proposal and not within any area of impact. The survey identified no other threatened frog species and concluded that with application of appropriate safeguards in Section 5 and other parts of the REF, the Proposal is likely to have minimal impacts on threatened frog species within and adjacent to the Proposal area.

The potential ancillary sites would lead to the potential loss of 1.28 hectares of Non-PCT vegetation including landscape plantings, highly disturbed areas with limited or no native vegetation and maintained mixed native exotic ground cover. No PCT native vegetation would be removed as part of the ancillary sites. No threatened flora or fauna species were identified within the potential ancillary sites and no species were assessed to have a moderate or high likelihood of occurring within these sites.

Based on the localised physical extent of the Proposal and that it is highly constrained to the existing highway corridor, especially in the east next the Wamberal Lagoon Nature Reserve, and with the implementation of the recommended management measures in Section 5, the overall impacts of the Proposal upon threatened and non-threatened biodiversity is considered to be low.

6.2 Recommendations

The Proposal is recommended to proceed subject to the consideration and implementation of the management measures provided in Section 5.

7.0 References

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Appendix A

Assessment of likelihood of occurrence

Appendix A Flora and fauna with the potential to occur within the study area

NOTE:

This likelihood of occurrence assessment has been undertaken for areas which were not previously assessed by WSP (2020), namely the compound sites. For assessment on species occurring within the main Proposal area, refer to Appendix B. Some species such as aquatic and marine species and oceanic birds were not included in this assessment due to the absolute lack of appropriate habitat at the compound sites.

This list of threatened species, populations, or ecological communities which may be affected directly or indirectly by Proposal area is derived from searches of the following databases as well as on ground survey conducted 5 May 2021:

1. NSW DPIE BioNet Database within a 10 km x 10 km area centred on the Proposal area (EES, 2020a)
2. Protected Matters Report that documents all Matters of National Environmental Significance (MNES) within a 10 km radius of the Proposal area. MNES include threatened species, communities and migratory species which are listed under the EPBC Act (DoEE, 2020)
3. BioNet Vegetation Classification Database (EES, 2021b)

V = Vulnerable, **E** = Endangered, EP = Endangered Population, **CE** = Critically Endangered

Scientific	Common name	BC Act	EPBC Act	Habitat	Likelihood of occurrence within the Proposal site
Amphibian					
Crinia tinnula	Wallum Froglet	V		Usually associated with acidic swamp on coastal sand plains and occur in a range of habitats, including sedgelands, wet heathland, paperbark swamps and drainage lines. This species can persist in disturbed areas and breed in both permanent and ephemeral water bodies. Shelter under leaf litter, debris or in burrows.	Low – unlikely to occur
Heleioporus australiacus	Giant Burrowing Frog	V	V	Distributed through the Sydney Basin sandstone country in woodland, open woodland and heath vegetation, breeding habitat is generally soaks or pools within first or second order streams, but also 'hanging swamp' seepage lines and where small pools form from the collected water. Spend the majority of time in non-breeding habitat up to 300 m away and burrows in soil surface or leaf litter.	Low – unlikely to occur
Litoria aurea	Green and Golden Bell Frog	E	V	Large populations in NSW are located around coastal and near coastal areas of the metropolitan areas of Sydney, Shoalhaven and mid north coast. It Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (Typha spp.) or spikerushes (Eleocharis spp.)	Low – unlikely to occur
Mixophyes balbus	Stuttering Frog	E	V	Inhabits rainforest and wet, tall open forest. Breeds in streams after summer rains and deposits eggs on rock shelves or in shallow riffles. Non-breeding habitat includes thick understorey vegetation and deep leaf litter on forest floors.	Low – unlikely to occur
Mixophyes iteratus	Giant Barred Frog	E	E	Occurs in damp rainforest, and both moist and dry eucalypt forest below 1000m. Inhabit deep leaf litter and breed in shallow, flowing rocky streams. Are capable of dispersing hundreds of metres from streams.	Low – unlikely to occur

Scientific	Common name	BC Act	EPBC Act	Habitat	Likelihood of occurrence within the Proposal site
Pseudophryne australis	Red-crowned Toadlet	V		Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter. Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters. Red-crowned Toadlets have not been recorded breeding in waters that are even mildly polluted or with a pH outside the range 5.5 to 6.5.	No habitat present
Bird					
Anthochaera phrygia	Regent Honeyeater	CE	CE	Inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. NSW the distribution is very patchy and mainly confined to the two main breeding areas at Capertee Valley and the Bundarra-Barraba region and surrounding fragmented woodlands. Birds are also found in drier coastal woodlands and forests. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-oak. These habitats have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. Nectar and fruit from the mistletoes are also eaten during the breeding season.	Low – unlikely to occur
Burhinus grallarius	Bush Stone-curlew	E		Inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber.	Low – unlikely to occur
Calidris canutus	Red Knot		E	Tidal mudflats, sandflats, beaches, saltmarsh, ploughed fields, flooded pasture	No habitat present
Calidris ferruginea	Curlew Sandpiper	E	CE	Coastal migratory species with a NSW distribution from Hastings Point to Shoalhavn Heads. Found in open, sandy beaches with exposed sand bars and rocky outcrops. Rare use of near-coastal wetlands.	No habitat present
Calidris tenuirostris	Great Knot	V	CE	Migratory shorebird distributed along entire coast of NSW. Occur on intertidal mudflats in sheltered coastal area	No habitat present

Scientific	Common name	BC Act	EPBC Act	Habitat	Likelihood of occurrence within the Proposal site
Calyptorhynchus lathami	Glossy Black-Cockatoo	V		Occupy coastal woodlands and drier forest areas, open inland woodlands or timbered watercourses where Casuarina and Allocasuarina species are present. This species is dependent on large hollow-bearing eucalypts for nesting.	Low – unlikely to occur
Charadrius mongolus	Lesser Sand-plover	V	E	Occur along the Australian coastline with highest abundance north of Shoalhaven estuary. Habitat preferences for beaches, mudflats and mangroves.	No habitat present
Daphoenositta chrysoptera	Varied Sittella	V		Inhabits most of mainland Australia except the treeless deserts and open grasslands. It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	Low – unlikely to occur
Ephippiorhynchus asiaticus	Black-necked Stork	E		Restricted to coastal and near-coastal habitat. Inhabits wetlands, floodplains and deeper permanent water bodies. Occurs in shallow, permanent freshwater terrestrial wetlands and surrounding marginal vegetation. Nest in tall, live isolated paddock trees near freshwater swamps and construct large nesting platform.	No habitat present
Falco hypoleucos	Grey Falcon	E		Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey. Preys primarily on birds, especially parrots and pigeons, using high-speed chases and stoops; reptiles and mammals are also taken. Like other falcons it utilises old nests of other birds of prey and ravens, usually high in a living eucalypt near water or a watercourse; peak laying season is in late winter and early spring; two or three eggs are laid.	No habitat present
Glossopsitta pusilla	Little Lorikeet	V		Mostly occur in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. Nest in small hollows (entrance approx. 3 cm) of Eucalyptus spp. between 2 - 15 m above the ground.	Present – within locality, not within impact area

Scientific	Common name	BC Act	EPBC Act	Habitat	Likelihood of occurrence within the Proposal site
Grantiella picta	Painted Honeyeater	V	V	Occurs in Eucalyptus woodland and forests, with a preference for mistletoe (Amyema spp.). Can also occur along watercourses and in farmland. Nests from spring to autumn in outer canopy of eucalypts, she-oak, paperbark and mistletoe branches.	Low – unlikely to occur
Haematopus fuliginosus	Sooty Oystercatcher	V		Occurs on rocky shorelines and headlands, stony beaches, offshore islands and exposed reefs and only occasionally on sandy beaches.	No habitat present
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	M	Coastlines, estuaries, large rivers and lakes; occasionally over adjacent habitats; builds a large stick nest in a tall tree, rarely on artificial structures	Present – within locality, not within impact area
Hieraaetus morphnoides	Little Eagle	V		Occupies habitats rich in prey (birds, reptiles and mammals) within open eucalypt forest, woodland or open woodland. Requires tall living trees for building a large stick nest and preys on birds, reptiles and mammals and occasionally carrion.	Low – unlikely to occur
Hirundapus caudacutus	White-throated Needletail		M	Aerial space over a variety of habitat types, but prefers to forage over treed habitats as these would provide a greater abundance of insect prey; often forage on the edge of low pressure systems and may follow these systems ; breeds in Asia.	Low – unlikely to occur
Ixobrychus flavicollis	Black Bittern	V		Occurs below 200 m above sea level and inhabit both terrestrial and estuarine wetlands, with a preference for permanent water bodies and dense vegetation. Roosts in trees or amongst dense reeds.	No habitat present
Lathamus discolor	Swift Parrot	E	CE	In NSW mostly occurs on the coast and south west slopes, occurring in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany (Eucalyptus robusta), Spotted Gum (Corymbia maculata), Red Bloodwood (C. gummifera), Mugga Ironbark (E. sideroxylon), and White Box (E. albens).	Present – within locality, not within impact area
Lophoictinia isura	Square-tailed Kite	V		Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.	Low – unlikely to occur

Scientific	Common name	BC Act	EPBC Act	Habitat	Likelihood of occurrence within the Proposal site
Ninox connivens	Barking Owl	V		Occurs throughout NSW, where it inhabits dry open sclerophyll forests and woodlands, favouring dense riparian stands of eucalypts or casuarinas along watercourses or around wetlands, where there are many large trees suitable for roosting or breeding.	Low – unlikely to occur
Ninox strenua	Powerful Owl	V		Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. They require large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. Powerful Owls nest in large tree hollows (at least 0.5m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old.	Present – within locality, not within impact area
Numenius madagascariensis	Eastern Curlew		CE	Estuaries, tidal mudflats, sandspits, saltmarsh, mangroves	No habitat present
Pandion cristatus	Eastern Osprey	V	M	Requires clear estuarine and inshore marine waters and coastal rivers for foraging, and nests in tall (usually dead or dead-topped) trees in coastal habitats from open woodland to open forest, within 1-2 km of water.	No habitat present
Ptilinopus magnificus	Wompoo Fruit-Dove	V		Typically occurs in patches of subtropical rainforest and adjoining wet sclerophyll habitats, with a preferennce for warmer, mature rainforests dominated by Ficus spp.	No habitat present
Ptilinopus superbus	Superb Fruit-Dove	V		Inhabits rainforests and similar closed forest at all altitudes.	
Rostratula australis	Painted Snipe (Australian subspecies)	E	E, M	Inhabits shallow inland wetlands, either freshwater or brackish water bodies. Nests on the ground amongst tall reed-like vegetation near water, and feeds near the water's edge and on mudflats.	No habitat present
Sternula albifrons	Little Tern	E	M	Almost exclusively coastal, preferring sheltered environments; however may occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records). Nests in small, scattered colonies in low dunes or on sandy beaches just above high tide mark near estuary mouths or adjacent to coastal lakes and islands.	No habitat present
Stictonetta naevosa	Freckled Duck	V		Prefers heavily vegetated wetlands; uses more open wetlands during drought in non-breeding period.	No habitat present

Scientific	Common name	BC Act	EPBC Act	Habitat	Likelihood of occurrence within the Proposal site
Tyto novaehollandiae	Masked Owl	V		Occurs throughout NSW, roosting and nesting in heavy forest. Hunts over open woodland and farmland, with a home range of 500 - 1000 ha. The main requirements are tall trees with suitable large hollows for nesting and roosting and adjacent areas for foraging. Feeds on small mammals.	Low – unlikely to occur
Tyto tenebricosa	Sooty Owl	V		Inhabits subtropical and warm temperate rainforest, and moist or dry eucalypt forest with a well-developed mid-storey of trees or shrubs. Roost and nest sites for the species occur in gullies. Utilise large hollows for nesting and prey on other hollow dependent species. Roost in hollows or dense vegetation.	Low – unlikely to occur
Insect					
Petalura gigantea	Giant Dragonfly	E		Live in permanent swamps and bogs with some free water and open vegetation. Adults spend most of their time settled on low vegetation on or adjacent to the swamp. Females lay eggs into moss, under other soft ground layer vegetation, and into moist litter and humic soils, often associated with groundwater seepage areas within appropriate swamp and bog habitats. The species does not utilise areas of standing water wetland, although it may utilise suitable boggy areas adjacent to open water wetlands.	No habitat present
Mammal					
Cercartetus nanus	Eastern Pygmy-possum	V		In New South Wales the species is found in coastal areas and at higher elevation. Inhabit shrubby vegetation in a wide variety of habitats, from open heathland or shrubland to sclerophyll or rain forest. Require flowering plants and shrubs for foraging and access to hollows/nesting vegetation.	Low – unlikely to occur
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Roosts in disused mine shafts, caves, overhangs and disused Fairy Martin nests for shelter and to raise young. Also potentially roost in tree hollows. Occurs in low to mid-elevation dry open forest and woodlands, preferably with extensive cliffs, caves or gullies. Pied Bat is largely restricted to the interface of sandstone escarpment (for roost habitat) and relatively fertile valleys (for foraging habitat).	Low – unlikely to occur

Scientific	Common name	BC Act	EPBC Act	Habitat	Likelihood of occurrence within the Proposal site
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Utilises a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.	Low – unlikely to occur
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		This species occupies tall, mature, wet forest and the species have been recorded roosting in stem holes in Eucalyptus and in buildings. Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	Low – unlikely to occur
Miniopterus australis	Little Bentwing-bat	V		This species occurs in moist eucalypt forest, rainforest or dense coastal banksia scrub. Little Bent-wing Bats roost in caves, tunnels and sometimes tree hollows during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	Low – unlikely to occur
Miniopterus orianae oceanensis	Large Bent-winged Bat	V		Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Maternity caves have very specific temperature and humidity regimes. At other times of the year, populations disperse within about 300 km range of maternity caves. Cold caves are used for hibernation in southern Australia. Breeding or roosting colonies can number from 100 to 150,000 individuals. Hunt in forested areas, catching moths and other flying insects above the tree tops.	No habitat present
Myotis macropus	Southern Myotis	V		This species generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. They forage over streams and pools catching insects and small fish by raking their feet across the water surface.	No habitat present

Scientific	Common name	BC Act	EPBC Act	Habitat	Likelihood of occurrence within the Proposal site
Petauroides volans	Greater Glider		V	The greater glider is an arboreal marsupial, largely restricted to eucalypt forests and woodlands. It is found in highest abundance typically in taller, montane, moist eucalypt forests, with relatively old trees and abundant hollows. The greater glider favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species. During the day it shelters in tree hollows, with a particular selection for large hollows in large, old trees.	Low – unlikely to occur
Petaurus australis	Yellow-bellied Glider	V		Typically occurs in tall, mature eucalypt forest in regions of high rainfall, but is also known to occur in drier areas. Preference for resource rich forests where mature trees provide nesting hollows and tree species composition with adequate food resources, including winter-flowering Eucalypts and sap-rich trees.	Low – unlikely to occur
Petaurus norfolcensis	Squirrel Glider	V		The Squirrel Glider inhabits dry sclerophyll forest and woodland. In NSW, potential habitat includes Box-Ironbark forests and woodlands in the west, the River Red Gum forests of the Murray Valley and the eucalypt forests of the northeast. Individuals have also been recorded in a diverse range of vegetation communities, including Blackbutt, Forest Red Gum and Red Bloodwood forests, Coastal Banksia heathland and Grey Gum/Spotted Gum/Grey Ironbark dry hardwood forests of the Central NSW Coast. The Squirrel Glider is nocturnal and shelters in tree hollows. This species is capable of gliding up to 50m.	Present – within locality, not within impact area
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	This species prefers rocky habitats, including loose boulder-piles, rocky outcrops, steep rocky slopes, cliffs, gorges, isolated rock stacks and tree limbs. Preference for north-facing slopes and cliff lines. A range of vegetation types are associated with Brush-tailed Rock-wallaby habitat, including dense rainforest, wet sclerophyll forest, vine thicket, dry sclerophyll forest, and open forest.	Low – unlikely to occur
Phascolarctos cinereus	Koala	V	V	Inhabits a range of eucalypt forest and woodland communities. Adequate floristic diversity, availability of feed trees (primarily Eucalyptus tereticornis and E. viminalis) and presence of mature trees very important. Preferred food tree species vary with locality and there are quite distinct regional preferences. They are able to persist in fragmented habitats, and even survive in isolated trees across a predominantly agricultural landscape.	Low – unlikely to occur

Scientific	Common name	BC Act	EPBC Act	Habitat	Likelihood of occurrence within the Proposal site
Potorous tridactylus	Long-nosed Potoroo	V	V	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature.	Low – unlikely to occur
Pseudomys novaehollandiae	New Holland Mouse		V	Inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes. Nest in burrows and have a preference for deeper top soils and softer substrates to aid digging. Spends considerable time foraging above-ground for food in areas of high floristic diversity.	Low – unlikely to occur
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are commonly found in gullies, close to water, in vegetation with a dense canopy. They travel up to 50 km to forage, on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines.	Low – unlikely to occur
Scoteanax rueppellii	Greater Broad-nosed Bat	V		Occurs in a variety of habitats including rainforest, dry and wet sclerophyll forest and eucalypt woodland. Large hollow bearing trees required for roosting.	Present – within locality, not within impact area
Vespadelus troughtoni	Eastern Cave Bat	V		A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals.	No habitat present
Reptile					
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Confined to the Sydney basin within a radius of approximately 200 km of Sydney. Preferred habitat of sandstone outcrops with woodland, open woodland and/or heath vegetation. Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges and tree hollows.	Low – unlikely to occur

Scientific	Common name	BC Act	EPBC Act	Habitat	Likelihood of occurrence within the Proposal site
Plant					
Acacia bynoeana	Bynoe's Wattle	E	V	Occurs mainly in heath and dry sclerophyll forest, open woodland with dense to sparse heath understorey; open woodlands with a sparse shrub cover and a grass/sedge ground cover; and heathlands with sparse overstorey. With sand or sandy clay substrate, often with ironstone gravel and usually well drained, infertile soil.	Low – unlikely to occur
Acacia pubescens	Downy Wattle	V	V	Occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravely soils, often with ironstone. Occurs in open woodland and forest, in a variety of plant communities, including Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland. Concentrated around the Bankstown-Fairfield-Rookwood area and the Pitt Town area.	Low – unlikely to occur
Acacia terminalis subsp. Terminalis	Sunshine Wattle	E	E	Habitat requirements include open coastal eucalypt woodland or forest, usually in sandy soil on creek banks, hill-slopes or in shallow soil in rock crevices and sandstone platforms on cliffs.	Low – unlikely to occur
Caladenia tessellata	Thick Lip Spider Orchid	E	V	Requires low, dry sclerophyll woodland with a heathy or sometimes grassy understorey on clay loams or sandy soils, specifically in dry, low Brittle Gum (Eucalyptus mannifera), Inland Scribbly Gum (E. rossii) and Allocasuarina spp. woodland with a sparse understorey and stony soil.	Low – unlikely to occur
Chamaesyce psammogeton	Sand Spurge	E		Grows on fore-dunes, pebbly strandlines and exposed headlands, often with Spinifex (Spinifex sericeus) and Prickly Couch (Zoysia macrantha). Sand Spurge seeds float, so some dispersal between beaches may occur.	No habitat present
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum (Eucalyptus sclerophylla), Silvertop Ash (E. sieberi), Red Bloodwood (Corymbia gummifera) and Black Sheoak (Allocasuarina littoralis); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (C. subulata) and the Tartan Tongue Orchid (C. erecta).	Low – unlikely to occur

Scientific	Common name	BC Act	EPBC Act	Habitat	Likelihood of occurrence within the Proposal site
Cynanchum elegans	White-flowered Wax Plant	E	E	The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree Leptospermum laevigatum – Coastal Banksia Banksia integrifolia subsp. integrifolia coastal scrub; Forest Red Gum Eucalyptus tereticornis aligned open forest and woodland; Spotted Gum Corymbia maculata aligned open forest and woodland; and Bracelet Honeymyrtle Melaleuca armillaris scrub to open scrub.	Low – not identified during survey
Diuris praecox	Rough Double Tail	V	V	Grows on hills and slopes of near-coastal districts in open forests which have a grassy to fairly dense understorey.	Low – unlikely to occur
Eucalyptus camfieldii	Camfield's Stringybark	V	V	Occurs mostly in small scattered stands in exposed situations on sandstone plateaus, ridges and slopes near the coast, often on the boundary of tall coastal heaths or low open woodland. Requires shallow sandy soils.	Present - adjacent to ancillary site 3 , not within impact area
Eucalyptus oblonga	Stringybark	EP		Normally found on in dry open forest with infertile sandy soils on sandstone.	Present - adjacent to compound area, not within impact area
Genoplesium baueri	Bauer's Midge Orchid	E	E	Occurs in coastal areas. Habitats include heathland, open forest, shrubby forest, heathy forest and woodland with sandy/sandy loam and well draining soils.	Low – unlikely to occur
Macadamia tetraphylla	Rough-shelled Bush Nut	V	V	Occurs in subtropical rainforest and complex notophyll vineforest, at the margins of these forests and in mixed sclerophyll forest. Grows on moderate to steep hillslopes on alluvial soils at well-drained sites	No habitat present
Melaleuca biconvexa	Biconvex Paperbark	V	V	The species may occur in dense stands forming a narrow strip adjacent to watercourses, in association with other Melaleuca species or as an understorey species in wet forest.	Low – unlikely to occur

Scientific	Common name	BC Act	EPBC Act	Habitat	Likelihood of occurrence within the Proposal site
Prostanthera askania	Tranquility Mintbush	E	E	Occurs adjacent to, but not immediately in, drainage lines on flat to moderately steep slopes formed on Narrabeen sandstone and alluvial soils derived from it. Occurs in moist sclerophyll forest and warm temperate rainforest communities, and the ecotone between them. These communities are generally tall forests with a mesic understorey; Sydney Blue Gum Eucalyptus saligna and Turpentine Syncarpia glomulifera are usually present, though canopy species present can be highly variable.	Low – unlikely to occur
Pultenaea maritima	Coast Headland Pea	V		The species occurs in grasslands, shrublands and heath on exposed coastal headlands and adjoining low coastal heath. Found on clay or sandy loam or clay loam over sandstone at altitude 50-30 m. Associated with Banksia integrifolia and Themeda australis. Flowers from (June) August to March; fruit occurs from January to March.	Low – not recorded during survey
Rhodamnia rubescens	Scrub Turpentine	CE		Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils. This species is characterised as highly to extremely susceptible to infection by Myrtle Rust. Myrtle Rust affects all plant parts	Low – unlikely to occur
Rhodomyrtus psidioides	Native Guava	CE		Pioneer species found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest often near creeks and drainage lines. This species is characterised being extremely susceptible to infection by Myrtle Rust. Myrtle Rust affects all plant parts.	Low – unlikely to occur
Senecio spathulatus	Coast Groundsel	E		A specialised coastal species occurring mostly on frontal dunes and forming low, broad clumps.	No habitat present
Syzygium paniculatum	Magenta Lilly Pilly	E	V	Grows in subtropical and littoral rainforest on sandy soils or stabilized dunes near the sea. On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest.	Low – unlikely to occur
Wilsonia backhousei	Narrow-leafed Wilsonia	V		This is a species of the margins of salt marshes and lakes.	No habitat present

Appendix B

BioNet database search results

Appendix C

PMST database search results

Australian Government

Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report

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

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

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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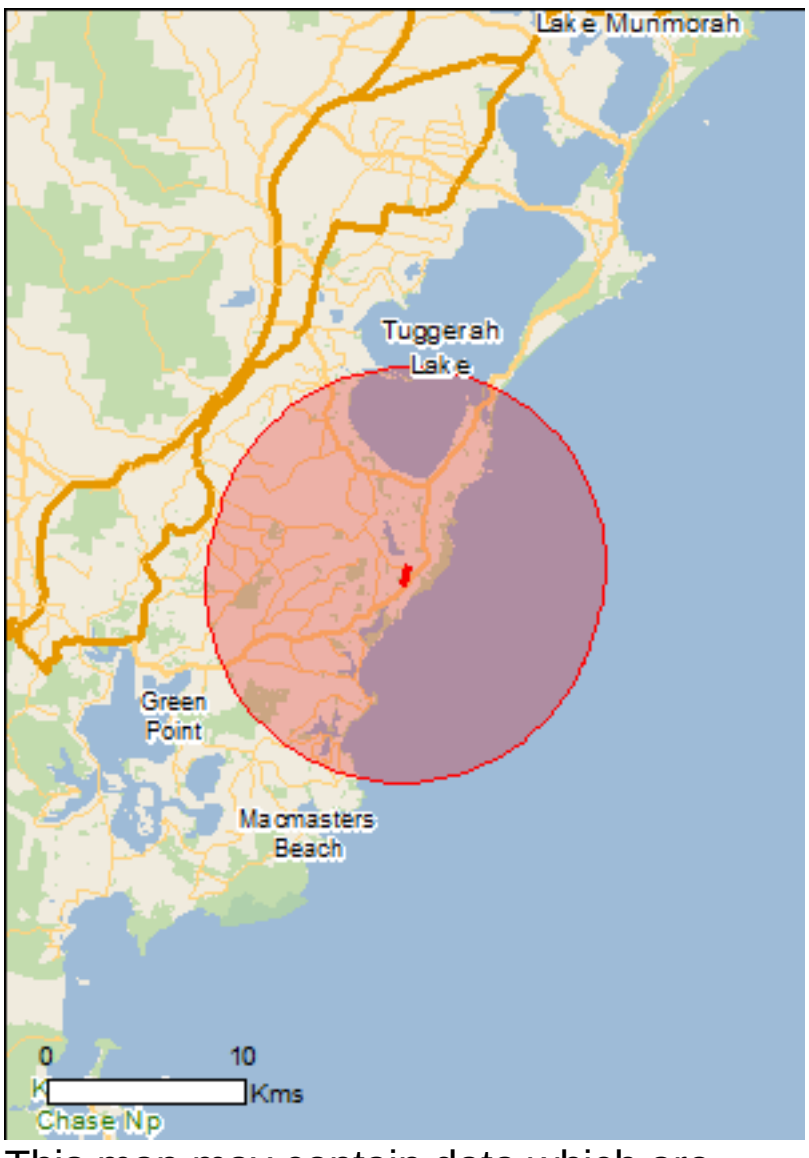

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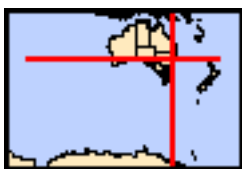

Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	89
Listed Migratory Species:	76

Other Matters Protected by the EPBC Act

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

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

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

Commonwealth Land:	5
Commonwealth Heritage Places:	None
Listed Marine Species:	95
Whales and Other Cetaceans:	16
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	5
Regional Forest Agreements:	1
Invasive Species:	49
Nationally Important Wetlands:	5
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

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

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

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

Name
Temperate East

Listed Threatened Ecological Communities [Resource Information]

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

Name	Status	Type of Presence
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Endangered	Community likely to occur within area
Coastal Upland Swamps in the Sydney Basin Bioregion	Endangered	Community may occur within area
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	Critically Endangered	Community likely to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Foraging, feeding or related behaviour known to occur within area

Name	Status	Type of Presence
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Foraging, feeding or related behaviour known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea antipodensis gibsoni Gibson's Albatross [82270]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Pterodroma neglecta neglecta Kermadec Petrel (western) [64450]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thinornis cucullatus cucullatus Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area
Fish		
Epinephelus daemelii Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
Hippocampus whitei White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240]	Endangered	Species or species habitat likely to occur within area
Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat likely to occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat likely to occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat known to occur

Name	Status	Type of Presence within area
Mixophyes balbus Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat likely to occur within area
Mixophyes iteratus Giant Barred Frog, Southern Barred Frog [1944]	Endangered	Species or species habitat likely to occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat known to occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus Long-nosed Potoroo (SE Mainland) [66645]	Vulnerable	Species or species habitat known to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat known to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Plants		
Acacia bynoeana Bynoe's Wattle, Tiny Wattle [8575]	Vulnerable	Species or species habitat may occur within area
Acacia pubescens Downy Wattle, Hairy Stemmed Wattle [18800]	Vulnerable	Species or species habitat may occur within area
Acacia terminalis subsp. terminalis MS Sunshine Wattle (Sydney region) [88882]	Endangered	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Caladenia tessellata Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat likely to occur within area
Corunastylis insignis Wyong Midge Orchid 1, Variable Midge Orchid 1 [84692]	Critically Endangered	Species or species habitat likely to occur within area
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat likely to occur within area
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat likely to occur within area
Diuris praecox Newcastle Doubletail [55086]	Vulnerable	Species or species habitat known to occur within area
Eucalyptus camfieldii Camfield's Stringybark [15460]	Vulnerable	Species or species habitat known to occur within area
Genoplesium baueri Yellow Gnat-orchid, Bauer's Midge Orchid, Brittle Midge Orchid [7528]	Endangered	Species or species habitat likely to occur within area
Grevillea parviflora subsp. parviflora Small-flower Grevillea [64910]	Vulnerable	Species or species habitat likely to occur within area
Melaleuca biconvexa Biconvex Paperbark [5583]	Vulnerable	Species or species habitat known to occur within area
Melaleuca deanei Deane's Melaleuca [5818]	Vulnerable	Species or species habitat may occur within area
Persicaria elatior Knotweed, Tall Knotweed [5831]	Vulnerable	Species or species habitat may occur within area
Persoonia hirsuta Hairy Geebung, Hairy Persoonia [19006]	Endangered	Species or species habitat may occur within area
Prostanthera askania Tranquillity Mintbush, Tranquility Mintbush [64958]	Endangered	Species or species habitat known to occur within area
Rhizanthella slateri Eastern Underground Orchid [11768]	Endangered	Species or species habitat may occur within area
Rhodamnia rubescens Scrub Turpentine, Brown Malletwood [15763]	Critically Endangered	Species or species habitat known to occur within area
Rhodomyrtus psidioides Native Guava [19162]	Critically Endangered	Species or species habitat known to occur within area
Rutidosis heterogama Heath Wrinklewort [13132]	Vulnerable	Species or species habitat may occur within area
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
[Tetratheca juncea](#) Black-eyed Susan [21407]	Vulnerable	Species or species habitat known to occur within area
[Thelymitra adorata](#) Wyong Sun Orchid [84724]	Critically Endangered	Species or species habitat likely to occur within area
[Thesium australe](#) Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area
Reptiles		
[Caretta caretta](#) Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Dermochelys coriacea](#) Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
[Eretmochelys imbricata](#) Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Hoplocephalus bungaroides](#) Broad-headed Snake [1182]	Vulnerable	Species or species habitat may occur within area
[Natator depressus](#) Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sharks		
[Carcharias taurus (east coast population)](#) Grey Nurse Shark (east coast population) [68751]	Critically Endangered	Species or species habitat likely to occur within area
[Carcharodon carcharias](#) White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
[Rhincodon typus](#) Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
[Anous stolidus](#) Common Noddy [825]		Species or species habitat likely to occur within area
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species habitat likely to occur within area
[Ardenna carneipes](#) Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
[Ardenna grisea](#) Sooty Shearwater [82651]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Sternula albifrons Little Tern [82849]		Breeding known to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		

Name	Threatened	Type of Presence
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Name	Threatened	Type of Presence
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Foraging, feeding or related behaviour known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Foraging, feeding or related behaviour known to occur within area
Calidris alba Sanderling [875]		Foraging, feeding or related behaviour known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Foraging, feeding or related behaviour known

Name	Threatened	Type of Presence
		to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Foraging, feeding or related behaviour known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Foraging, feeding or related behaviour known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Foraging, feeding or related behaviour known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat likely to occur within area
Gallinago megala Swinhoe's Snipe [864]		Foraging, feeding or related behaviour likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Foraging, feeding or related behaviour likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Foraging, feeding or related behaviour known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour likely to occur within area
Numenius phaeopus Whimbrel [849]		Foraging, feeding or related behaviour known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Foraging, feeding or related behaviour known to occur within area
Pluvialis squatarola Grey Plover [865]		Foraging, feeding or related behaviour known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Foraging, feeding or related behaviour known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Foraging, feeding or related behaviour known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Foraging, feeding or related behaviour known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Australian Postal Corporation
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Defence Housing Authority
Commonwealth Land - Telstra Corporation Limited
Defence - ERINA GRES DEPOT

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Foraging, feeding or related behaviour known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Foraging, feeding or related behaviour known to occur within area
Calidris alba Sanderling [875]		Foraging, feeding or related behaviour known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Foraging, feeding or related behaviour known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Foraging, feeding or related behaviour known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Charadrius bicinctus Double-banded Plover [895]		Foraging, feeding or related behaviour known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Foraging, feeding or related behaviour known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Foraging, feeding or related behaviour known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat likely to occur within area
Gallinago megala Swinhoe's Snipe [864]		Foraging, feeding or related behaviour likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Foraging, feeding or related behaviour likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Foraging, feeding or related behaviour known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Foraging, feeding or related behaviour known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Foraging, feeding or related behaviour known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour likely to occur within area
Numenius phaeopus Whimbrel [849]		Foraging, feeding or related behaviour known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Foraging, feeding or related behaviour known to occur within area
Pluvialis squatarola Grey Plover [865]		Foraging, feeding or related behaviour known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed		Foraging, feeding or

Name	Threatened	Type of Presence
Shearwater [1043]		related behaviour likely to occur within area
[Puffinus griseus](#) Sooty Shearwater [1024]		Species or species habitat likely to occur within area
[Rhipidura rufifrons](#) Rufous Fantail [592]		Species or species habitat known to occur within area
[Rostratula benghalensis (sensu lato)](#) Painted Snipe [889]	Endangered*	Species or species habitat known to occur within area
[Sterna albifrons](#) Little Tern [813]		Breeding known to occur within area
[Thalassarche bulleri](#) Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
[Thalassarche cauta](#) Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
[Thalassarche eremita](#) Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
[Thalassarche impavida](#) Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
[Thalassarche melanophris](#) Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
[Thalassarche salvini](#) Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Thalassarche sp. nov.](#) Pacific Albatross [66511]	Vulnerable*	Species or species habitat may occur within area
[Thalassarche steadi](#) White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Thinornis rubricollis rubricollis](#) Hooded Plover (eastern) [66726]	Vulnerable*	Species or species habitat known to occur within area
[Tringa nebularia](#) Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
[Tringa stagnatilis](#) Marsh Sandpiper, Little Greenshank [833]		Foraging, feeding or related behaviour known to occur within area
[Xenus cinereus](#) Terek Sandpiper [59300]		Foraging, feeding or related behaviour known to occur within area
Fish		
[Acentronura tentaculata](#) Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area
[Festucalex cinctus](#) Girdled Pipefish [66214]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
[Filicampus tigris](#) Tiger Pipefish [66217]		Species or species habitat may occur within area
[Heraldia nocturna](#) Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
[Hippichthys penicillus](#) Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
[Hippocampus abdominalis](#) Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
[Hippocampus whitei](#) White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240]	Endangered	Species or species habitat likely to occur within area
[Histiogamphelus briggsii](#) Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
[Lissocampus runa](#) Javelin Pipefish [66251]		Species or species habitat may occur within area
[Maroubra perserrata](#) Sawtooth Pipefish [66252]		Species or species habitat may occur within area
[Notiocampus ruber](#) Red Pipefish [66265]		Species or species habitat may occur within area
[Phyllopteryx taeniolatus](#) Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
[Solegnathus spinosissimus](#) Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
[Solenostomus cyanopterus](#) Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
[Solenostomus paradoxus](#) Ornate Ghostpipefish, Harlequin Ghost Pipefish, Ornate Ghost Pipefish [66184]		Species or species habitat may occur within area
[Stigmatopora argus](#) Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
[Stigmatopora nigra](#) Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
[Syngnathoides biaculeatus](#) Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
[Trachyrhamphus bicoarctatus](#) Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
[Urocampus carinirostris](#) Hairy Pipefish [66282]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
[Vanacampus margaritifer](#) Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Mammals		
[Arctocephalus forsteri](#) Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
[Arctocephalus pusillus](#) Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Reptiles		
[Caretta caretta](#) Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Dermochelys coriacea](#) Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
[Eretmochelys imbricata](#) Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Natator depressus](#) Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Pelamis platurus](#) Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
[Balaenoptera acutorostrata](#) Minke Whale [33]		Species or species habitat may occur within area
[Balaenoptera borealis](#) Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Balaenoptera edeni](#) Bryde's Whale [35]		Species or species habitat may occur within area
[Balaenoptera musculus](#) Blue Whale [36]	Endangered	Species or species habitat may occur within area
[Balaenoptera physalus](#) Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Caperea marginata](#) Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
[Delphinus delphis](#) Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
[Eubalaena australis](#) Southern Right Whale [40]	Endangered	Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Gosford Coastal Open Space System	NSW
Tuggerah	NSW
Wamberal Lagoon	NSW
Wambina	NSW
Wyrrabalong	NSW

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
North East NSW RFA	New South Wales

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Asparagus scandens Asparagus Fern, Climbing Asparagus Fern [23255]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species

Name	Status	Type of Presence
		habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Avoca Lagoon	NSW
Cockrone Lagoon	NSW
Terrigal Lagoon	NSW
Tuggerah Lake	NSW
Wamberal Lagoon	NSW

Caveat

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

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

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

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

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-33.397663 151.465989,-33.405805 151.463028,-33.405568 151.463151

Acknowledgements

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

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

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

Please feel free to provide feedback via the Contact Us page.

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Appendix D

Biodiversity Assessment Report (WSP, 2020)

Central Coast Highway and Tumbi Road intersection upgrade, Wamberal

Biodiversity Assessment Report

Transport for NSW | May 2020

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Transport for NSW

Central Coast Highway and Tumbi Road intersection upgrade, Wamberal

Biodiversity Assessment Report

May 2020

Prepared by WSP and Transport for NSW

Project no: PS118977
Date: 15/05/2020

Rev	Date	Details
A	21/04/2020	First Draft
B	15/05/2020	Final

Author, Reviewer and Approver details				
Prepared by:	Allan Richardson Mark Stables Lukas Clews	Date: 015/05/2020	Signature:	
Reviewed by:	Mark Stables	Date: 15/05/2020	Signature:	
Approved by:	Toby Lambert	Date: 15/05/2020	Signature:	

This report has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the client and WSP (scope of services). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or disturbance constraints.

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

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

Executive summary

NSW Government has committed to spend $387 million to duplicate the Central Coast Highway between Bateau Bay and Wamberal to deliver safer, faster and more reliable trips. In the short-term, the NSW Government has committed $19.5 million for planning and development works, with funds released in the 2019-20 Budget year to commence planning.

Transport for NSW is proposing an upgrade of the Central Coast Highway and Tumbi Road intersection, Wamberal (the proposal). This would involve the removal of the existing roundabout and widening the highway to two lanes in each direction for about 425 metres before merging back to the existing single lane. This is known as Stage 1 and is the proposal assessed in this report.

The remainder of the road widening and intersection upgrades to Bateau Bay Road would be undertaken in the future as part of Stage 2 and will be assessed in a separate report.

The key impacts of the proposal include the removal of 0.48 hectares of native vegetation and associated habitat, including:

- 0.09 ha of Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (BC Act: listed as endangered).

The summary of native vegetation removal is presented in the table below:

Plant community type (PCT)	Condition class	BC Act	EPBC Act	Percent cleared in IBRA region[1]	Proposal area[2] (Ha)
PCT 1589 - Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast	Intact	-	-	71%	0.20
	Modified	-	-		0.04
PCT 1625 - Red Bloodwood -Sydney Peppermint - *Podocarpus spinulosus* shrubby open forest of the southern Central Coast	Intact	-	-	88%	0.15
PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast	Type variant - Intact	E	-	66%	0.09
	Melaleuca nodosa variant - Intact	E	-		0.00
Total native vegetation impacted					0.48

One threatened ecological community was recorded within the study area being, Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions. This threatened ecological community is listed as Endangered under the BC Act although it is not listed under the EPBC Act.

One threatened flora species, *Rhodamnia rubescens* (Scrub Turpentine), listed as Critically Endangered under the BC Act, was recorded within the study area. This species, recorded within Wamberal Lagoon Nature Reserve, will not be directly impacted and is unlikely to be affected by any indirect impacts.

Assumed presence of *Caladenia tessellata* (Thick Lip Spider Orchid), *Cryptostylis hunteriana* (Leafless Tongue Orchid) and *Diuris praecox* (Rough Double Tail) is based on associated vegetation being present within the study area and because surveys were conducted outside the known flowering period for these species. The area of assumed habitat that will be impacted by the proposal is <0.3 hectares.

Field surveys recorded two threatened fauna species within the study area, being:

- *Miniopterus australis* (Little Bent-winged Bat) (BC Act Vulnerable)
- *Pteropus poliocephalus* (Grey-headed Flying-fox) (BC Act Vulnerable, EPBC Act Vulnerable)

Likelihood of occurrence assessments identified an additional 11 threatened fauna species as having a moderate or higher likelihood of occurrence within the study area, being:

- *Crinia tinnula* (Wallum Froglet)
- *Callocephalon fimbriatum* (Gang-Gang Cockatoo)
- *Daphoenositta chrysoptera* (Varied Sittella)
- *Falsistrellus tasmaniensis* (Eastern False Pipistrelle)
- *Glossopsitta pusilla* (Little Lorikeet)
- *Lathamus discolor* (Swift Parrot)
- *Lophoictinia isura* (Square-tailed Kite)
- *Micronomus norfolkensis* (Eastern Freetail-bat)
- *Miniopterus orianae oceanensis* (Large Bent-winged Bat)
- *Ninox strenua* (Powerful Owl)
- *Petaurus norfolcensis* (Squirrel Glider)

Assessments of impact significance were conducted for all threatened species and ecological communities considered likely to be affected by the proposal. These impact assessments determined that the proposal is unlikely to lead to a significant impact on threatened species, populations, ecological communities or their habitats.

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

The Transport for NSW Guideline for Biodiversity Offsets (November 2016) indicates that offsets are not required for this proposal as the impacts do not exceed biodiversity offset thresholds.

Further targeted surveys should be considered in spring for *Caladenia tessellata* (Thick Lip Spider Orchid), *Cryptostylis hunteriana* (Leafless Tongue Orchid) and *Diuris praecox* (Rough Double Tail).

Contents

Glossary of terms for this template

Definitions	
Biodiversity credits	Ecosystem credits or species credits
Biodiversity credit report	The report produced by the Biodiversity Credit Calculator 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 (OEH 2017).
Biodiversity offsets	Management actions that are undertaken to achieve a gain in biodiversity values on areas of land in order to compensate for losses to biodiversity values from the impacts of development (OEH 2017).
Biodiversity Credit Calculator (BCC)	The computer program that provides decision support to assessors and proponents by applying the BAM, and which calculates the number and class of biodiversity credits required to offset the impacts of a development or created at a biodiversity stewardship site (OEH 2017).
Biodiversity values map	Is established according to clause 7.3 of the BC Regulation 2017. Development within an area identified on the map requires assessment using the BAM.
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 the Project SEARs for cumulative impact assessment requirements.
Development footprint	The area of land that is directly impacted on by a proposed development, including access roads, and areas used to store construction materials (OEH 2017).
Direct impact	An impact on biodiversity values that is a direct result of vegetation clearance for a development. It is predictable, usually occurs at or near to the development site and can be readily identified during the planning, design, construction, and operational phases of a development (OEH 2017).
Ecosystem credit	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at a biodiversity stewardship site.
Ecosystem credit species	A measurement of the value of threatened species habitat for species that can be reliably predicted to occur with a PCT (OEH 2014).
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic component.
Indirect impact	An impact on biodiversity values that occurs when development related activities affect threatened species, threatened species habitat, or ecological communities in a manner other than direct impact. Compared to direct impacts, indirect impacts often: • Occur over a wider area than just the site of the development • Have a lower intensity of impact in the extent to which they occur compared to direct impacts • Occur off site • Have a lower predictability of when the impact occurs • Have unclear boundaries of responsibility (OEH 2017).
Local population	The population that occurs in the study area. In cases where multiple populations occur in the study area or a population occupies part of the study area, impacts on each subpopulation must be assessed separately (OEH 2017).
MNES	A matter of national environmental significance (MNES) protected by a provision of Part 3 of the EPBC Act
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000 (OEH 2014).
Mitigation	Action to reduce the severity of an impact (OEH 2014).
Mitigation measure	Any measure that facilitates the safe movement of wildlife and/or prevents wildlife mortality.
Population	A group of organisms, all of the same species, occupying a particular area.

Proposal site	The area of land that is directly impacted on by a proposed project that is under the EP&A Act, including access roads, and areas used to store construction materials.
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.
Species credit species	Threatened species that are assessed according to Section 6.4. of the BAM
Subject land	Land to which the BAM is applied in Stage 1 to assess the biodiversity values of the land. It includes land that may be a development site, clearing site, proposed for biodiversity certification or land that is proposed for a biodiversity stewardship agreement (OEH 2017).
Study area	The subject land and any other areas surveyed and assessed for biodiversity values which may be subject to indirect impacts (20m from design footprint)
Target species	A species that is the focus of a study or intended beneficiary of a conservation action or connectivity measure.
Threatened Biodiversity Data Collection	Part of the BioNet database, published by OEH and accessible from the BioNet website at www.bionet.nsw.gov.au.

Abbreviations

BAM	Biodiversity Assessment Method
BC Act	*Biodiversity Conservation Act 2016*
BAR	Biodiversity Assessment Report
CEMP	Construction Environmental Management Plan
DPIE	Department of Planning, Infrastructure and Environment
DPI	Department of Primary Industries
EEC	Endangered ecological community
EIS	Environmental Impact Statement
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999 (Federal).*
FM Act	*Fisheries Management Act 1994* (NSW)
GDE	Groundwater dependent ecosystems
IBRA	Interim Biogeographical Regionalisation of Australia
MNES	Matters of National Environmental Significance
PCT	Plant Community Type
REF	Review of Environmental Factors
SEPP	State Environmental Planning Policy
TBDC	Threatened Biodiversity Data Collection
TECs	Threatened Ecological Communities
Transport	Transport for NSW
VIS	Vegetation information system

1 Introduction

1.1 Proposal background

A strategic design is under development for the staged upgrade of the Central Coast Highway and Tumbi Road intersection, Wamberal (the proposal). Existing traffic volumes are resulting in congestion on the Central Coast Highway between Wamberal and Bateau Bay, particularly during the AM and PM peak periods. This is expected to worsen with projected traffic growth. The proposal is needed to address this issue. NSW Government has committed to spend $387 million to duplicate the Central Coast Highway between Bateau Bay and Wamberal to deliver safer, faster and more reliable trips. In the short-term, the NSW Government has provided $19.5 million for planning and development works, with funds released in the 2019-20 Budget year to commence planning.

The objectives of the proposal are to:

- Improve traffic efficiency
- Improve road safety
- Minimise environmental and community impacts.

The proposal is located at the existing Central Coast Highway and Tumbi Road Intersection at Wamberal in the Central Coast Council Local Government Area (study area, see Figure 1.1 and 1.2). Note that the design is at the early strategic stage only and subject to future concept and detailed design, however is considered suitable for the purposes of this assessment at a strategic level.

1.2 The proposal

The overall future upgrade would involve the widening of the highway from single to dual lanes in each direction with a raised central median and sealed shoulders. A number of intersection upgrades would occur as follows:

- Tumbi Road / Central Coast Highway from a roundabout to signalised intersection
- Crystal Street / Central Coast Highway from a roundabout to signalised intersection
- Forresters Beach Road / Central Coast Highway from a seagull to signalised intersection
- Bellevue Road / Central Coast Highway from an un-signalised to signalised intersection
- Passage Road / Central Coast Highway from a roundabout to signalised intersection
- Upgraded traffic lights at Bateau Bay Road
- Roundabout upgrades at Cresthaven Avenue.

Also forming part of the upgrade would be associated drainage works, utility relocations and improved shared path connections.

The nominated priority stage of the Central Coast Highway – Wamberal to Bateau Bay project is to construct the Tumbi Road Intersection Upgrade at Wamberal (the Proposal) in its ultimate layout in isolation.

The upgrade will involve the demolition of the existing roundabout and replacement with a signalised intersection. Two through-lanes would be provided northbound and southbound along the highway.

Given current design constraints, there will be high angle entry left turns. A double right turn from Tumbi Road to Central Coast Highway would be provided. A single right turn on the southbound highway approach to Tumbi Road would be provided.

Map: PS118997_GIS_002_A2	Author: David.Naiken
Date: 09-Apr-20	Approved by: Mark.Stables

0 200 400 m

1:15,000

Coordinate system: GDA 1994 MGA Zone 56
Scale ratio correct when printed at A3

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community © Department Finance, Services and Innovation 2019

Central Coast Highway and Tumbi Road intersection upgrade, Wamberal

Figure 1.1
Proposal Context

Map: PS118997_GIS_003_A2	Author: David.Naiken
Date: 09-Apr-20	Approved by: Mark.Stables

0 30 60 m

1:2,500

Coordinate system: GDA 1994 MGA Zone 56
Scale ratio correct when printed at A3

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community © Department Finance, Services and Innovation 2019

Central Coast Highway and Tumbi Road intersection upgrade, Wamberal

Figure 1.2
The Proposal

The southern limit of works is approximately 200m south of the Tumbi Road intersection adjacent to the Old Tumbi road cul-de-sac. The northern limit of works is approximately 400m north of the Tumbi Road intersection. The western limit of works would be in proximity to the Old Tumbi Road / Tumbi Road intersection. The road would tie back in to the existing lane near to bus stops mid-way between Tumbi Road and Crystal Street.

Full egress at Apollo Resort is maintained by including a seagull intersection.

Indented bus bays are provided on both sides of the highway. The bus bay and stop on Tumbi Road north side is consolidated after discussions with RedBus and TfNSW bus planners.

The proposal would impact properties on the western side of the highway. The Wamberal Nature Reserve borders the road corridor on the eastern side of the highway. Strategic design development has focussed on avoiding impacts to the Reserve.

This is known as Stage 1 and is the proposal assessed here in this report.

The remainder of the road widening and intersection upgrades to Bateau Bay Road would be undertaken in the future as part of Stage 2 and will be assessed in a separate report.

1.3 Study area

The proposal is located along the existing Central Coast Highway and Tumbi Road Intersection at Wamberal in the Central Coast Council Local Government Area (study area, see Figure 1.1 and 1.2). The following areas are discussed throughout the Biodiversity Assessment Report (BAR) and are defined as:

- Proposal construction footprint: the proposal is the environmental assessment construction footprint as defined by Transport for NSW (Transport) for the project (refer to Figure 1.2), which is strategic at this stage
- Study area: includes the proposal construction footprint and a 20 metre buffer
- Locality: This is taken to be a 10 kilometre radius surrounding the proposal footprint.
- The study area is located in the Sydney Basin bioregion (Wyong subregion) (Thackway and Cresswell, 1995).

1.4 Report objectives

The objectives of this report are to:

- Inform the strategic design and evaluation of the proposal.
- Form part of future assessments of the Project to fulfil the requirements of Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act)
- Provide assessment information for future concept design development and the preparation of future review of environmental factors (REF) document/s
- Take into account all matters affecting or likely to affect terrestrial and aquatic biodiversity as a result of the proposal
- Identify any likely biodiversity offset obligations in accordance with the Biodiversity Offset Guidelines (RMS 2016).

This report identifies and assesses the likely impacts to species, populations and communities listed as threatened under the *Biodiversity Conservation Act 2016* (BC Act), *Fisheries Management Act 1994* (FM Act) and Matters of National Environmental Significance (MNES) listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

1.5 Legislative context

A Review of Environmental Factors (REF) has been prepared to satisfy Transport duties under s5.5 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 BAR forms part of the REF being prepared for the proposal and assesses the biodiversity impacts of the proposal to meet the requirements of the EP&A Act.

Sections 7.3 of the *Biodiversity Conservation Act 2016* (BC Act) and Part 7A of the *Fisheries Management Act 1994* (FFM Act) require that the significance of the impact on threatened species, and endangered ecological communities is assessed using a five-part test. Where a significant impact is likely to occur, a species impact statement (SIS) must be prepared in accordance with the Director-General's requirements or a Biodiversity Proposal Assessment Report (BDAR) must be prepared by an accredited assessor in accordance with the Biodiversity Assessment Method (BAM).

In September 2015, a "strategic assessment" approval was granted by the Federal Minister in accordance with the EPBC Act. The approval applies to Transport activities being assessed under Part 5 Division 5.1 of the EP&A Act with respect to potential impacts on nationally listed threatened species, ecological communities and migratory species.

As a result, Transport for NSW proposals assessed via an REF:

- must address and consider potential impacts on nationally 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 Federal Department of the Environment for these matters, even if the activity is likely to have a significant impact.

Transport must consider impacts to nationally listed threatened species, ecological communities and migratory species as part of the approval process under the strategic assessment. To assist with this, assessments are required in accordance with the *Matters of National Environmental Significance: Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999* (Department of the Environment 2013).

2 Methods

2.1 Personnel

This BAR has been prepared by a team of qualified and experienced ecologists and accredited BAM assessors (see Table 2.1).

Table 2.1 Personnel

Name	Role	Qualifications
Alex Cockerill	Ecology National Team Executive – Project director	Bachelor of Science (Hons) BAM Accredited Assessor
Toby Lambert	Principal Ecologist – Field survey and report preparation including technical review.	Bachelor of Environmental Science BAM Accredited Assessor
Mark Stables	Principal Ecologist – Field survey and report preparation.	Bachelor of Science (Hons) BAM Accredited Assessor
Lukas Clews	Principal Ecologist – Report preparation.	Master of Scientific Studies, Graduate Certificate in Applied Science, Diploma Conservation and Land Management, Bachelor of Science BAM accredited assessor
Allan Richardson	Senior Ecologist – Field survey and report preparation.	Bachelor of Environmental Science (Hons)
Paul Shelley	Senior Ecologist – Field survey	Graduate Certificate of Applied Science (Ornithology)
Trent Bowman	GIS Consultant – Mapping and data management	Bachelor of Science (Hons); Master of Science in Geoscience

2.2 Background research

A background review of existing information was carried out to identify the existing environment within a nominal search area of 10 kilometres surrounding the study area to identify:

- the likely distribution of vegetation communities, based on previous mapping and aerial photograph interpretation, to allow for targeted field verification
- a list of candidate threatened species and populations of plants to consider during vegetation surveys and habitat assessment
- a list of candidate threatened species and populations of animals and migratory animals to consider during field-based habitat assessment
- local landscape-scale features of potential significance to biodiversity; e.g. riparian zones and potential wildlife movement corridors
- evaluate baseline information and determine whether additional surveys, mapping and reporting is required.
- if any Areas of Outstanding Biodiversity Value were present.

The desk-based assessment included analysis of the following information sources:

- topographic map and aerial photographs

- priority weed listings for the Greater Sydney region (Department of Primary Industries 2020)
- previous vegetation mapping, ecological studies and other relevant studies of the study area and surrounds:
  - Central Coast Highway improvements, between Wamberal and Bateau Bay Preliminary environmental investigation (Roads & Maritime Services 2019).
  - 'Vegetation survey, classification and mapping – Lower Hunter and Central Coast Regional Environment Management Strategy' (Lower Hunter and Central Coast Regional Environmental Management Strategy, 2000) (LHCCREMs);
  - 'The Natural Vegetation of the Gosford Local Government Area, Central Coast, New South Wales' (Bell, 2009);
  - 'Hunter, Central and Lower North Coast Vegetation Classification and Mapping' (Somerville, 2009) (HCCREMs);
  - Draft Biodiversity Strategy (Central Coast Council 2019);
  - Central Coast Flying-fox Management Strategy (Central Coast Council et al 2017);
  - Wamberal Lagoon Nature Reserve Plan of Management (NSW National Parks and Wildlife Service 1993).

Records of threatened species, populations and ecological communities known or predicted to occur in the locality of the study area were obtained from a range of databases as detailed in Table 2.2.

Table 2.2 Database searches undertaken

Database	Search date	Area searched	Reference
Bionet Atlas of NSW Wildlife	03/03/2020	10 km buffer around the study area	Environment, Energy and Science Group (2020a)
Protected Matters Search Tool	03/03/2020	10 km buffer around the study area	Department of the Environment and Energy (2020)
PlantNet	03/03/2020	LGA spatial search	Royal Botanic Gardens Sydney (2020)

Other relevant documents and data that were reviewed as part of this study are referenced throughout this report where appropriate.

2.3 Habitat assessment

A habitat assessment was undertaken within the study area on the identified list of threatened flora and fauna species known or predicted to occur within a 10-kilometre radius of the proposal (see Appendix B for the habitat assessment results). This list was identified from databases and literature as well as past surveys. The habitat assessment compared the preferred habitat features for these species with the type and quality of the habitats identified in the study area. This habitat assessment was completed to assess the likelihood of the species being present in the study area (i.e. candidate threatened species). The habitat assessment formed the basis for targeted surveys within the study area.

The criteria used in the habitat assessment are detailed in Table 2.3. The results of the habitat assessment are provided in Appendix B.

Table 2.3 Likelihood of occurrence classification and criteria

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey
High	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods such as winter flowering resources), has been recorded recently in the locality (10km) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (i.e. for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
Low	It is unlikely that the species inhabits the study area and has not been recorded recently in the locality (10km). It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent (i.e. for breeding or important life cycle periods such as winter flowering resources) on available habitat. Specific habitat is not present in the study area or the species are non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
None	Suitable habitat is absent from the study area.

2.4 Field survey

The field survey aimed to ground-truth the results of the background research and habitat assessment. As such, all threatened species, populations and communities that were considered likely to occur within the study area were targeted during the field survey to determine presence or likely occurrence. A description of all field surveys completed to inform this report is provided below.

2.4.1 Weather conditions

Weather conditions can affect activity (and therefore detectability) of some species. If adverse weather conditions occur during field surveys the validity of survey techniques are affected and can impact the probability of detecting a species if it was present within the study area. During the field survey program weather conditions were generally mild with low to moderate winds and temperatures recorded. Low amounts of rainfall were received during the survey program. These conditions were somewhat favourable and are outlined in Table 2.4.

Table 2.4 Field survey dates and weather conditions

Date	Temp. Min.	Temp. Max.	Wind direction (Km/hr)	Rain (mm)
9 March 2020	18.6	24.3	SSE 37	0.2
10 March 2020	17.3	23.4	SE 37	0
11 March 2020	16.4	24.8	SSE 33	0
12 March 2020	17.7	26.6	E 24	0
13 March 2020	16.5	25.3	NNE 33	0

Norah Head AWS (station 061366)

2.4.2 Vegetation surveys

The field surveys aimed to ground-truth the results of the background research including desktop analysis of vegetation and habitat assessment. The floristic diversity and possible presence of threatened species was assessed using a combination of survey techniques including; plot-based (quadrat/transect), rapid point assessments and parallel line transverses in accordance with the relevant guidelines.

Verification of existing vegetation mapping

Vegetation within the study area and locality has been previously mapped at the regional scale by the following:

- 'Vegetation survey, classification and mapping – Lower Hunter and Central Coast Regional Environment Management Strategy' (Lower Hunter and Central Coast Regional Environmental Management Strategy, 2000) (LHCCREMs);
- 'The Natural Vegetation of the Gosford Local Government Area, Central Coast, New South Wales' (Bell, 2009);
- 'Hunter, Central and Lower North Coast Vegetation Classification and Mapping' (Somerville, 2009) (HCCREMs).

Field validation (ground-truthing) of this existing mapping within the proposal area was completed to confirm the vegetation structure, dominant canopy species, native diversity, underlying geology, condition and presence of threatened ecological communities. This was based on the completion of random meanders, rapid data points and drive by assessments. Five vegetation integrity plots, as described in the Biodiversity Assessment Methodology (BAM) (Office of Environment & Heritage, 2017), were completed across all vegetation types recorded.

The information collected during the survey was used to determine the Plant Community Type (PCT) for each vegetation type recorded as detailed in the BioNet Vegetation Classification System (Office of Environment Energy and Science, 2020b) and whether vegetation within the study area aligned to any state or commonwealth listed ecological communities.

Condition of vegetation

The vegetation within the study area was firstly assessed to a PCT and then aligned to a vegetation zone which is defined in the BAM as 'an area of native vegetation on the subject land that is the same PCT and has a similar broad condition state' (Office of Environment & Heritage, 2017). A broad condition state infers that the vegetation has a similar tree cover, shrub cover, ground cover, weediness or combinations of these attributes which determine vegetation condition.

The broad condition states that were applied to vegetation within the study area are summarised in Table 2.5. These factors were defined by using factors such as levels of disturbance, weed invasion and resilience.

Table 2.5 Vegetation broad condition states

Broad condition state	Description
Intact	Native vegetation where all tree, shrub, grass and/or forb structural growth form groups expected for a plant community type are present. Exotic weed cover is generally <30%.
Modified	Native vegetation where one or more structural understorey components of the vegetation is entirely removed or severely reduced. Exotic weed cover is generally >30%.

Broad condition state	Description
Regrowth	Native vegetation where a proportion of over-storey and mid-storey species characteristic of the PCT are naturally regenerating. Most over-storey species present have a diameter at breast height <5cm, and there are no trees at the large tree benchmark present. This native vegetation may also include native plantings. Groundcover component is generally >50% native however may be co-dominated by exotic species in highly modified landscapes.
Derived	PCTs that have changed to an alternative stable state because of land management practices since European settlement. Over-storey structural components of derived communities have either entirely been removed or are severely reduced (i.e. derived native grasslands with or without scatted paddock trees). Exotic weed cover is <50%.
Native plantings	Areas where native plant species (both indigenous and non-indigenous to the region) have been planted. Groundcover component may be either be dominated or co-dominated by native and exotic species depending on current or historic land management practices.

Plot and transect survey

Vegetation surveys were carried out in accordance with the BAM (Office of Environment & Heritage, 2017). A plot based full floristic survey was carried out based on a 20 x 20 m quadrat, with function data collected using and 20m x 50m plot (henceforth referred to as a vegetation integrity plot (VI plot)).

Native vegetation recorded within the study area was aligned to Plant Community Types (PCTs) as contained in the BioNet Vegetation Classification Database (Environment Energy and Science Group, 2020b). This was achieved by identifying native vegetation to formation, class and type and its corresponding Threatened Ecological Community (where applicable). Furthermore, other characteristics such as florist composition, underlying geology, soil type, landform and other description attributes were collected where available and assessed against BioNet Vegetation Classification Database PCT profiles.

Areas of non-native vegetation were also identified and mapped. Data was collected in these areas through rapid point assessments to show the composition and abundance of non-native vegetation within the study area.

The number of plots completed for each identified vegetation zone is provided in Table 2.6 with the location of each transect/plot identified in Table 2.7 and Figure 2.1.

Table 2.6 Vegetation survey effort

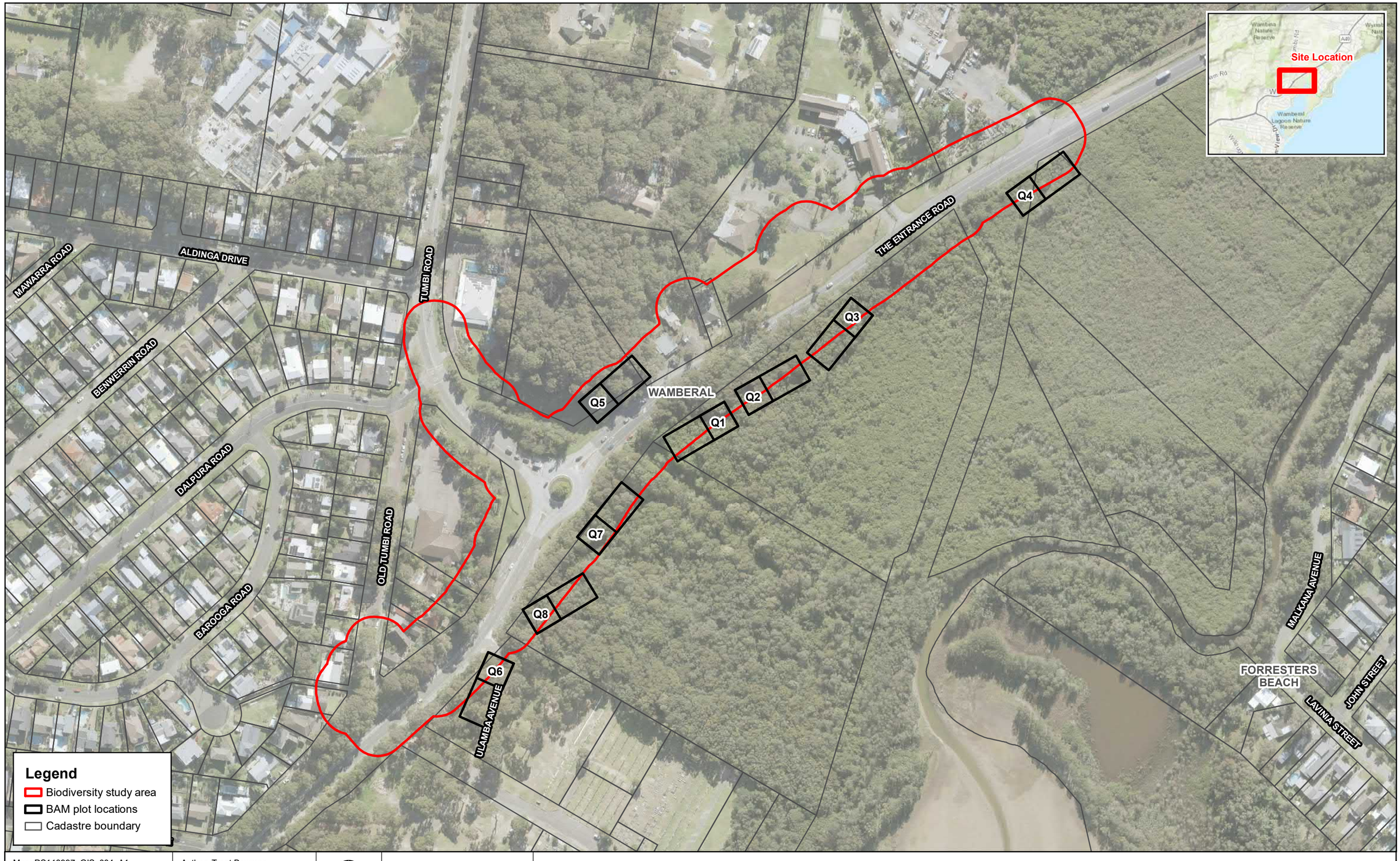
Plant community type	Vegetation zone	Area in study area (ha)	Minimum Number of VI Plots required (BAM 2017)	Survey effort
PCT 1589 - Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast	Intact	0.64	1	2 Q2, Q8
PCT 1589 - Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast	Modified	0.45	1	2 Q5, Q6

Plant community type	Vegetation zone	Area in study area (ha)	Minimum Number of VI Plots required (BAM 2017)	Survey effort
PCT 1625 - Red Bloodwood -Sydney Peppermint - Podocarpus spinulosus shrubby open forest of the southern Central Coast (Intact)	Intact	0.43	1	1 Q3
PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast	Type variant - intact	0.42	1	2 Q1, Q7
PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast	Melaleuca nodosa variant - Intact	0.22	1	1 Q4

Table 2.7 BAM VI plots completed within the study area

Plot ID	Vegetation type and zone	Easting	Northing	Orientation
Q1	PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast (Type variant - Intact)	356041	6301700	240
Q2	PCT 1589 - Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast (Intact)	356039	6301718	25
Q3	PCT 1625 - Red Bloodwood -Sydney Peppermint - *Podocarpus spinulosus* shrubby open forest of the southern Central Coast (Intact)	356135	6301775	220
Q4	PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast (*Melaleuca nodosa* variant - Intact)	356257	6301861	55
Q5	PCT 1589 - Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast (Modified)	355952	6301711	50
Q6	PCT 1589 - Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast forest (Modified)	355880	6301523	205
Q7	PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast (Type variant - Intact)	355952	6301617	40
Q8	PCT 1589 - Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast (Intact)	355912	6301562	60

Zone 56, GDA94



Map: PS118997_GIS_004_A1	Author: Trent.Bowman		0 30 60 m 1:2,500
Date: 3/04/2020	Approved by: Mark.Stables		Coordinate system: GDA 1994 MGA Zone 56 Scale ratio correct when printed at A3

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community © Department Finance, Services and Innovation 2019

Central Coast Highway and Tumbi Road intersection upgrade, Wamberal

Figure 2.1
Vegetation survey locations

2.4.3 Targeted flora surveys

Targeted threatened flora surveys were conducted for candidate species that were considered to have a moderate or higher likelihood of occurrence (Appendix B). Targeted flora surveys were completed by conducting reference checks, parallel line traverses, random meanders and during BAM VI plot surveys. A summary of the targeted flora surveys completed is outlined below with a comprehensive overview provided in Table 2.8.

Vegetation integrity plots

Plot and transect surveys were carried out in accordance with the BAM (Office of Environment & Heritage, 2017). At each plot and transect survey location, dedicated 20 minute searches were conducted for threatened species assessed as having a moderate or high likelihood of occurrence within each vegetation type sampled. The number of plots completed for each identified vegetation zone is provided in Table 2.6 with the location of each transect/plot identified in Table 2.7 and Figure 2.1.

Parallel line traverses

Targeted flora surveys in the form of parallel line transverses were used to search for threatened species assessed as having a moderate or high likelihood of occurrence within the high condition vegetation within the study area. This involved two ecologists searching along parallel transverses (20m width) across potential habitat for each threatened species. This methodology is consistent with the current guidelines for NSW threatened plant surveys (Office of Environment & Heritage, 2016).

Random Meander

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

Random meander surveys were conducted to locate candidate threatened species and populations within area of suitable habitat. Where a threatened flora species was located, parallel field traverses were then conducted to determine the size and extent of the population.

2.4.4 Targeted fauna surveys

Targeted fauna surveys were conducted over the study area in early March 2020. Surveys were undertaken for threatened species identified during desktop assessments, which were considered likely to use habitats within the study area. The March fauna survey works were undertaken most specifically for species that were likely to be detectable during the early autumn seasonal context.

While study area fauna surveys were undertaken, habitat assessments were also conducted to assess the value of the habitats present for threatened fauna. Throughout the March survey period, opportunistic observations of all fauna species were recorded.

Generally, surveys followed the methods described in the Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities – Working Draft 2004 (DECC 2004). Targeted surveys and methodologies are outlined below, and a summary of survey effort conducted is provided below with a summary overview presented in Table 2.9.

Nocturnal surveys

Nocturnal surveys were conducted in late early March 2020, consisting of spotlighting and call playback. The methodologies of each survey technique are described below.

Spotlighting

The objective of this survey technique was to target arboreal, flying and large ground-dwelling mammals, as well as nocturnal birds, reptiles and amphibians. Spotlighting was done after

dusk across suitable habitat within the study area. Two person hours of survey effort was carried out each night on foot using two spotlights. The survey concentrated on areas that contained suitable habitat for nocturnal species, with sighted animals identified to the species level.

Call playback

Call playback was used to survey for threatened owls (Powerful, Masked, Barking and Sooty Owl) and arboreal mammals (predominantly Gliders) using the methods of Kavanagh (Kavanagh and Peake, 1993) and Debus (Debus, 1995). Call playback was conducted after dusk each night, within suitable habitat in the study area. An initial listening period of 10 minutes was undertaken, followed by a spotlight search for 10 minutes to detect any animals in the immediate vicinity.

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

Diurnal bird surveys

Bird surveys were completed by at each VI plot for a period of 20 minutes. All birds were identified to the species level, either through direct observation or identification of calls. Bird surveys were completed during different times of the day, but generally occurred in the morning and evening. Birds were also recorded opportunistically during all other surveys throughout the study area.

Koala spot assessments

In addition to habitat assessments, the Spot Assessment Technique (SAT) was undertaken within the study area to detect potential Koala presence. In areas where Koalas are present, the SAT also measures Koala feed-tree species preferences by measuring the rate at which individual trees are utilised by Koalas.

The SAT samples Koala activity by selecting a prominent tree, usually a known Koala feed-tree species, and surveying its trunk and surrounding leaf litter for signs of Koala activity. A minimum of 29 surrounding trees are sampled systematically for Koala faecal pellets for 1 metre around the base of each tree. The activity of Koala usage for each SAT is then expressed as the percentage equivalent of the proportion of the surveyed trees within each SAT. The percentage is then compared to prescribed ranges for activity levels for Koalas within NSW (Phillips and Callaghan, 2011).

A total of two SAT surveys were conducted within the study area that focused on suitable Koala feed trees within PCT 1589 - Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast and PCT 1625 - Red Bloodwood -Sydney Peppermint - *Podocarpus spinulosus* shrubby open forest of the southern Central Coast.

Elliot and Cage Trapping

Elliott A and Elliott B traps, as well as cage traps, were set in the field for four consecutive nights commencing on 9 March 2020, then continuing to, and including, the night of 12 March 2020. Twenty-five (25) Elliott A traps were set terrestrially to target small terrestrial fauna, for a total of one-hundred (100) trap nights & six (6) of the larger Elliott B traps were set on the trunks of mature hollow-bearing trees, where possible, to target arboreal mammals, for a total of twenty-four (24) trap nights. Six (6) cage traps were set during the same period to target medium sized terrestrial fauna, for a total of twenty-four (24) trap nights.

Each trap was baited with a suitable food source for each of the targeted species. Traps were checked at dawn each morning and captured animals were identified to species level before

being released. All live trapping followed guidelines and policies for wildlife research in accordance with animal ethics protocols.

Anabats

One ultrasonic Anabat detector (Anabat Express, Titley Scientific QLD) was deployed within the study area over four (4) nights at two separate locations within the study area, from 9-12 March, to record echolocation calls of microchiropteran bats. The Anabat detectors recorded bat vocalisations across each night with the recordings starting at dusk. Bat activity is used as a substitute for abundance and is based on the number of microchiropteran bat calls recorded during the survey period, including those calls assigned to a species complex (i.e. not positively attributable to an individual species).

Microbat call analysis was completed by Nathan Cooper (Senior Ecologist, WSP), with the presentation of data considering the guidelines of the Australasian Bat Society. Calls were analysed using Anabat Insight software (Version 1.9.1) with reference to 'Bat calls of NSW: Region based guide to the echolocation calls of Microchiropteran bats' (Pennay et al., 2004).

Opportunistic sightings

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

During these surveys, a hand-held GPS was used to record the locations of:

- hollow-bearing trees;
- aquatic habitats;
- rock outcrops.

Fauna habitat assessment

Fauna habitat assessments were undertaken to assess the likelihood of threatened fauna species (those species known or predicted to occur within the locality from the literature and database review) occurring within the study area. Fauna habitat assessments were the primary assessment tool in assessing whether threatened species are likely to occur within the study area, if they are not observed during field surveys. Fauna habitat characteristics assessed included:

- structure and floristics of the canopy, understorey and ground cover, including the presence of flowering and fruiting trees representing potential foraging resources;
- presence of hollow-bearing trees offering potential roosting and breeding habitat for arboreal mammals, birds and herpetiles;
- presence of ground cover vegetation, leaf litter, rock outcrops and fallen timber increasing niche opportunity for ground-dwelling mammals, birds and herpetiles;
- presence of waterways (ephemeral or permanent) and water bodies.

Condition of Fauna habitat

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

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

2.4.5 Aquatic Surveys

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

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

The proposal does not cross any Class 1 or Class 2 watercourses and no detailed aquatic surveys were conducted, although general assessment of minor aquatic habitats were undertaken.

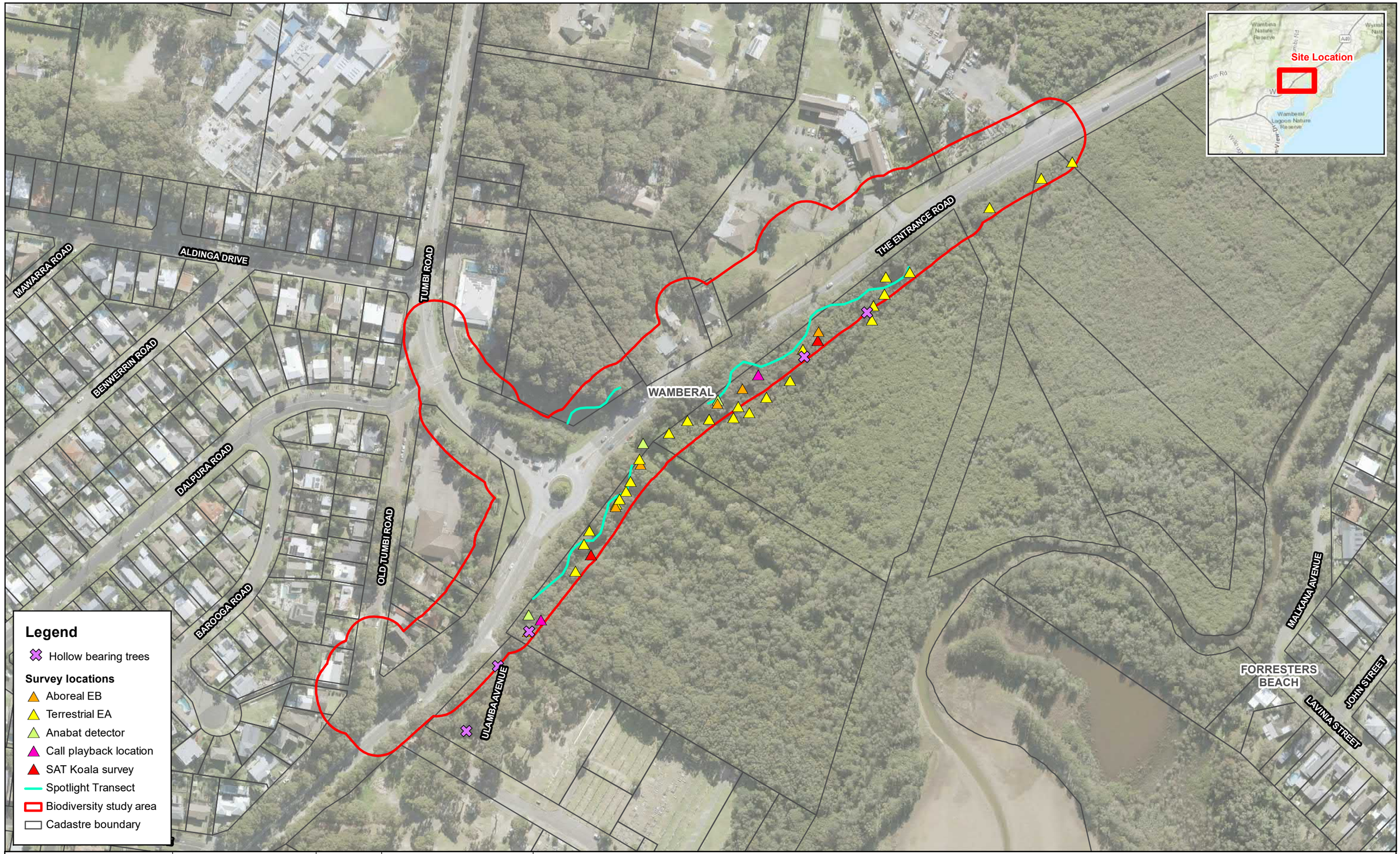
Key Fish Habitat

No Key Fish Habitat occurs within the study area or likely to be affected by the proposal (Department of Primary Industries, 2020c)

2.4.6 Summary of survey effort

Targeted surveys were completed for threatened flora and fauna species identified as having a moderate to high chance of occurring. Surveys generally adhered to the methods described in the NSW Guide to Surveying Threatened Plants (Office of Environment & Heritage, 2016) and the Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities – Working Draft (Department of Environment and Conservation, 2004).

Survey effort undertaken for threatened flora species for the proposal is summarised in Table 2.8 with threatened fauna survey effort shown in Table 2.9. The location of threatened flora and fauna survey effort is illustrated on Figure 2.2. All other parts of the study area outside of the point locations were also covered during the survey.



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Date: 3/04/2020	Approved by: Mark.Stables

0 30 60 m
1:2,500

Coordinate system: GDA 1994 MGA Zone 56
Scale ratio correct when printed at A3

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community © Department Finance, Services and Innovation 2019

Central Coast Highway and Tumbi Road intersection upgrade, Wamberal

Figure 2.2
Threatened species survey locations

Table 2.8 Survey effort for candidate threatened flora species

Scientific name	Common name	Survey technique	Survey effort	Optimum survey period	Period surveyed	Comments
Acacia bynoeana	Bynoes Wattle	Targeted surveys - BAM VI Plots, Parallel Line Traverses and Random Meanders Opportunistic sightings whilst conducting other surveys	Targeted – 10 person hours in habitat Opportunistic – 8 person hours in habitat	All year	9 - 13 March 2020	Targeted PCT 1589
Caladenia tessellata	Thick Lip Spider Orchid		Surveys not completed. Detailed habitat constraint and suitability assessments undertaken for this species.	Sept – Oct		Surveys completed outside optimal flowering period for this species
Cryptostylis hunteriana	Leafless Tongue Orchid			Nov – Jan		
Diuris praecox	Rough Double Tail			Sept		
Eucalyptus camfieldii	Heart-leaved Stringybark		Targeted – 10 person hours in habitat Opportunistic – 8 person hours in habitat	All year		Targeted PCT 1716 - (Melaleuca nodosa variant - Intact)
Eucalyptus oblonga population at Bateau Bay, Forresters Beach and Tumbi Umbi in the Wyong local government area			Targeted – 10 person hours in habitat Opportunistic – 8 person hours in habitat	All year		
Grevillea parviflora subsp. parviflora	Small-flower Grevillea		Targeted – 10 person hours in habitat Opportunistic – 8 person hours in habitat	Aug - Nov		Targeted PCT 1589
Melaleuca biconvexa	Biconvex Paperbark		Targeted – 20 person hours in habitat Opportunistic – 16 person hours in habitat	All year		Targeted all PCTs
Persicaria elatior	Tall Knotweed		Targeted – 10 person hours in habitat Opportunistic – 8 person hours in habitat	Sept-Nov		Targeted PCT 1589
Rhodamnia rubescens	Scrub Turpentine		Targeted – 20 person hours in habitat Opportunistic – 16 person hours in habitat	All year		Targeted all PCTs
Rutidosis heterogama	*Heath Wrinklewort*		Targeted – 10 person hours in habitat Opportunistic – 8 person hours in habitat	All year		Targeted PCT 1589
Thesium australe	Austral toadflax		Targeted – 10 person hours in habitat Opportunistic – 8 person hours in habitat	Nov – Feb		Targeted PCT 1589

Table 2.9 Survey effort for candidate threatened fauna species

Species Targeted	Survey Technique	Survey Effort	Optimum Survey Period	Period Surveyed	Comments
Birds					
Diurnal Forest birds					
Varied Sittella	Surveys at each VI plot Opportunistic surveys Habitat assessment	Opportunistic surveys – 60 person hours in habitat Habitat assessments (including at VI plot locations) – 60 person hours in habitat	All year	9 to 13 Mar 2020	Habitat assessments made due to lack of records.
Gang-Gang Cockatoo			All year	9 to 13 Mar 2020	
Glossy Black-Cockatoo			Apr to Aug Breeding	9 to 13 Mar 2020	
Diurnal blossom nomads					
Little Lorikeet	Surveys at each VI plot Opportunistic surveys Habitat assessment	Opportunistic surveys – 60 person hours in habitat Habitat assessments (including at VI plot locations) – 60 person hours in habitat	All year	9 to 13 Mar 2020	Out of season for Swift Parrot and Regent Honeyeater – habitat assessments made for habitat potential and quality.
Regent Honeyeater			All year	9 to 13 Mar 2020	
Swift Parrot			Apr to Sep	9 to 13 Mar 2020	
Diurnal birds of prey					
Square-tailed Kite		Targeted – 14 person hours in habitat Opportunistic – 16 person hours in habitat	Aug to Oct Breeding	9 to 13 Mar 2020	Habitat assessments made due to lack of records.
Square-tailed Kite			Sep to Jan Breeding	9 to 13 Mar 2020	
White-bellied Sea-eagle			Jul to Sep Breeding	9 to 13 Mar 2020	
Nocturnal birds of prey					
Powerful Owl	Spotlighting surveys and Owl call playback	Targeted – 2 person hours on 2 nights including spotlighting and call playback	May to Aug Breeding	9 & 11 Mar 2020	Habitat assessments made due to lack of records.
Barking Owl			May to Dec Breeding	9 & 11 Mar 2020	
Masked Owl			May to Aug Breeding	9 & 11 Mar 2020	
Sooty Owl			Apr to Aug Breeding	9 & 11 Mar 2020	
Arboreal nocturnal mammals					
Koala	Scat searches (SPOT Assessment)	2 x Spot Assessment Technique sites (SATs)	All year	9 to 13 Mar 2020	Considered unlikely to occur other than accidental occurrences.
	Spotlight transects	Targeted – 2 person hours on 2 nights		9 & 11 Mar 2020	

Species Targeted	Survey Technique	Survey Effort	Optimum Survey Period	Period Surveyed	Comments
	Opportunistic sightings	7 days of opportunistic daylight surveys		9 to 13 Mar 2020	
Squirrel Glider	Spotlight transects Arboreal Elliott A trapping Habitat assessments made	Targeted – 2 person hours on 2 nights 6 Elliott B traps x 4 consecutive nights – 24 trap nights	All year	Spotlighting – 9 & 11 Mar 2020 Trapping - 9 to 12 Mar 2020	Habitat assessments made due to lack of records.
Brush-tailed Phascogale			Dec - Jun		
Yellow-bellied Glider			All year		
Greater Glider			All year		
Grey-headed Flying-fox	Spotlight transects	Targeted – 2 person hours on 2 nights	All year Oct – Nov Breeding	9 & 11 Mar 2020	No roosting camps identified within or near study area
	Opportunistic sightings	Opportunistic surveys – 60 person hours in habitat		9 to 13 Mar 2020	
Spotted-tailed Quoll	Opportunistic sightings	Opportunistic surveys – 60 person hours in habitat	All year	9 to 13 Mar 2020	Considered unlikely to occur other than accidental occurrences.
	Cage Traps	6 Cage traps x 4 consecutive nights – 24 trap nights		Trapping - 9 to 12 Mar 2020	
	Spotlight transects	Targeted – 2 person hours on 2 nights		9 & 11 Mar 2020	
Terrestrial mammals					
Common Planigale	Elliot A trapping	25 Elliot A traps x 4 consecutive nights – 100 trap nights	All year	Trapping - 9 to 12 Mar 2020	-
New Holland Mouse					
Long-nosed Potoroo	Cage Traps	6 Cage traps x 4 consecutive nights – 24 trap nights	Spring	Trapping - 9 to 12 Mar 2020	
	Spotlight transects	Targeted – 2 person hours on 2 nights	Spring	Spotlighting – 9 & 11 Mar 2020	
	Opportunistic sightings	Opportunistic – 16 person hours in habitat	All year	August & November 2019	
Cave-dwelling Microchiropteran bats					
Little Bent-winged Bat	Anabat surveys Culvert surveys	1 Anabat per night for 4 nights 2 culverts examined for roosting potential	Dec – Feb Breeding	Anabat - 9 to 12 Mar 2020	-
Eastern Bent-winged Bat			Dec – Feb Breeding		
Southern Myotis			Oct - Mar		
Hollow-dwelling Microchiropteran bats					
Eastern False Pipistrelle		1 Anabat per night for 4 nights	All year		-

Species Targeted	Survey Technique	Survey Effort	Optimum Survey Period	Period Surveyed	Comments
Eastern Coastal Free-tailed Bat	Anabat surveys Hollow-bearing tree surveys	Hollow-bearing tree locations surveyed and recorded	All year	Anabat - 9 to 12 Mar 2020	
Yellow-bellied Sheathtail-bat			All year		
Greater Broad-nosed Bat			All year		
Amphibians					
Wallum Froglet	Spotlighting surveys Opportunistic sightings Habitat Assessments	Targeted – 2 person hours on 2 nights Opportunistic surveys – 60 person hours in habitat	All year	Spotlighting – 9 & 11 Mar 2020	Survey conditions were not optimal for amphibian survey, due to low water levels.
Mahony's Toadlet			Oct – Mar		
Green and Golden Bell Frog			Nov – Mar		

2.5 Limitations

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

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

2.5.1 Other limitations

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

Reliance on externally supplied information

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

Study for benefit of client

This document has been prepared for the exclusive benefit of the client and no other party. WSP assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with in this study, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in this study (including without limitation matters arising from any negligent act or omission of WSP or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in this study).

Other parties should not rely upon the study or the accuracy or completeness of any conclusions and should make their own inquiries and obtain independent advice in relation to such matters.

2.5.2 Changing circumstances

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

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

3 Existing environment

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

3.1 Summary of landscape features

The landscape context of the study area, including IBRA bioregions and subregions, Mitchell landscapes, catchment areas and land uses are described in Table 3.1.

Table 3.1 Landscape features

Landscape feature	Subject land
IBRA bioregions and subregions	Sydney Basin Bioregion / Wyong subregion
NSW landscape regions (Mitchell landscapes)	Gosford - Cooranbong Coastal Slopes and Sydney - Newcastle Barriers and Beaches
Local Government Area (LGA)	Central Coast Council
Native vegetation extent in the buffer area	Within the study area buffer, as defined in the BAM, native vegetation cover has been identified as 30 – 70%
Cleared areas	Cleared areas are associated with residential housing, rural-residential and cemetery in the suburbs of Wamberal and Forresters Beach.
Rivers and streams	Two first order streams occur within the study area. These streams run through existing culverts under the Central Coast Highway and flow southeast into Forresters Creek prior to discharge into Wamberal Lagoon (see Figure 1.1).
Wetlands	A SEPP Coastal Management 2018 Coastal Wetland and associated proximity buffers occur within the study area (see Figure 1.1).
Connectivity features	Native vegetation within the study area provides connectivity to large patches of remnant native vegetation within Wamberal Lagoon Nature Reserve.
Areas of Geological Significance and Soil Hazard Features	There are no areas identified to have geological significance. Potential high risk acid sulphate soils, associated with low lying alluvial flats along the southern side of the Central Coast Highway have been identified within the study area.
Areas of outstanding biodiversity value	None recorded.
Key Fish Habitat	No Key Fish Habitat occurs within the study area or likely to be affected by the proposal (Department of Primary Industries, 2020c)

3.2 Plant community types

A total of three NSW Plant Community Types (PCTs) were recorded in the study area. These are:

- PCT 1589 - Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast
- PCT 1625 - Red Bloodwood -Sydney Peppermint - *Podocarpus spinulosus* shrubby open forest of the southern Central Coast
- PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast

In addition, two non-native vegetation types were assigned to a miscellaneous ecosystem class, being:

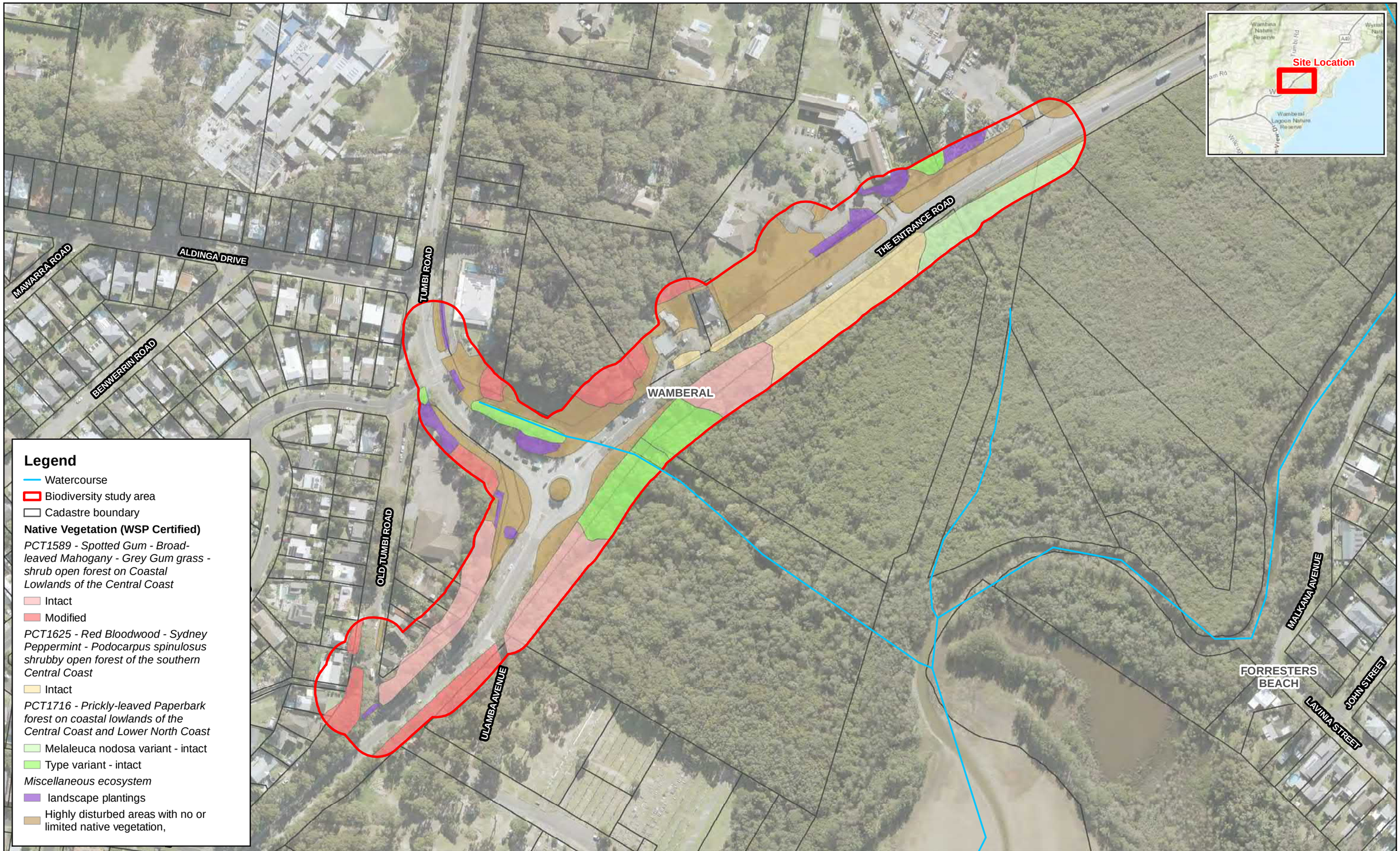
- Miscellaneous ecosystem – landscape plantings
- Miscellaneous ecosystem – highly disturbed areas with no or limited native vegetation

These three native vegetation communities (listed above) were assigned to five discrete vegetation zones based on broad vegetation condition class criteria as outlined in Table 2.5. A summary of PCTs and associated vegetation zones are presented in Table 3.2 with the extent and distribution shown in Figure 3.1.

Table 3.2 Plant community types

Plant community type (PCT)	Condition class	Threatened ecological community?	Area (ha) study area	Area (ha) impacted
PCT 1589 - Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast	Intact	No	0.64	0.20
	Modified	No	0.45	0.04
PCT 1625 - Red Bloodwood - Sydney Peppermint - *Podocarpus spinulosus* shrubby open forest of the southern Central Coast	Intact	No	0.43	0.15
PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast	Type variant - Intact	Yes – Swamp Sclerophyll Forest on Coastal Floodplain	0.42	0.09
	Melaleuca nodosa variant - Intact		0.22	0.00
Total extent of native vegetation			**2.16**	**0.48**
Miscellaneous ecosystem – landscape plantings	n/a	No	0.22	0.04
Miscellaneous ecosystem – highly disturbed areas with no or limited native vegetation	n/a	No	1.33	0.62
Total extent of non-native vegetation			**1.55**	**0.66**
Total native and non-native vegetation			**3.71**	**1.14**

Detailed description and selection justification for each PCT and vegetation zone is provided below



Map: PS118997_GIS_006_A3	Author: David.Naiken
Date: 09-Apr-20	Approved by: Mark.Stables

0 30 60 m
1:2,500

Coordinate system: GDA 1994 MGA Zone 56
Scale ratio correct when printed at A3

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community © Department Finance, Services and Innovation 2019

Central Coast Highway and Tumbi Road intersection upgrade, Wamberal

Figure 3.1
Plant Community Types

PCT 1589 - Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast

The occurrence of this vegetation type within the development site is illustrated in Figure 3.1 with photographic representation provided in Photo 3.1 to Photo 3.4. An overview of floristic and structural composition is presented in

Table 3.3 and a general description provided below.

Vegetation formation: KF_CH5A Dry Sclerophyll Forest (Shrub/grass sub-formation)

Vegetation class: Hunter-Macleay Dry Sclerophyll Forests

Other mapping sources: Unit E15a – Tumbi Spotted Gum-Ironbark Forest (Bell 2009)

Estimate of percent cleared: 71%

Conservation status: Does not form part of any listed threatened ecological community under either the BC Act or EPBC Act.

It is noted that PCT 1589 is known, in some locations, to form part of the Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion which is listed as Endangered under the BC Act. Tumbi Spotted Gum-Ironbark Forest is not considered to form part of this threatened ecological community based on geographical position and is considered more closely aligned to the broader *Corymbia maculata - Eucalyptus paniculata* association within New South Wales (Bell and Stables 2012). This broader vegetation association includes Unit 15 - Coastal Footslopes Spotted Gum-Ironbark Forest (NPWS 2000) and Map Unit 30 - Narrabeen Dooralong Spotted Gum-Ironbark Forest (Bell 2002) both of which extend throughout the northern coastal footslopes of the Central Coast region.

Landscape position: This vegetation type occurs on footslopes and low rises. It occurs mostly around the Wamberal Cemetery and to the northern side of the Central Coast Highway and either side of the Tumbi Road intersection.

PCT justification: Two PCTs were considered in assigning this vegetation type being:

- PCT 1589 - Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast
- PCT 1590 - Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest

Using the BioNet vegetation classification plant community identification tool (Office of Environment Energy and Science Group, 2020b) and applying vegetation formation, class, IBRA region and an upper stratum of *Corymbia maculate* (Spotted Gum) - *Eucalyptus paniculata* (Grey ironbark), PCT 1589 scored 4 and was first in the list of potential PCTs. The lack of *Eucalyptus fibrosa* (Red Ironbark) and sclerophyll shrubs along with the linage history of PCT 1589 (being PCT 1216 - Spotted Gum - Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin Bioregion) identified PCT 1589 as the most closely aligned PCT for this vegetation type.

Vegetation zones: Two distinct vegetation zones were assigned within this vegetation type based on broad condition state. These are:

Intact: This broad condition state occurs relatively undisturbed with all stratum present. Exotic weed incursions were recorded in both the ground and middle stratum although native species are dominant through all structural layers. This vegetation zone mostly occurs to the south and east of the Central Coast Highway and extends within the Wamberal Lagoon Nature Reserve.

Modified: Mostly occurs as intact canopy only or scattered trees with modified ground and middle stratum. This vegetation zone is mostly associated with private lands and road verges.

Vegetation integrity survey plots: Q2, Q8 (Intact) and Q5, Q6 (modified). See Appendix A for full floristic and structural data.

Photo 3.1 PCT 1589 intact Q8

Photo 3.2 PCT 1589 intact Q2

Photo 3.3 PCT 1589 modified Q5

Photo 3.4 PCT 1589 modified northern side of Central Coast Highway

Table 3.3 PCT 1589 overview of floristic and structural composition

Structure	Average height and height range (m)	Average cover	Typical species
Trees	26 (24-34)	45	*Corymbia maculata* (Spotted Gum), *Eucalyptus paniculata* subsp. *paniculata* (Grey Ironbark), *Eucalyptus resinifera* subsp. *resinifera* (Red Mahogany), *Syncarpia glomulifera* subsp. *glomulifera* (Turpentine)
Small trees	8 (6-12)	15	*Glochidion ferdinandi* var. *ferdinandi* (Cheese Tree), *Callistemon salignus* (Willow Bottlebrush), *Melaleuca styphelioides* (Prickly-leaved Tea Tree)
Shrubs	2 (1.2-4)	20	*Pittosporum undulatum* (Sweet Pittosporum), *Breynia oblongifolia* (Coffee Bush), *Notelaea longifolia f. longifolia* (Mock Olive), *Acacia longifolia* subsp. *longifolia* (Sydney Golden Wattle)
Ground covers	0.7 (0.1-1.4)	35	*Oplismenus imbecillis* (Creeping Beard Grass), *Lomandra longifolia* (Spiny-headed Mat-rush), *Entolasia stricta* (Wiry Panic), *Dianella caerulea* var. *producta* (Blue Flax lily), *Paspalidium distans*, *Pseuderanthemum variabile* (Pastel Flower)
Vines & climbers	n/a	12	*Parsonsia straminea* (Common Silkpod), *Pandorea pandorana* (Wonga Wonga Vine), *Tylophora barbata* (Bearded Tylophora), *Smilax australis* (Lawyer Vine)

PCT 1625 - Red Bloodwood -Sydney Peppermint - *Podocarpus spinulosus* shrubby open forest of the southern Central Coast

The occurrence of this vegetation type within the development site is illustrated in Figure 3.1 with photographic representation provided in Photo 3.5 and Photo 3.6. An overview of floristic and structural composition is presented in Table 3.4 and a general description provided below.

Vegetation formation: KF_CH5B Dry Sclerophyll Forest (Shrub sub-formation)

Vegetation class: Sydney Coastal Dry Sclerophyll Forests

Other mapping sources: Unit E101 – Wamberal Low Open Heath Forest (Bell 2009)

Estimate of percent cleared: 88%

Conservation status: Does not form part of any listed threatened ecological community under either the BC Act or EPBC Act.

Landscape position: Low coastal hills of the southern Central Coast on Quaternary sands and Triassic sandstones. This vegetation type occurred on slightly elevated sandy soils on both sides of the Central Coast Highway to the north of the Tumbi Road intersection.

PCT Justification: Using the BioNet vegetation classification plant community identification tool (Office of Environment Energy and Science Group, 2020b) and applying vegetation formation, class, IBRA region and an upper stratum of *Corymbia gummifera* (Red Bloodwood), *Eucalyptus piperita* (Sydney Peppermint), *Syncarpia glomulifera* subsp. *glomulifera* (Turpentine) and a middle stratum of *Melaleuca nodosa* (Ball Honeymyrtle), *Notelaea longifolia f. longifolia* (Mock Olive), PCT 1625 was one of about 10 PCTs that scored 5.

The selection of PCT 1625 was based on an upper stratum tree canopy dominated by of *Corymbia gummifera* (Red Bloodwood), *Eucalyptus piperita* (Sydney Peppermint) and a middle stratum comprising of small trees and diverse shrubs. The selection of PCT 1625 also fit this vegetation association in terms of landscape position being on low coastal hills of the southern Central Coast on Quaternary sands and Triassic sandstones.

Vegetation zones: This vegetation type occurred in a single broad condition state of intact where all floristic structural strata were dominated by native species. It is likely that small patches of this vegetation zone on the northwest side of the Central Coast Highway maybe slightly modified however given these patches were not able to be representatively sampled using a vegetation integrity plot they were clumped within the single broad condition state.

Vegetation integrity survey plots: Q3 see Appendix A for full floristic and structural data.

Photo 3.5 PCT 1625 intact Q3

Photo 3.6 PCT 1625 intact Q3

Table 3.4 PCT 1624 overview of floristic and structural composition

Structure	Average height and height range (m)	Average cover	Typical species
Trees	22 (18-24)	53	*Corymbia gummifera* (Red Bloodwood), *Eucalyptus piperita* (Sydney Peppermint), *Syncarpia glomulifera* subsp. *glomulifera* (Turpentine)
Small trees	8 (6-10)	9	*Allocasuarina torulosa* (Forest Oak), *Glochidion ferdinandi* var. *ferdinandi* (Cheese Tree)
Shrubs	2.2 (1-3.5)	25	*Melaleuca nodosa* (Ball Honeymyrtle), *Notelaea longifolia f. longifolia* (Mock Olive), *Pittosporum revolutum* (Rough Fruit Pittosporum), *Pittosporum undulatum* (Sweet Pittosporum)
Ground covers	0.8 (0.1-1)	30	*Cyathochaeta diandra*, *Entolasia stricta* (Wiry Panic), *Ptilothrix deusta*, *Lomandra longifolia* (Spiny-headed Mat-rush), *Imperata cylindrica* (Blady Grass), *Lepidosperma laterale* (Variable Sword-sedge)
Vines & climbers	n/a	11	*Parsonsia straminea* (Common Silkpod), *Pandorea pandorana* (Wonga Wonga Vine), *Smilax australis* (Lawyer Vine)
Exotic weeds	n/a	1	*Asparagus aethiopicus** (Asparagus Fern), *Lantana camara** (Lantana), *Ochna serrulata** (Mickey Mouse Plant), *Senna pendula** (Easter Cassia)

PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast

The occurrence of this vegetation type within the development site is illustrated in Figure 3.1 with photographic representation provided in Photo 3.7 to Photo 3.10. An overview of floristic and structural composition is presented in Table 3.5 and a general description provided below.

Vegetation formation: KF_CH9 Forested Wetlands

Vegetation class: Coastal Swamp Forests

Other mapping sources: Unit E37a – Alluvial Paperbark Sedge Forest (Bell 2009)

Estimate of percent cleared: % 66

Conservation status: This vegetation type forms part of the broader Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions threatened ecological community, listed as Endangered under the BC Act.

Swamp Sclerophyll Forest on Coastal Floodplains is not a listed threatened ecological community under the EPBC Act.

One plant of the threatened flora species, *Rhodamnia rubescens* (Scrub Turpentine), listed as Critically Endangered under the BC Act, was recorded within this vegetation type.

Landscape position: This vegetation type is found on poorly drained areas on the undulating coastal lowlands associated with Wamberal Lagoon Nature Reserve.

PCT Justification: Using the BioNet vegetation classification plant community identification tool (Office of Environment Energy and Science Group, 2020b) and applying vegetation formation, class, IBRA region and an upper stratum of *Melaleuca styphelioides* (Prickly-leaved Tea Tree), *Melaleuca nodosa* (Ball Honeymyrtle), PCT 1716 was the most closely aligned PCT for this vegetation type.

Vegetation zones: Two distinct vegetation zones were assigned within this vegetation type based on broad condition state. These are:

Type variant - Intact: This vegetation zone was dominated by a mixed paperbark canopy comprising of *Melaleuca styphelioides* (Prickly-leaved Tea Tree), *Melaleuca nodosa* (Ball Honeymyrtle), *Callistemon salignus* (Willow Bottlebrush) and *Melaleuca linariifolia* (Snow-in-Summer). Scattered emergent eucalypts also occur in this vegetation zone along with a variety of mesic shrubs and ground stratum dominated by sedges and grasses.

Melaleuca nodosa variant – Intact: This vegetation zone occurs as a low dense thicket variant dominated by *Melaleuca nodosa* (Ball Honeymyrtle). This variant also exhibits a more wet heath shrub layer that includes species such as *Banksia oblongifolia* (Fern-leaved Banksia), *Hakea teretifolia* (Dagger Hakea) and *Monotoca elliptica* (Tree Broom-heath).

Vegetation integrity survey plots: Q1, Q7 (Type variant - Intact) and Q4 (*Melaleuca nodosa* variant – Intact). See Appendix A for full floristic and structural data.

Photo 3.7 PCT 1716 Type variant intact

Photo 3.8 PCT 1716 Type variant Q1

Photo 3.9 PCT 1716 *Melaleuca nodosa* variant

Photo 3.10 PCT 1716 Melaleuca nodosa variant Q4

Table 3.5 PCT 1716 overview of floristic and structural composition

Structure	Average height and height range (m)	Average cover	Typical species
Trees Type variant - Intact	16 (14-24)	53	*Melaleuca styphelioides* (Prickly-leaved Tea Tree), *Melaleuca nodosa* (Ball Honeymyrtle), *Callistemon salignus* (Willow Bottlebrush), *Melaleuca linariifolia* (Snow-in-Summer)
Trees Melaleuca nodosa variant – Intact	5 (3-6)	47	*Melaleuca nodosa* (Ball Honeymyrtle), *Glochidion ferdinandi* var. *ferdinandi* (Cheese Tree), *Casuarina glauca* (Swamp oak)
Shrubs	3 (1.2 -5)	25	*Melaleuca nodosa* (Ball Honeymyrtle), *Pittosporum undulatum* (Sweet Pittosporum), *Glochidion ferdinandi* var. *ferdinandi* (Cheese Tree)
Ground covers	1 (0.1-1.5)	30	*Gahnia clarkei* (Tall Saw-sedge), *Lepidosperma longitudinale* (Pithy sword-sedge), *Oplismenus imbecillis* (Creeping Beard Grass), *Lomandra longifolia* (Spiny-headed Mat-rush), *Entolasia stricta* (Wiry Panic),
Vines & climbers	n/a	11	*Parsonsia straminea* (Common Silkpod), *Cassytha pubescens* (Common Devil's Twine), *Gynochthodes jasminoides* (Scrambling Lily)
Exotic weeds	n/a	28	*Asparagus aethiopicus** (Asparagus Fern), *Lantana camara** (Lantana), *Ochna serrulata** (Mickey Mouse Plant), *Senna pendula** (Easter Cassia)

Miscellaneous ecosystem - landscape plantings

This vegetation type does not align to any recognised plant community type in NSW and is the result of ornamental landscape plantings. Most patches of this vegetation type have resulted from Transport post-construction landscape plantings from previous Central Coast Highway upgrades, mostly to the south and west of the Tumbi Road intersection.

Other patches of this vegetation type occur on private lands as part of ornamental gardens. Commonly planted species include *Agapanthus praecox* subsp. *orientalis** (Agapanthus), *Callistemon* sp. Cultivar (Bottlebrush), *Jacaranda mimosifolia** (Jacaranda), *Melaleuca bracteata* 'planted ornamental' (Black Tea-tree), *Murraya paniculata** (Orange Jessamine), *Polygala myrtifolia** (Myrtle-leaf Milkwort), *Schinus molle* var. *areira** (Pepper Corn) among others.

Photo 3.11 Miscellaneous ecosystem - landscape plantings

Miscellaneous ecosystem - highly disturbed areas with no or limited native vegetation

This vegetation type does not align to any recognised plant community type in NSW due to its limited native vegetation and degraded condition. As such, it has been aligned to Highly disturbed areas with no or limited native vegetation. Within the study area this vegetation type was mostly dominated by exotic perennial grass species such as *Axonopus fissifolius** (Narrow-leaf Carpet Grass), *Cenchrus clandestinus** (Kikuyu), *Eragrostis curvula** (African Love Grass) and *Paspalum dilatatum** (Paspalum).

Photo 3.12 Miscellaneous ecosystem - highly disturbed areas with no or limited native vegetation

3.3 Flora recorded

Within the study area, a total of 228 flora species were recorded. Of these, 145 were native indigenous (64%) and 83 were non-native exotic species or native planted ornamental species (36%). One plant of the threatened flora species was recorded within the study area being *Rhodamnia rubescens* (Scrub Turpentine), which is listed as Critically Endangered under the BC Act.

A full inventory of flora species recorded and vegetation integrity plot data is presented in Appendix A.

3.3.1 Priority Weeds

Of the 83 recorded exotic species, six are listed as Priority Weeds under the NSW *Biosecurity Act 2015* (Biosecurity Act) for the Greater Sydney Local Land Service region and are also listed Weeds of National Significance (WONs) (Table 3.6). Under the Biosecurity Act, land managers are required to follow the regional and non-regional duties which have been allocated to each Priority Weed.

Table 3.6 Weeds of concern recorded within the study area

Scientific name	Common name	Priority weed duty	WONS
*Asparagus aethiopicus**	Asparagus Fern	**Prohibition on dealings** Must not be imported into the State or sold	Yes
*Asparagus plumosus**	Climbing Asparagus Fern		Yes
*Chrysanthemoides monilifera subsp. rotundata**	Bitou bush		Yes
*Lantana camara**	Lantana		Yes
*Opuntia sp.**	Prickly Pear		Yes

Scientific name	Common name	Priority weed duty	WONS
Senecio madagascariensis *	Fireweed		Yes

3.4 Threatened ecological communities

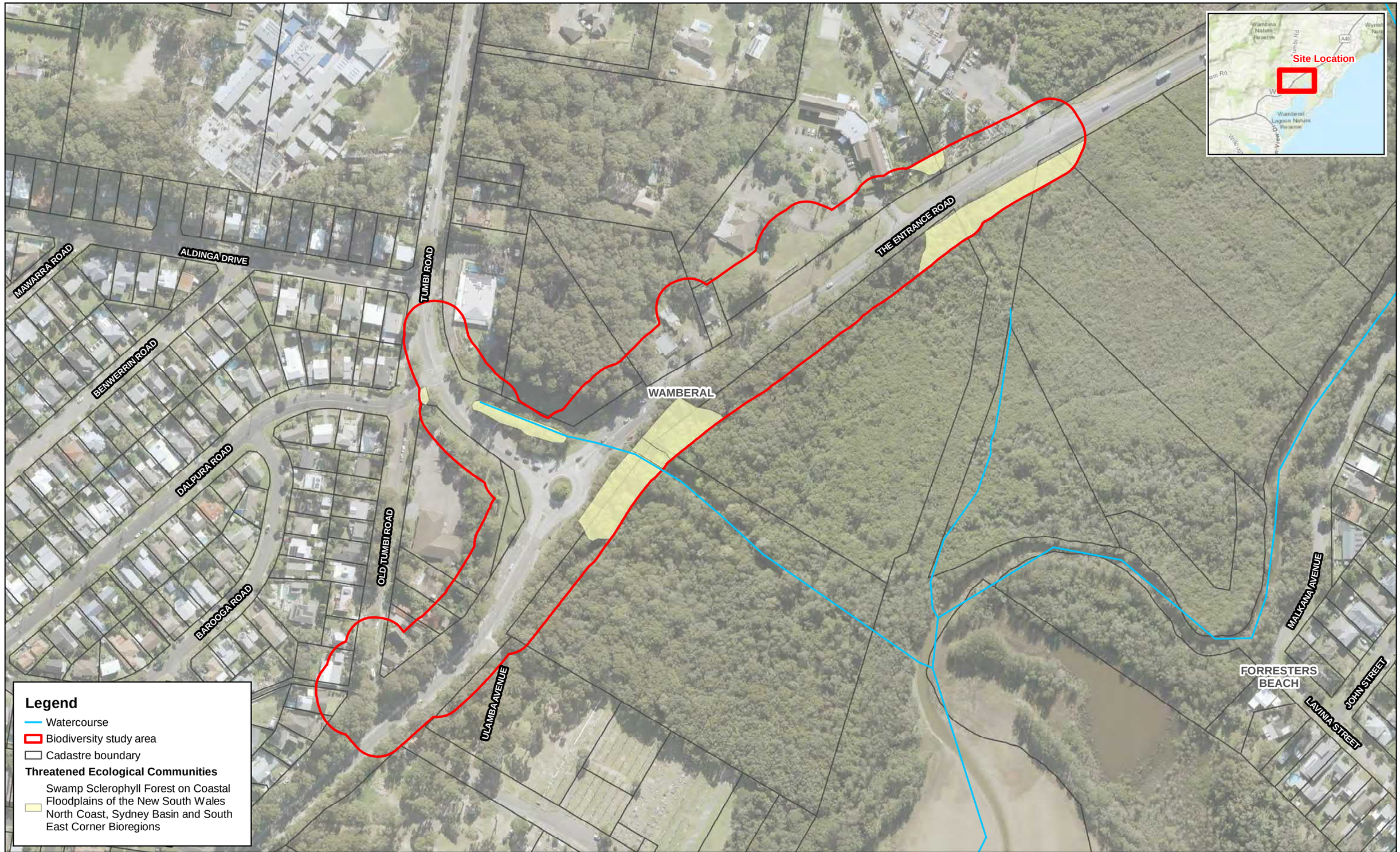
One threatened ecological community was recorded within the study area being, Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions. This threatened ecological community is listed as Endangered under the BC Act although it is not listed under the EPBC Act. The occurrence of Swamp Sclerophyll Forest on Coastal Floodplains within the study area is shown in Figure 3.2.

PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast is consistent with the final determination for the Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

A comparison of Swamp Sclerophyll Forest on Coastal Floodplains final determination criteria (NSW Scientific Committee 2011) and PCT 1716 attributes within the study area is provided in Table 3.7.

Table 3.7 A comparison of Swamp Sclerophyll Forest on Coastal Floodplains final determination criteria and PCT 1716 attributes within the study area

Final determination listing criteria	Swamp Sclerophyll Forest on Coastal Floodplain	PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast
Area occupied by the EEC	Occurs in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Yes, PCT 1716 occurs in the Sydney Basin IBRA Bioregion
Soils	The community is associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains	Yes, PCT 1716 occurs on periodically inundated alluvial flats of the Wamberal Lagoon catchment.
Elevation	Does the PCT occur below 20 m	Yes, the PCT occurs at elevations between 10m and 20m
Floristic Structure	The community is typically open forest but can be reduced the canopy to scattered trees. In some areas, the tree stratum is low and dense, so the community takes on the structure of a scrub.	Yes, PCT 1716 Type variant is mostly an open forest structure while PCT 1716 Melaleuca nodosa variant exhibits a low and dense scrub structure
Assemblage of Species	59 characteristic species of Swamp Sclerophyll Forest on Coastal Floodplains are listed in the Scientific Determination	Yes, Q1 recorded 16, Q4, 19 and Q7, 12 diagnostic species
Location within LGAs	Previously recorded from the local government areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, Lake Macquarie, Wyong, Gosford, Hornsby, Pittwater, Warringah, Manly, Liverpool, Rockdale, Botany Bay, Randwick, Sutherland, Wollongong, Shellharbour, Kiama and Shoalhaven but may occur elsewhere in these bioregions.	Yes, this PCT occurs within the Central Coast local government area (formerly Wyong, Gosford).
Outcome		**Yes**



Map: PS118997_GIS_007_A2	Author: David.Naiken
Date: 09-Apr-20	Approved by: Mark.Stables

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community © Department Finance, Services and Innovation 2019

0 30 60 m

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Coordinate system: GDA 1994 MGA Zone 56
Scale ratio correct when printed at A3

Central Coast Highway and Tumbi Road intersection upgrade, Wamberal

Figure 3.2
Threatened Ecological Communities Recorded within the Study Area

3.5 Groundwater dependent ecosystems

Groundwater dependant ecosystems (GDEs) are communities of plants, animals and other organisms whose extent and life processes are dependent on groundwater (Department of Land and Water Conservation, 2002).

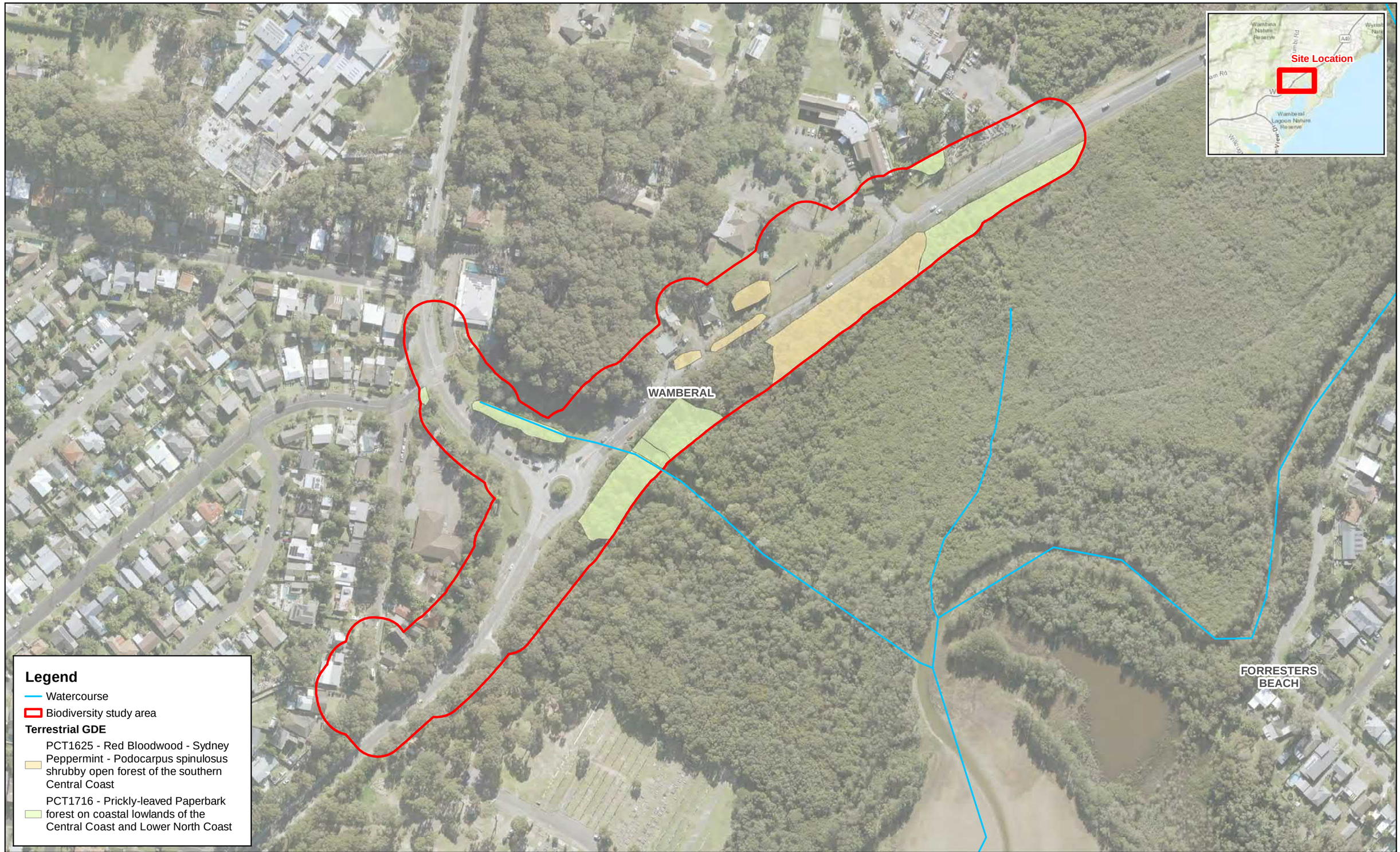
GDEs include a diverse range of ecosystems from those entirely dependent on groundwater to those that may use groundwater while not having a dependency on it for survival (i.e. ecosystems or organisms that use groundwater opportunistically or as a supplementary source of water) (Hatton and Evans, 1998).
GDEs possess a range of values, including being important and sometimes rare ecosystems in themselves, as well as providing important ecosystem services such as water purification (Department of Land and Water Conservation, 2002).

The dependence (or interaction) of the vegetation communities identified within the proposal footprint, on groundwater was determined by aligning them with the groundwater dependant ecosystem types identified by Eamus *et al.* (2006) ().

PCT 1625 - Red Bloodwood -Sydney Peppermint - *Podocarpus spinulosus* shrubby open forest of the southern Central Coast and PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast vegetation communities are highly to moderately likely to be GDEs which are reliant on surface expressions of groundwater or on subsurface groundwater in the study area (Bureau of Meteorology 2020).

PCTs identified within the study area are considered likely to be classified as terrestrial GDE or “Vadophytic vegetation” (). The location of each of these GDEs within the study area is shown in Figure 3.3. No groundwater aquifer or cave systems, or defined wetlands were identified within the study area from the field surveys and desktop assessment.

The proposal has potential to directly or indirectly interfere with subsurface or groundwater flows associated with the coastal floodplain and Wamberal Lagoon.



Map: PS118997_GIS_008_A3	Author: David.Naiken
Date: 09-Apr-20	Approved by: Mark.Stables

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Coordinate system: GDA 1994 MGA Zone 56
Scale ratio correct when printed at A3

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community © Department Finance, Services and Innovation 2019

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Figure 3.3
Groundwater Dependent Ecosystems

3.6 Threatened species and populations

Based on the results of habitat likelihood of occurrence assessments, 27 threatened flora species were known or predicted to occur in the locality of which 12 have been identified as having a moderate or higher likelihood of occurring within the study area (Appendix B). These species became the focus of detailed targeted surveys that have result in the identification of one species, *Rhodamnia rubescens* (Scrub Turpentine). An additional three threatened orchid species, that were not able to be surveyed due to seasonality issues, have been assumed to be present, for the purposes of this assessment.

In terms of threatened fauna species, the results of habitat likelihood of occurrence assessments identified 94 species as known or predicted to occur in the locality of which 13 have been identified as having a moderate or higher likelihood of occurring within the study area (Appendix B).

An overview of threatened flora and fauna species results are presented in Table 3.8. The location of all recorded threatened species is shown in Figure 3.4.

Table 3.8 Habitat assessment and surveys results

Scientific name	Common Name	Status		Potential occurrence	Serious and Irreversible Impact entity?	Affected species?
		BC Act[1]	EPBC Act[2]			
Flora						
Acacia bynoeana	Bynoes Wattle	E	V	Moderate	No	No - surveyed
Caladenia tessellata	Thick Lip Spider Orchid	E	V	Moderate	No	Yes – assumed present
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	Moderate	No	Yes – assumed present
Diuris praecox	Rough Double Tail	V	V	Moderate	No	Yes – assumed present
Eucalyptus camfieldii	Heart-leaved Stringybark	V	V	Moderate	No	No - surveyed
Eucalyptus oblonga population at Bateau Bay, Forresters Beach and Tumbi Umbi in the Wyong local government area		E	-	Moderate	No	No - surveyed
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	V	Moderate	No	No - surveyed
Melaleuca biconvexa	Biconvex Paperbark	V	V	Moderate	No	No - surveyed
Persicaria elatior	Tall Knotweed	V	V	Moderate	No	No - surveyed
Rhodamnia rubescens	Scrub Turpentine	CE	-	Recorded	Yes	Yes – however impact avoided
Rutidosis heterogama	Heath Wrinklewort	E	E	Moderate	No	No - surveyed

Scientific name	Common Name	Status		Potential occurrence	Serious and Irreversible Impact entity?	Affected species?
		BC Act[1]	EPBC Act[2]			
Thesium australe	Austral toadflax	V	V	Moderate	No	No - surveyed
Fauna						
Crinia tinnula	Wallum Froglet	V	-	Moderate	No	Yes
Callocephalon fimbriatum	Gang-Gang Cockatoo	V	-	Moderate	No	Yes
Daphoenositta chrysoptera	Varied Sittella	V	-	Moderate	No	Yes
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Moderate	No	Yes
Glossopsitta pusilla	Little Lorikeet	V	-	Moderate	No	Yes
Lathamus discolor	Swift Parrot	E1	CE	Moderate	Yes	Yes
Lophoictinia isura	Square-tailed Kite	V	-	Moderate	No	Yes
Micronomus norfolkensis	Eastern Freetail-bat	V	-	Moderate	No	Yes
Miniopterus australis	Little Bent-winged Bat	V	-	Recorded	No	Yes
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	Moderate	No	Yes
Ninox strenua	Powerful Owl	V	-	Moderate	No	Yes
Petaurus norfolcensis	Squirrel Glider	V	-	Moderate	No	Yes
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Recorded	No	Yes

1. Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the BC Act
2. Vulnerable (V), Endangered (E), Critically Endangered (CE), Migratory (M) as listed on the EPBC Act

NOTE: EPBC Migratory species that are not listed as Threatened have not been included in the table, these species have been included in Section 5.5 below.

All recorded or potentially occurring threatened biodiversity are discussed further below.

3.6.1 Threatened Flora

***Caladenia tessellata* (Thick Lip Spider Orchid)**

On the Central Coast this species is known from three populations in the Wyong area. Associated vegetation occurs within the study area in the form of PCT 1589 - Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast. This species is only detectable when in flower during spring, being September to October.

Surveys conducted within the study area were undertaken during March and as such the presence / absence of this species cannot be determined. Given targeted surveys are not possible due to seasonal limitations, a precautionary approach has been taken and the species is assumed present based on associated habitat within the study area. Assumed presence is restricted to PCT 1589 intact vegetation zone only.

Cryptostylis hunteriana (Leafless Tongue Orchid)

Although not recorded within the locality associated vegetation occurs within the study area for *Cryptostylis hunteriana* (Leafless Tongue Orchid) in the form of PCT 1589 - Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast and PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast. This species is only detectable when in flower that occurs during late spring to early summer, being November to December.

Surveys conducted within the study area were undertaken during March and as such the presence / absence of this species cannot be determined. Given targeted surveys are not possible due to seasonal limitations, a precautionary approach has been taken and the species is assumed present based on associated habitat within the study area. Assumed presence is restricted to PCT 1589 and PCT 1716 intact vegetation zone only.

Diuris praecox (Rough Double Tail)

In the locality, this species is known from a coastal headland at Wyrrabalong National Park near Bateau Bay. Associated vegetation occurs within the study area in the form of PCT 1589 - Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast and PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast. This species is only detectable when in flower that occurs during late winter, being August.

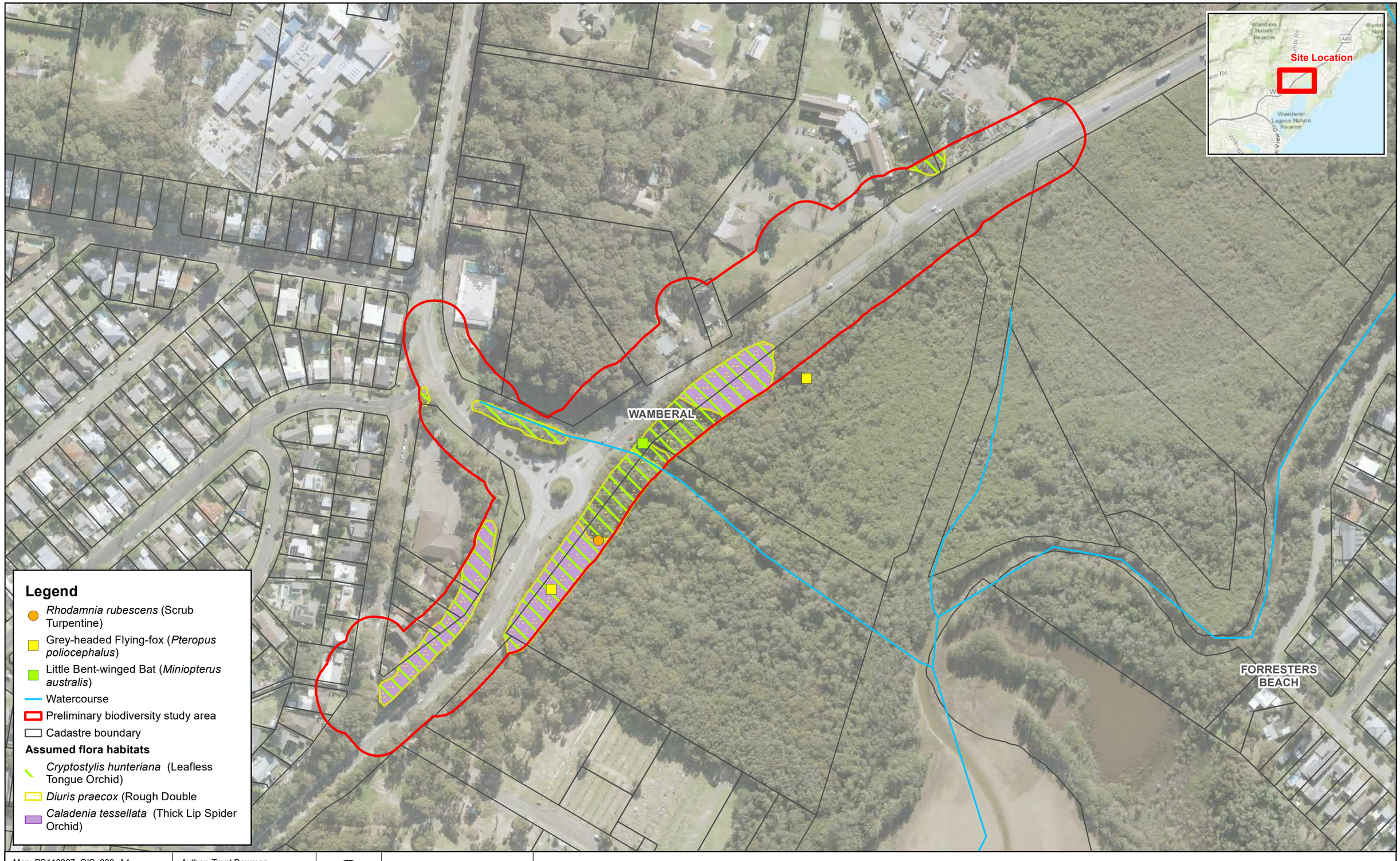
Surveys conducted within the study area were undertaken during March and as such the presence / absence of this species cannot be determined. Given targeted surveys are not possible due to seasonal limitations, a precautionary approach has been taken and the species is assumed present based on associated habitat within the study area. Assumed presence is restricted to PCT 1589 and PCT 1716 intact vegetation zone only.

Rhodamnia rubescens (Scrub Turpentine)

A single individual of *Rhodamnia rubescens* (Scrub Turpentine) was recorded from the study area within PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast. *Rhodamnia rubescens* (Scrub Turpentine) is listed as Critically Endangered under the BC Act primarily due to the species susceptibility to the exotic fungus disease known as Myrtle Rust.

The individual recorded was in a juvenile age class, about 50 centimetres in height with 4 or 5 small branches. Given the young age class of the individual no seed production or propagation within the study area is considered likely. Evidence of Myrtle Rust infection was also observed (see Photo 3.13).

The location of the species within the study area is shown in Figure 3.4.



Map: PS118997_GIS_009_A4	Author: Trent.Bowman
Date: 14-May-20	Approved by: Mark.Stables

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Coordinate system: GDA 1994 MGA Zone 56
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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community © Department Finance, Services and Innovation 2019

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Figure 3.4
Recorded threatened species

Photo 3.13 A single individual of *Rhodamnia rubescens* (Scrub Turpentine) recorded within the study area showing evidence of Myrtle Rust

3.6.2 Threatened Fauna

Wallum Froglet – *Crinia tinnula*

The Wallum Froglet prefers vegetated freshwater wetland habitats in near coastal areas. The eastern edges of most of the study area, in its northern portion, abut low-lying topographies subject to inundation where wetland communities form. At the very northern end of the eastern sections of the study area, semi-permanent wetland habitats extend into the study area to the edge of the existing roadway foundations. During onsite surveys, those areas colonised by wetland plants exhibited low water levels, which prevented the use of such areas by amphibians for breeding purposes. Nevertheless, under suitable climatic conditions, when water levels are suitably higher, the northern sections of the study area are considered to provide potential breeding habitat for the Wallum Froglet.

Gang-Gang Cockatoo – *Callocephalon fimbriatum*
In the Central Coast region, the Gang-Gang Cockatoo is generally a bird of tall forested ranges. However, the birds sometimes disperse from upland forests to lowland areas, apparently associated with low foraging resources in the ranges. In the Morisset/Cooranbong and Coal Fields areas they have been observed in lowland areas on a number of occasions, foraging on the fruit of Blackbutt (*Eucalyptus pilularis*) and Scribbly Gum (*E. signata*) (WSP Ecologist, pers. obs.). There are records in the vicinity, including one in Bateau Bay to the north, and although records in the vicinity are sparse, the study area occurs within the range of local populations and contains at least three myrtaceous tree species, the fruit of which, Gang-Gang Cockatoos have been recorded as foraging on, including *Eucalyptus pilularis*, *Corymbia gummifera* and *C. maculata* (Higgins, 1999).

On the eastern side of the study area, *E. pilularis* and *C. gummifera* occur to the north of the Tumbi Road roundabout and *C. maculata* occurs south from the Tumbi Road roundabout in increasing density to the Wamberal Cemetery grounds, where it dominates the canopy. *C. maculata* is a dominant canopy species on the western side of the study area.

Varied Sittella (*Daphoenositta chrysoptera*)
The Varied Sittella is a bird of the trunks and branches of trees, where it forages bark crevices, holes and curls for invertebrate prey. In the Central Coast Region, they forage in forests and woodlands from the ranges across the coastal strip within a wide variety of forest and woodland types. The study area contains suitable foraging and breeding habitat opportunities for this species, and it is considered likely that the study area represents part of the home

range for local individuals. All forested areas of the study area provide suitable habitat for the Varied Sittella.

Swift Parrot – *Lathamus discolour*
The entire Swift Parrot population spends the September to March breeding season in Tasmania. During late autumn to early spring (generally April to early September) Swift Parrots migrate to south-eastern Australia to forage on blossom available during the winter period. Their presence in a given mainland location from year to year is generally rare, due to annual variability in blossom availability, so favoured sites may have return rates spaced by a good number of years. The variations in blossom availability during a given season can vary greatly, due to tree species flowering return rates, blossom resource extent and rainfall values.

While in some years Swift Parrots can sometimes be spoilt for resources choice, there are some years in which blossom availability is relatively low. During, those low-blossom seasons small areas of blossom that are flowering well can be of great importance to the species. While Swift Parrots regularly use blossom resources, lerps (a leaf-scale insect construction) are an equally, if not more, important foraging resource for them. The site contains two winter flowering tree species that are known to be used regularly by Swift Parrots, Spotted Gum (*C. maculata*) and *Eucalyptus robusta* (Swamp Mahogany). The site also contains one species of tree, which can be subject to lerp infestations, *Eucalyptus pilularis* (Blackbutt).

On the eastern side of the study area, *E. pilularis* and *E. robusta* occur north of the Tumbi Road roundabout and *C. maculata* occurs south from the Tumbi Road roundabout in increasing density to the Wamberal Cemetery grounds, where it dominates the canopy. *C. maculata* is a dominant canopy species on the western side of the study area.

Cave-dwelling Microchiropteran Bats
The study area contains culverts and drainage pipes, which are sometimes used by cave-dwelling microchiropteran bats, but inspection of the culverts found no features within the drainage pipes, which would offer suitable roosting sites for such species. Nevertheless, the study area's forest and woodland habitats provide foraging opportunities for all microchiropteran bat species, due to the insect populations they attract and support. One species of microchiropteran bat, the Little Bent-winged Bat (*Miniopterus australis*) was recorded within the study area during the survey.

A closely related species, the Large Bent-winged Bat (*M. orianae oceanensis*) is also considered very likely to use the site for foraging on an intermittent basis. There are also a number of other threatened cave-dwelling bat species, which occur in the wider locality, but have only been recorded in very small numbers. Although those species may very rarely use the study area for foraging, potential impacts to the study area's wooded habitats would not significantly differ from the impacts to the two Bent-winged Bat species considered the most likely cave-dwelling microchiropteran bat species to use the site on at least an intermittent basis.

The removal of any vegetation within the study area would represent a reduction in potential foraging habitat for Cave-dwelling microchiropteran bats.

Hollow-dwelling Microchiropteran Bats
The study area contains a relatively small number of hollow-bearing trees. The trees that contain hollows represent roosting opportunities for hollow-dwelling microchiropteran bats. Furthermore, the study area's forest and woodland habitats provide foraging opportunities for hollow-dwelling microchiropteran bat species, due to the insect populations they attract and support. No species of hollow-dwelling microchiropteran bat was recorded within the study area during onsite surveys conducted by WSP ecologists. Nevertheless, the very occasional use of the study area's habitats by threatened hollow-dwelling microchiropteran bats cannot be discounted and due to their mobility it is considered likely that such species would occasionally use the study area. The most likely species being *Falsistrellus tasmaniensis* (Eastern False Pipistrelle) and *Micronomus norfolkensis* (Eastern Freetail-bat). Other hollow-

dwelling species, for which there is a paucity of records in the vicinity of the site, may rarely use the study area including *Scoteanax rueppellii* (Large Broad-nosed Bat).

The removal of hollow-bearing trees, and the removal of any vegetation within the study area, would represent a reduction in potential roosting and foraging habitat for Hollow-dwelling microchiropteran bats, respectively.

Powerful Owl – *Ninox strenua*
The study area contains a relatively small number of hollow-bearing trees, none of which are of sufficient size and maturity to produce hollow sizes suited to the breeding purposes of the Powerful Owl. The overall low density of hollows within the study area also place limitations on populations of arboreal mammals, which are the favoured prey of the Powerful Owl. More common arboreal mammals were scarce during nocturnal surveys, with the skull of Common Brushtail Possum being the only evidence that the study area supports a population of arboreal fauna. Although the study area is unlikely to be important to local Powerful Owls, it is likely to fall within the home ranges of local individuals, which may visit it for foraging purposes on an intermittent basis.

Squirrel Glider – *Petaurus norfolcensis*
The study area contains a relatively small number of hollow-bearing trees, with a very low density of hollows in the size range suited to the shelter requirements of Squirrel Gliders. The overall low density of hollows within the study area places limitations on populations of arboreal mammals, such as the Squirrel Glider and more common arboreal mammals were not observed during nocturnal surveys. Although the study area is unlikely to be important to local Squirrel Gliders, it may occur within the home range of local individuals, which may visit it for foraging purposes when seasonal resources are available within its wooded habitats.

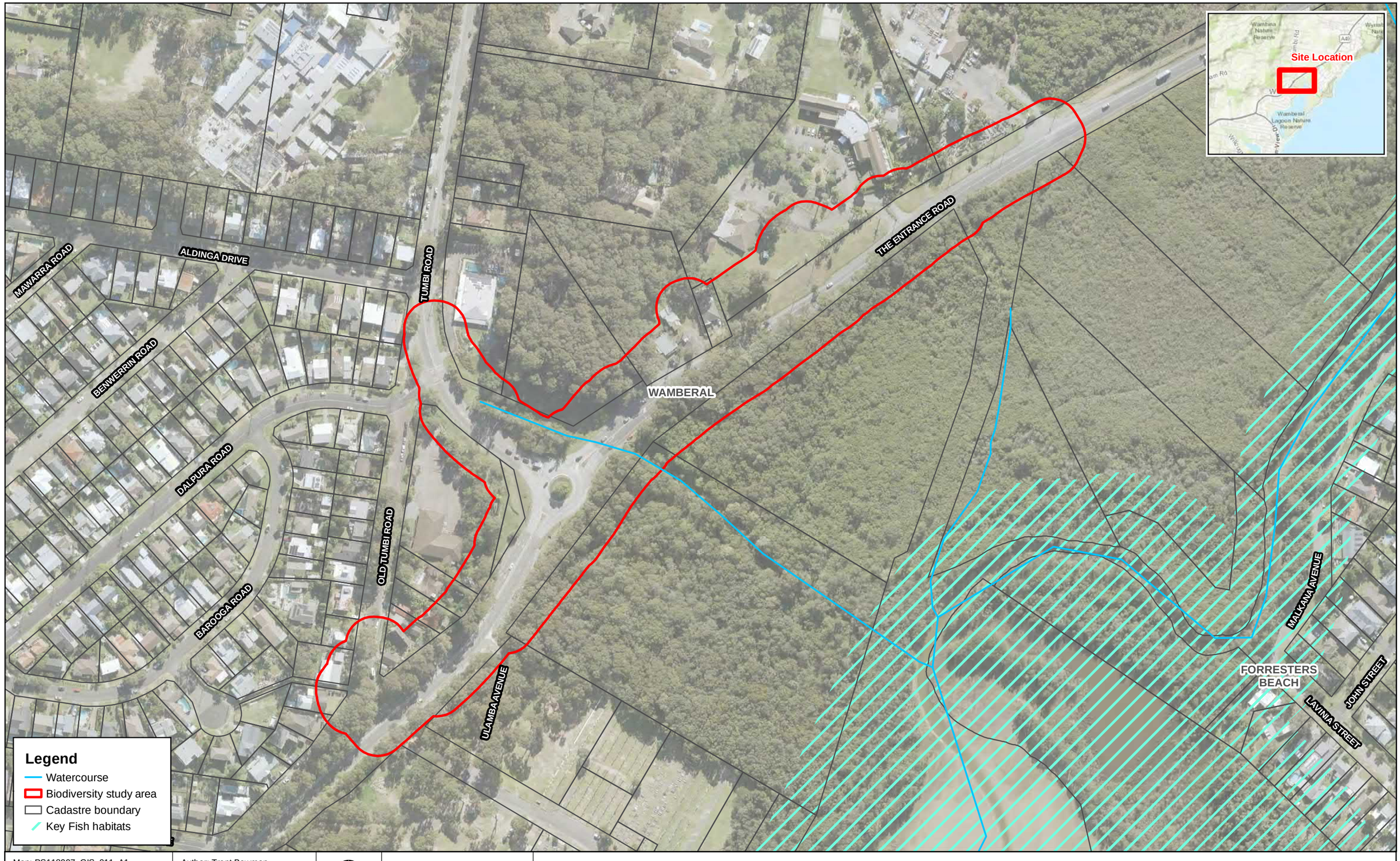
Grey-headed Flying-fox – *Pteropus poliocephalus*
The study area is dominated by forested habitats in which the canopy is dominated by myrtaceous tree species represented by *Eucalyptus* and *Corymbia* species. Canopies within the study area are variously dominated by the following myrtaceous tree species; *Corymbia gummifera* (Red Bloodwood), *C. maculata* (Spotted Gum), *Eucalyptus paniculata* ssp. *paniculata* (Grey Ironbark), *E. pilularis* (Blackbutt), *E. piperita* (Sydney Peppermint), *E. resinifera* ssp. *resinifera* (Red Mahogany), *E. robusta* (Swamp Mahogany), *E. umbra* (False White Mahogany), and *Syncarpia glomulifera* (Turpentine). Of these nine canopy trees eight are known to be used by Grey-headed Flying-foxes. *E. umbra* (False White Mahogany), which occurs within the study at low densities, is the only canopy tree on site not know to be used by Grey-headed Flying-fox. Grey-headed Flying-fox were observed feeding on canopy blossom during nocturnal surveys conducted on 11 March 2020.

The removal of any canopy vegetation within the study area will represent the removal of foraging habitat for the Grey-headed Flying-fox.

3.7 Aquatic habitat

The aquatic habitat in the study area is limited to an unnamed stream (Strahler 1st order stream) which rises within the study area and supports intermittent flow following rain events. The stream appears to have been channelled in previous roadworks and has also been piped through concrete culverts under the existing Central Coast Highway, with a concrete apron on the eastern side as it enters Wamberal Lagoon Nature Reserve.

No Key Fish Habitat has been mapped within the study area or is likely to be affected by the Proposal (Department of Primary Industries, 2020c). The closest area of mapped Key Fish Habitat occurs to the east of the study area within Wamberal Lagoon Nature Reserve (see Figure 3.5).



Map: PS118997_GIS_011_A1	Author: Trent.Bowman
Date: 8/04/2020	Approved by: Mark.Stables

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Coordinate system: GDA 1994 MGA Zone 56
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Figure 3.5
Key Fish Habitat mapping

3.8 Critical habitat

The registers of critical habitat listed under the EPBC Act, BC Act and FM Act searched during the desktop analysis and no critical habitat was found to occur within or in the locality of the study area.

3.9 Wildlife connectivity corridors

Wildlife corridors are generally links of native vegetation that join two or more areas of similar habitat and are critical for sustaining ecological processes, such as provision for animal movement and the maintenance of viable populations (Department of Environment, 2016). The study area is already impacted by fragmentation. Wildlife corridors in association with the study area are fragmented due to the existing Central Coast Highway, the associated power easements both north and south of Central Coast Highway as well as clearing for residential development and for the existing cemetery at the southern end of the study area. Whilst no impassable barriers occur (i.e. significant fencing, water bodies or large areas of development), these open areas are likely to limit and deter fauna from regularly using the study area as a corridor.

However, due to large patches of continuous vegetation occurring on either side of the study area north of the Tumbi Road intersection and the existing road being single lane type, fauna species (especially larger and more mobile species) may still currently cross the study area across the Central Coast Highway. It is unlikely that the study area acts as a key wildlife corridor for fauna and the contiguous vegetation is extensive in the locality particularly to the east within Wamberal Lagoon Nature Reserve and to the north and east through Forresters Beach and then west to Wambina Nature Reserve.

3.10 NSW State Environmental Planning Policy's

There are two NSW State Environmental Planning Policy's (SEPPs) that relate to biodiversity that are considered for the study area. These are:

- SEPP (Coastal Management) 2018
- SEPP (Koala Habitat Protection) 2019

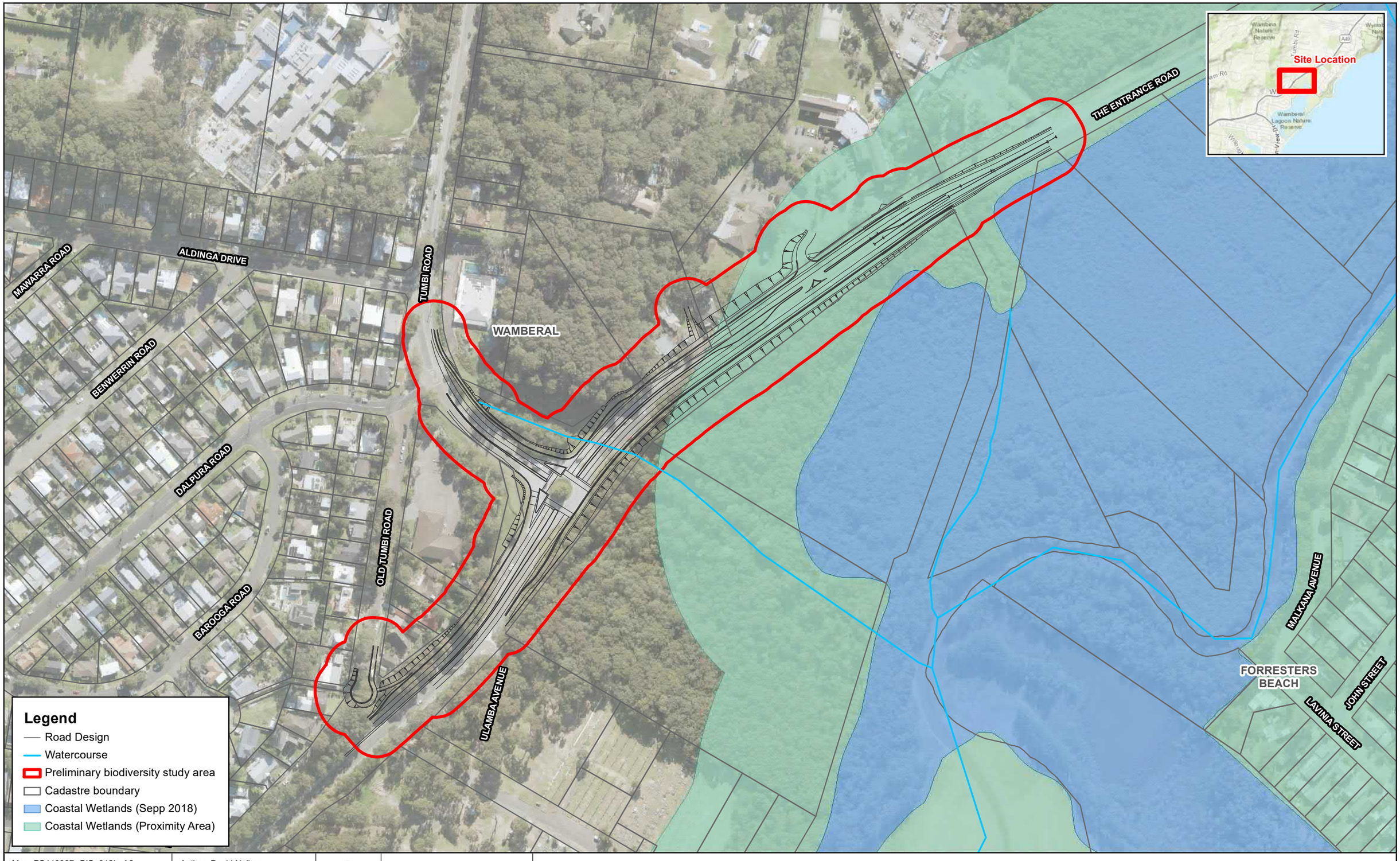
An overview of each SEPP and the relevance to the study area is provided below.

3.10.1 SEPP (Coastal Management) 2018

The State Environmental Planning Policy Coastal Management 2018 (Coastal Management SEPP) was introduced to provide an integrated policy for coastal assets. Under the Coastal Management SEPP, areas of 'Coastal Wetlands' and 'Proximity Coastal Wetlands (100 metre buffer)' have been mapped across the state.

The study area occurs within and immediately adjacent to areas mapped as 'Coastal Wetlands' and 'Proximity Coastal Wetlands (100 metre buffer)' as determined by the Coastal Management SEPP. An overview of the extent of these wetlands and the current design footprint is provided in Figure 3.6.

The proposal has currently been designed to avoid all direct impacts to mapped coastal wetlands and but will unavoidably result in encroachment to the proximity coastal wetlands as the existing Central Coast Highway already sit within the area mapped as this category. Impacts to proximity coastal wetlands can be assessed and if acceptable approved under Part 5.1 of the EP&A Act and will be assessed further in section 4 of this report.



Map: PS118997_GIS_012b_A2	Author: David.Naiken
Date: 14-May-20	Approved by: Mark.Stables

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Coordinate system: GDA 1994 MGA Zone 56
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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community © Department Finance, Services and Innovation 2019

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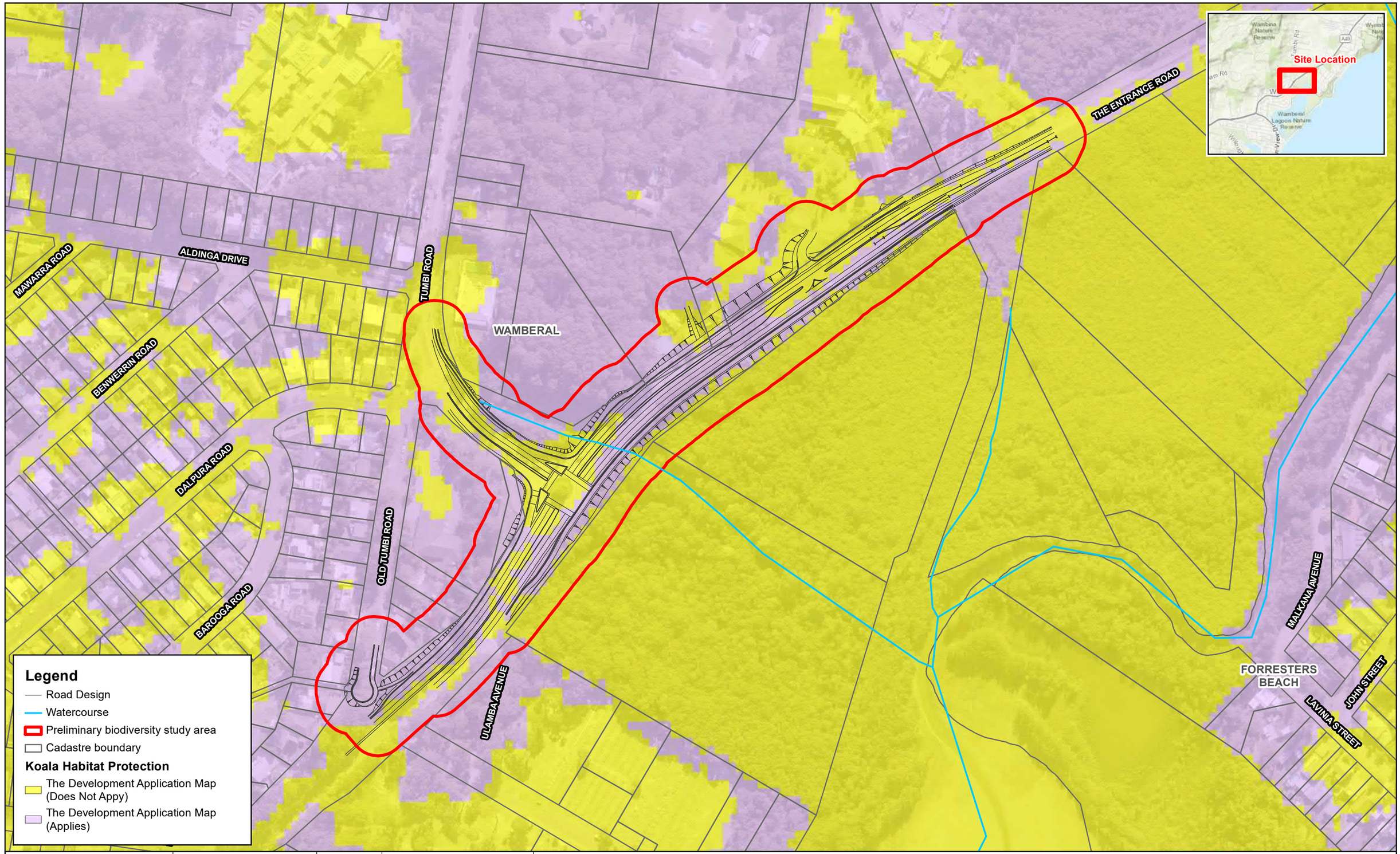
Figure 3.6
NSW State Environmental Planning Policy (Coastal Wetlands) 2018 map



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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community © Department Finance, Services and Innovation 2019

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Figure 3.7
NSW State Environmental Planning Policy (Koala Habitat Protection) 2019 map

3.10.2 SEPP (Koala habitat protection) 2019

The Koala Habitat Protection SEPP came into effect on 1 March 2020. Figure 3.7 shows the mapping as it applies to the locality. Although the study area occurs in the Central Coast LGA which is listed under Schedule 1, the proposal does not require assessment in accordance with the SEPP as it is an activity being considered under Part 5.1 of the EP&A Act.

Nevertheless targeted surveys conducted for the presence of Koala's, including Spot Assessment Technique surveys did not record any evidence of this species within the study area. Impacts in relation to the koala and its habitat have been assessed as part of the broader threatened fauna assessments within this report.

3.11 Matters of National Environmental Significance

The focus of this section is threatened species, populations and communities and migratory species listed under the EPBC Act. It also included a discussion of the following MNES as they relate to biodiversity:

- World and national heritage
- Wetlands of international and national importance.

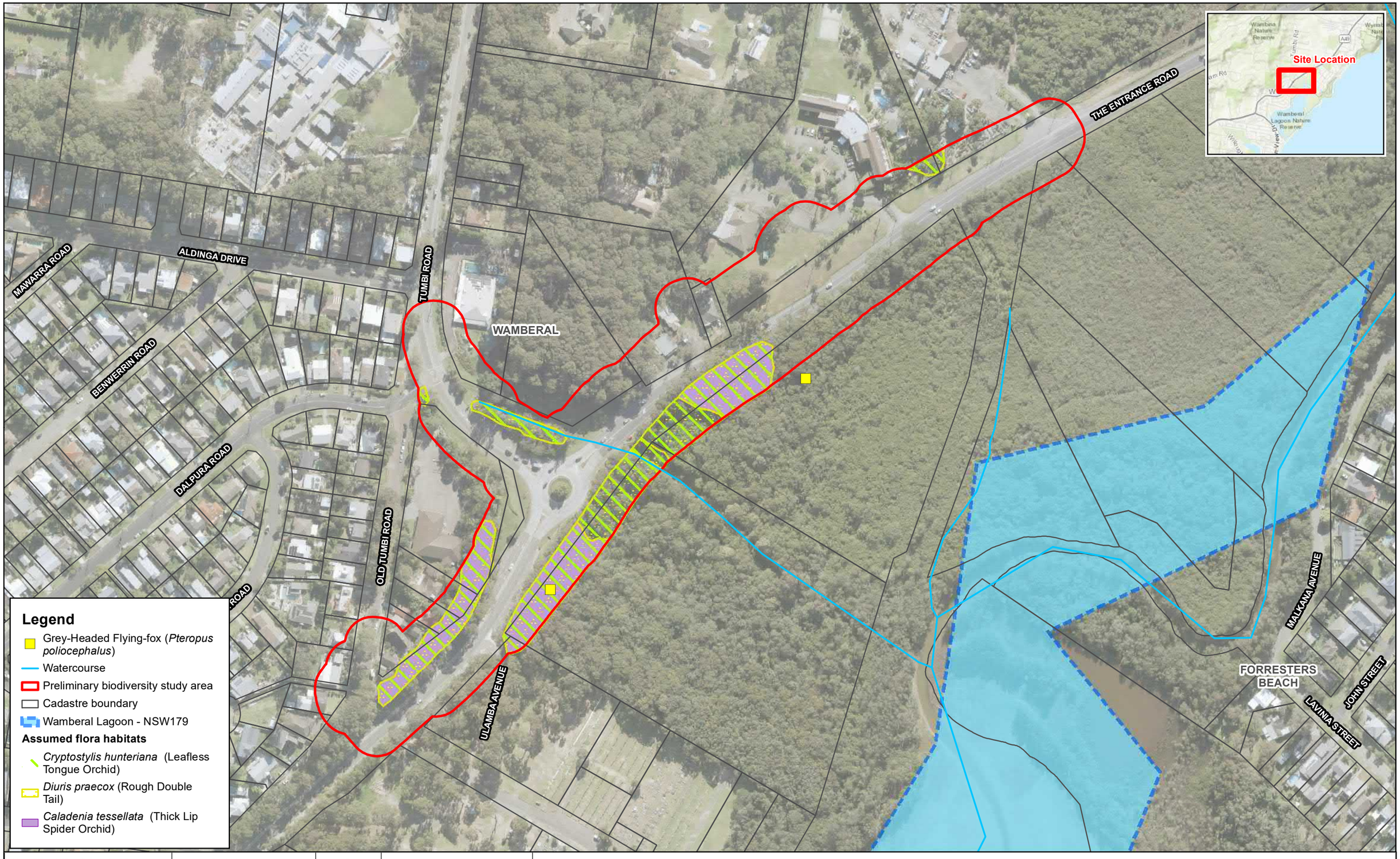
3.11.1 Threatened communities listed under the EPBC Act

No vegetation types recorded within the study area corresponded to any threatened ecological community listed under the EPBC Act.

3.11.2 Threatened flora listed under the EPBC Act

Databased searches identified 19 EPBC Act listed threatened flora species to potentially occur in the locality of the study area. Of these 10 were considered to have a moderate likelihood of occurrence (Table 3.9).

Targeted surveys were undertaken within the study area for these threatened flora species and to date, none have been recorded. Due to seasonality issues around surveys for threatened orchid species, those that have associated habitat within the study area have been assumed to be present. The location of assumed habitat for these species is shown in Figure 3.8. If possible, future targeted surveys for this species can confirm or exclude the presence of these species. Significance assessments for these species have been undertaken and are presented in Appendix C.



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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community © Department Finance, Services and Innovation 2019

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Figure 3.8
Matters of National Environmental Significance

Table 3.9 Threatened flora species listed on the EPBC Act with moderate or higher likelihood of occurrence.

Scientific name	Common Name	Status		Potential occurrence	Affected species?
		BC Act[1]	EPBC Act[2]		
Acacia bynoeana	Bynoes Wattle	E	V	Moderate – although not recorded within the locality associated vegetation occurs within the study area in the form of PCT 1589. This species was not recorded in the study area during targeted surveys.	No - surveyed
Caladenia tessellata	Thick Lip Spider Orchid	E	V	Moderate – on the Central Coast this species is known from three population in the Wyong area. Associated vegetation occurs in the form of PCT 1589. Surveys were conducted outside the known flowering period for this orchid species and as such the presence / absence of this species cannot be confirmed.	Yes – assumed present
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	Moderate – although not recorded within the locality associated vegetation occurs within the study area in the form of PCT 1589 and PCT 1716. Surveys were conducted outside the known flowering period for this orchid species and as such the presence / absence of this species cannot be confirmed.	Yes – assumed present
Diuris praecox	Rough Double Tail	V	V	Moderate – although not recorded within the locality associated vegetation occurs within the study area in the form of PCT 1589 and PCT 1716. Surveys were conducted outside the known flowering period for this orchid species and as such the presence / absence of this species cannot be confirmed.	Yes – assumed present
Eucalyptus camfieldii	Heart-leaved Stringybark	V	V	Moderate – this species is known to occur within the locality with a population occurring to the north of the study area at Forrester Beach. This species was not recorded in the study area during targeted surveys.	No - surveyed
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	V	Moderate – although not recorded within the locality associated vegetation occurs within the study area in the form of PCT 1589. This species was not recorded in the study area during targeted surveys.	No - surveyed
Melaleuca biconvexa	Biconvex Paperbark	V	V	High – this species is known to occur within the locality and associated habitat occurs in the form of PCT 1589 and PCT 1716. This species was not recorded in the study area during targeted surveys.	No - surveyed
Persicaria elatior	Tall Knotweed	V	V	Moderate – this species is not known to occur within the locality although associated habitat occurs in the form of PCT 1716. This species was not recorded in the study area during targeted surveys.	No - surveyed

Scientific name	Common Name	Status		Potential occurrence	Affected species?
		BC Act[1]	EPBC Act[2]		
Rutidosis heterogama	*Heath Wrinklewort*	E	E	Moderate – although not recorded within the locality associated vegetation occurs within the study area in the form of PCT 1589. This species was not recorded in the study area during targeted surveys.	No - surveyed
Thesium australe	Austral toadflax	V	V	Moderate – although not recorded within the locality associated vegetation occurs within the study area in the form of PCT 1589. This species was not recorded in the study area during targeted surveys.	No - surveyed

1. Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the BC Act
2. Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the EPBC Act

3.11.3 Threatened fauna listed under the EPBC Act

Threatened species of fauna listed under the EPBC Act considered to have a moderate or higher likelihood of occurrence within the study area, based on desktop and field-based habitat assessment, are shown in Table 3.10. During the field surveys, the Grey-headed Flying-fox was recorded. The detailed likelihood of occurrence assessment for species considered during the desktop study is presented in Appendix B. Significance assessments for these species have been undertaken and are presented in Appendix C.

Table 3.10 Threatened fauna species listed on the EPBC Act with moderate or higher likelihood of occurrence.

Scientific name	Common Name	Status		Potential occurrence	Affected species?
		BC Act[1]	EPBC Act[2]		
Lathamus discolor	Swift Parrot	E1	CE	Moderate – study area contains winter flowering tree species, which may be used by this species intermittently on a seasonal basis.	Yes
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	**Recorded** – a diverse range of suitable seasonal foraging habitat identified within the study area, with an abundance of local records. Species observed foraging on Red Mahogany blossom (*Eucalyptus resinifera* ssp. *resinifera*).	Yes

1. Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the BC Act
3. Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the EPBC Act

3.11.4 Migratory Species

Migratory species returned from interrogation of Commonwealth, and State databases, were strongly influenced by the study area's relative proximity to Wamberal Lagoon and the Tasman Sea. For this reason, a high proportion of the migratory species listed in Table C1 of Appendix C are represented by shorebirds that inhabit estuarine wetlands, mudflats, sandspits and coastal beaches and rock platforms. There are no habitats within the study area that are suitable for migratory shorebirds, terns, or waterbirds.

Nevertheless, drainages traverse the study area before entering Wamberal Lagoon Nature Reserve and ultimately flows into Wamberal Lagoon. As such, excavation works within the study area have the potential to offer opportunities for substrate materials to be entrained and transported by rainwater, so that effects originating in the study area might be brought to bear

on the habitats of migratory shorebirds occurring outside of the study area boundary, unless managed appropriately.

Database searches also returned a small number of terrestrial migratory species, which are considered likely to use the study area during migratory movements or post-breeding dispersals, such as the Black-faced Monarch, and one species that may use the study area for breeding purposes, the Rufous Fantail. Apart from their migratory status, both species are not otherwise listed as threatened under State, Commonwealth or International legislations, therefore they are not at risk of extinction by works conducted within the study area.

3.11.5 Oceanic Species

In addition to the return of many migratory estuarine fauna, listed as migratory or threatened, within Commonwealth, and State legislations, another group of fauna, oceanic species, were strongly influenced by the study area's relative proximity to the Tasman Sea. Such species as Sea Turtles, Whales, Albatross, Shearwaters and Petrels were returned from database searches. Due to their lack of suitable habitat within the study area or estuarine habitats within the vicinity of the study area, these species were not considered for impact assessment within Table C1 of Appendix C.

3.11.6 Wetlands of international importance

No wetlands of international importance occur within or adjoining the study area.

Of interest is that one wetland of national importance occurs near the study area being Wamberal Lagoon – NSW 179.

A first order ephemeral drainage channel rises within the study area and drains to the southeast into Forresters Creek that discharges into the Wamberal lagoon wetland. The location of the wetland in relation to the study area is shown in Figure 3.8.

3.11.7 World or national heritage

Databases searches revealed no occurrence of any listed world or national heritage places within 10 kilometres of the study area.

4 Impact assessment

The proposal's likely direct and indirect impacts on biodiversity during construction and operational phases are summarised in this chapter. There are a range of potential biodiversity impacts that may occur due to the proposal including:

- Removal of native vegetation
- Removal of threatened fauna species habitat and habitat features
- Removal of threatened plants
- Aquatic impacts
- Impacts to groundwater dependent ecosystems
- Changes to hydrology
- Injury and mortality of fauna
- Alteration to wildlife connectivity and habitat fragmentation
- Edge effects on adjacent native vegetation and habitat
- Invasion and spread of weeds
- Invasion and spread of pests
- Invasion and spread of pathogens and disease
- Noise, light and vibration.

4.1 Construction impacts

4.1.1 Removal of native vegetation

Under the current strategic design, the estimated clearing of native vegetation is about 0.48 hectares consisting of the following PCTs:

- PCT 1589 - Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast
- PCT 1625 - Red Bloodwood -Sydney Peppermint - *Podocarpus spinulosus* shrubby open forest of the southern Central Coast
- PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast

A breakdown of approximate native vegetation removal in each vegetation zone is provided in Table 4.1. The impacts assessed here are based on a worst-case scenario.

The local occurrence of each PCT is defined as the area of the PCT that occurs within the study area and adjacent areas that form part of a larger contiguous area of the PCT, in which movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated. The PCTs within the study area on the south-east side of the Central Coast Highway are connected to the native vegetation within Wamberal Lagoon Nature Reserve. The PCTs in this area are connected and part of the local occurrence. Movement of individuals and exchange of genetic material from the vegetation in the study area to and from the PCTs within the Wamberal Lagoon Nature Reserve can be expected.

The proposal would also result in the removal of about 0.04 ha of miscellaneous ecosystem – landscape plantings and about 0.66 ha of miscellaneous ecosystem – highly disturbed areas with no or limited native vegetation.

Table 4.1 Impacts on native vegetation

Plant community type (PCT)	Condition class	BC Act	EPBC Act	Percent cleared in IBRA region[1]	Proposal area[2] (Ha)
PCT 1589 - Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast	Intact	-	-	71%	0.20
	Modified	-	-		0.04
PCT 1625 - Red Bloodwood -Sydney Peppermint - *Podocarpus spinulosus* shrubby open forest of the southern Central Coast	Intact	-	-	88%	0.15
PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast	Type variant - Intact	E	-	66%	0.09
	Melaleuca nodosa variant - Intact	E	-		0.00
Total native vegetation impacted					0.48

1. Based on the VIS classification database.
4. Area to be cleared based on ground-truthed vegetation mapping within the study area.

4.1.2 Removal of threatened fauna habitat

The extent of vegetation clearing estimated to result from the proposal is outlined above in Section 4.1.1. This vegetation, including planted trees, provides suitable habitat for a range of threatened fauna species listed under the BC Act and EPBC Act. As such, direct impacts to habitat for threatened fauna species (although it is only moderate to poor quality) would occur during construction.

The direct impacts of the proposal to habitats for threatened fauna has been estimated based on the current design and are based on a worst-case scenario. A breakdown of the direct impacts to habitat for threatened fauna species is provided in Table 4.2

Table 4.2 Impacts on threatened fauna and fauna habitat

Species	Potential occurrence	Impacted by proposal?	Impact (ha/ individuals)
Crinia tinnula (Wallum Froglet)	Moderate	Yes	0.09
Callocephalon fimbriatum (Gang-Gang Cockatoo)	Moderate	Yes	0.48
Daphoenositta chrysoptera (Varied Sittella)	Moderate	Yes	0.48
Falsistrellus tasmaniensis (Eastern False Pipistrelle)	Moderate	Yes	0.48
Glossopsitta pusilla (Little Lorikeet)	Moderate	Yes	0.48
Lathamus discolor (Swift Parrot)	Moderate	Yes	0.48
Lophoictinia isura (Square-tailed Kite)	Moderate	Yes	0.48
Micronomus norfolkensis (Eastern Freetail-bat)	Moderate	Yes	0.48
Miniopterus australis (Little Bent-winged Bat)	Recorded	Yes	0.48
Miniopterus orianae oceanensis (Large Bent-winged Bat)	Moderate	Yes	0.48
Ninox strenua (Powerful Owl)	Moderate	Yes	0.48
Petaurus norfolcensis (Squirrel Glider)	Moderate	Yes	0.48
Pteropus poliocephalus (Grey-headed Flying-fox)	Recorded	Yes	0.48

4.1.3 Removal of threatened flora

There will be no direct impacts to any recorded threatened flora species. Impacts will be restricted to habitat associated with three assumed present threatened orchid species.

One threatened flora species, *Rhodamnia rubescens* (Scrub Turpentine), listed as Critically Endangered under the BC Act, was recorded within the study area. This species was recorded within Wamberal Lagoon Nature Reserve and will not be directly impacted and is unlikely to be affected by any indirect impacts.

Assumed presence of *Caladenia tessellata* (Thick Lip Spider Orchid), *Cryptostylis hunteriana* (Leafless Tongue Orchid) and *Diuris praecox* (Rough Double Tail) is based on associated vegetation being present within the study area and because surveys were conducted outside the known flowering period for these species.

The direct impacts of the proposal to threatened plant species has been estimated based on the current design. A breakdown of the direct impacts to threatened flora species and their habitats is provided in Table 4.3. Impacts upon the suitable habitat of these orchids overall is comparatively minor in a local context.

Table 4.3 Impacts on threatened flora

Species	Potential occurrence	Impacted by proposal?	Impact (ha/ individuals)
Caladenia tessellata (Thick Lip Spider Orchid)	Assumed present	Yes – potential habitat PCT 1589	0.20 ha
Cryptostylis hunteriana (Leafless Tongue Orchid)	Assumed present	Yes – potential habitat PCT 1589 & 1716	0.29 ha
Diuris praecox (Rough Double Tail)	Assumed present	Yes – potential habitat PCT 1589 & 1716	0.29 ha
Rhodamnia rubescens (Scrub Turpentine)	Recorded	No – avoided	0 individuals

4.1.4 Aquatic impacts

The first order drainage line to be affected by the proposal is in poor condition due to previous development, modification and activity within the catchment which has resulted in changes to hydrological conditions, increased input of nutrients, sedimentation and weed invasion. As outlined in Appendix B, no threatened species listed under the FM Act are likely to occur in these streams due to their poor condition and lack of characteristic habitat features associated with threatened species.

As discussed in Section 3.7, the aquatic habitat in the study area is limited to an unnamed stream (Strahler 1st order stream) with intermittent flow following rain events. The stream been modified during previous road construction and has been piped through concrete culverts under the existing Central Coast Highway and has a concrete apron on the eastern side as it flows into Wamberal Lagoon Nature Reserve. The stream within the study area is not a Type 1, Type 2 or Type 3 sensitive key fish habitat. There are no Class 1 (major key fish habitat), Class 2 (moderate key fish habitat) or Class 3 (minimal key fish habitat) waterways in the study area. As such, there would be no impacts to sensitive or key fish habitats.

Impacts to aquatic habitat would be of low magnitude and standard mitigation measures would be implemented to limit impacts (see Section 5).

4.1.5 Injury and mortality

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

that may be impacted during vegetation removal. Reptiles and frogs may also be impacted during construction as habitat is cleared.

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

There is a chance of fauna mortality during the operational phase of the proposal through vehicle collision (i.e. roadkill). Vehicle collision is a direct impact that reduces local population numbers. Mammals, reptiles, amphibians and birds are all at risk of vehicle strike. As there are no definitive data on current rates of roadkill or fauna population densities in the study area, the consequences of vehicle strike on local populations is unknown. With the expansion of an existing road the risk of vehicle strike should remain in a similar level to that currently experienced but the significance of such an impact cannot be predicted. The impact on threatened species however is expected to be minimal. Based on evidence from other roadways in the locality most vehicle strike impacts can be expected to occur to common mammals such as birds and possums and exotic animals including foxes.

Mitigation measures designed to reduce an injury and mortality of fauna are provided in Section 5.

4.2 Indirect/operational impacts

4.2.1 Wildlife connectivity and habitat fragmentation

Habitat fragmentation *per se* relates to the physical dividing up of once continuous habitats into separate smaller 'fragments'. The habitats within the study area are fragments that have formed since the initial habitat clearing that has occurred. The current alignment of the Central Coast Highway and Tumbi Road divide the remaining habitats in the study area. The barrier posed by the existing Central Coast Highway and Tumbi Road serve to restrict fauna movements between habitat patches. However, functional habitat connectivity for more mobile species (e.g. birds, flying-foxes, insectivorous bats, insects, plants) is still present. The current roadways do not totally prevent fauna movement between habitat fragments (fauna can and likely do cross the road) but the roads do create a considerable hazard.

The proposal would not break apart continuous habitats into separate smaller fragments. The proposal would however result in an increase in isolation of habitats as the current habitat patches would be made smaller which would increase the physical distance between habitat fragments. The isolation that may be caused by the proposal is not likely to have an appreciable impact on nomadic or migratory species such as birds. The proposal is likely to be detrimental to the dispersal of arboreal mammals and other species including frogs and reptiles, but the effects would only be marginally greater than that which is already experienced.

The predicted level of isolation from the proposal is not likely to be enough to prevent the breeding and dispersal of plant pollinators or the dispersal of plant propagules (i.e. seed or other vegetative reproductive material) between habitat patches. Functional connectivity for many species would remain in the study area. However, local division of some wildlife populations, isolation of key habitat resources, loss of genetic interchange, and loss of population viability for some species may result.

This impact would be of low magnitude and specific mitigation measures are not deemed to be necessary.

4.2.2 Edge effects on adjacent native vegetation and habitat

The development of linear infrastructure is known to cause disturbance in terms of reducing habitat quality in adjacent areas. This is due to the greater potential for edge effects and habitat fragmentation and barrier effects due to the high perimeter to area ratio of linear developments. The proposal would be built in an area that is currently subject to a high level of edge effects

from the existing roadways and urban development. The proposal has been designed to avoid impacts on Wamberal Lagoon Nature Reserve and is restricted to existing edge affected areas. Post construction landscapes should be restricted to native local indigenous plants and as such this impact would be of low magnitude and additional mitigation measures are not deemed necessary.

4.2.3 Invasion and spread of weeds

Proliferation of weed and pest species is an indirect impact (i.e. not a direct result of proposal activities). Proliferation of weeds is likely to occur during construction and operation, although impacts would be greatest because of vegetation clearing during the construction phase. The most likely causes of weed dispersal and importation associated with the proposal include earthworks, movement of soil, and attachment of seed (and other propagules) to vehicles and machinery during all phases. The study area contains significant weed growth and no undisturbed weed free habitat exists. As such, weeds must be managed during construction.

Mitigation measures designed to limit the spread and germination of weeds are provided in Section 5.

4.2.4 Invasion and spread of pests

The study area is currently habitat for a range of commonly occurring pest species including European Fox and possibly rabbits. Proposal activities have the potential to disperse pest species out of the proposal footprint across the surrounding landscape, but the magnitude of this impact would be low and mitigation measures are not deemed necessary.

4.2.5 Invasion and spread of pathogens and disease

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

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

These three pathogens have all been recorded in the Sydney Basin bioregion and have potential to occur on within the proposal site at present or in the future. The occurrence of Myrtle rust was observed on an individual of the threatened plant species, *Rhodamnia rubescens* (Scrub Turpentine). This exotic rust is highly mobile and widely dispersed in coastal NSW and no cost-effective control measure is currently available.

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

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

Pathogens would be managed within the proposal site according to the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (NSW Roads and Traffic Authority, 2011) (see Section 5).

4.2.6 Changes to hydrology

The existing hydrological conditions of the project are already affected by altered landform and altered stormwater runoff and velocity because of surrounding land uses and existing roads. The project may result in further alteration to the hydrology of the study area due to an increase in surface runoff.

It is recommended that the stormwater design for the Proposal project be done in accordance with 'Managing urban stormwater: Soils and construction, Volume 2D: Main Road Construction, Sydney' (Blue Book) (Department of Environment & Climate Change, 2008) to avoid potential impacts to surrounding native vegetation communities.

4.2.7 Noise, light and vibration

Considering the existing levels of noise and vibration from the surrounding urban development and the high levels of use of the existing Central Coast Highway and Tumbi Road by vehicles, it is unlikely there would be a significant increase in noise and vibration during operation of the road that would result in any increased impacts to biodiversity within the study area. There is however potential for impacts to locally common fauna from noise and vibration during construction, which may result in fauna temporarily avoiding habitats adjacent to the construction, however traffic noise is likely to be significant deterrent to most fauna groups already. The magnitude of this impact would be low and mitigation measures are not deemed necessary.

Lighting maybe used at night to enable work to be completed that may result in impacts to nocturnal fauna. Nocturnal species such as possums and microbats may avoid the habitat in the study area during construction as temporary 'daylight' conditions would be created by the mobile lighting system. This impact is considered temporary and would not have long lasting effects on the biodiversity of the study area. The magnitude of this impact would be low and mitigation measures are not deemed necessary.

4.2.8 Groundwater dependent ecosystems

The PCTs within the study area are likely to be opportunistic facultative GDEs that depend on the subsurface presence of groundwater (often accessed via the capillary fringe – subsurface water just above the water table) when an alternative source of water (i.e. rainfall) cannot be accessed to maintain ecological function. The proposal would impact on these PCTs (see Section 4.1.1).

4.3 Cumulative impacts

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

There are no substantial developments or projects nearby that would impact significantly on biodiversity. Several isolated property development applications in the surrounding residential areas of Wamberal and Forresters Beach exist which may have limited impacts on biodiversity. Publicly available information in Statement of Environment Effects for these developments do not provide sufficient information regarding impacts on biodiversity.

4.4 Assessments of significance

An Assessment of Significance has been conducted for threatened species and ecological communities that have been positively identified within the study area or that are considered to have a moderate or high likelihood of occurring in the study area due to the presence of suitable habitat.

The proposed works would be assessed under Part 5, Division 5.1 of the EP&A Act. Section 7.3 of the BC Act outlines the 'test of significance' that is to be undertaken to assess the likelihood of significant impact upon threatened species or ecological communities listed under the BC Act. Assessments were undertaken in accordance with the guidelines provided in the *Threatened Species Test of Significance Guidelines: The Assessment of Significance* (Office of Environment & Heritage, 2018) which outlines a set of guidelines to help applicants/proponents of a development or activity with interpreting and applying the factors of assessment in the former 'seven-part test'. The guidance provided by the Department of Environment and Climate Change (2007) has been used here in preparing these tests of significance and in determining whether there is likely to be a significant effect to a threatened species, population or ecological community listed under the BC Act.

Full details of assessment of significance under the BC Act are presented in Appendix C. The conclusions of the EP&A Act assessment are provided in Table 4.5, which indicates that a significant effect is considered unlikely on any threatened species or ecological communities listed under the BC Act.

Table 4.4 Summary findings of the BC Act test of significance

Biodiversity Conservation Act 2016 test of significance						
Threatened species, or communities	**Significance assessment question[1]**					**Likely significant effect?**
	a	**b**	**c**	**d**	**e**	
Swamp Sclerophyll Forest on Coastal Floodplain	X	N	N	N	Y	Unlikely
Caladenia tessellata (Thick Lip Spider Orchid)	N	X	N	N	Y	Unlikely
Cryptostylis hunteriana (Leafless Tongue Orchid)	N	X	N	N	Y	Unlikely
Diuris praecox (Rough Double Tail)	N	X	N	N	Y	Unlikely
Rhodamnia rubescens (Scrub Turpentine)	N	X	N	N	Y	Unlikely
Crinia tinnula (Wallum Froglet)	N	X	N	N	Y	Unlikely
Callocephalon fimbriatum (Gang-Gang Cockatoo)	N	X	N	N	Y	Unlikely
Daphoenositta chrysoptera (Varied Sittella)	N	X	N	N	Y	Unlikely
Falsistrellus tasmaniensis (Eastern False Pipistrelle)	N	X	N	N	Y	Unlikely
Glossopsitta pusilla (Little Lorikeet)	N	X	N	N	Y	Unlikely
Lathamus discolor (Swift Parrot)	N	X	N	N	Y	Unlikely
Lophoictinia isura (Square-tailed Kite)	N	X	N	N	Y	Unlikely
Micronomus norfolkensis (Eastern Freetail-bat)	N	X	N	N	Y	Unlikely
Miniopterus australis (Little Bent-winged Bat)	N	X	N	N	Y	Unlikely
Miniopterus orianae oceanensis (Large Bent-winged Bat)	N	X	N	N	Y	Unlikely
Ninox strenua (Powerful Owl)	N	X	N	N	Y	Unlikely
Petaurus norfolcensis (Squirrel Glider)	N	X	N	N	Y	Unlikely
Pteropus poliocephalus (Grey-headed Flying-fox)	N	X	N	N	Y	Unlikely

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

1. Significance Assessment Questions as set out in the *Biodiversity Conservation Act 2016:*
   - 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.
   - b in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
     - (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
     - (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

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.

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),

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

For threatened biodiversity listed under the EPBC Act, significance assessments have been completed in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Department of Environment, 2013). Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment that is affected, and upon the intensity, duration, magnitude and geographic extent of the impacts (Department of Environment, 2013). Importantly, for a 'significant impact' to be 'likely', it is not necessary for a significant impact to have a greater than 50 per cent chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility (Department of Environment, 2013). This advice has been considered while undertaking the assessments.

A significant impact is considered unlikely for any Matter of NES and a referral of the proposal would not be required (see Table 4.6). Full details of the assessment of significance for threatened species under the EPBC Act are presented in Appendix C.

Table 4.5 Summary findings of the EPBC Act significance assessments

Species/Ecological Community	*Assessment of significance questions (EPBC Act)									Important Population+	Likely Significant Impact
	1	2	3	4	5	6	7	8	9		
Vulnerable species+											
Caladenia tessellata (Thick Lip Spider Orchid)	N	N	N	N	N	N	N	N	N	N	Unlikely
Cryptostylis hunteriana (Leafless Tongue Orchid)	N	N	N	N	N	N	N	N	N	N	Unlikely
Diuris praecox (Rough Double Tail)	N	N	N	N	N	N	N	N	N	N	Unlikely
Pteropus poliocephalus (Grey-headed Flying-fox)	N	N	N	N	N	N	N	N	N	N	Unlikely
Critically Endangered species											
Lathamus discolor (Swift Parrot)	N	N	N	N	N	N	N	N	N	N	Unlikely

Notes: Y= Yes (negative impact), N= No (no or positive impact), X= not applicable, ?= unknown impact.
An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

1) reduce the extent of an ecological community
2) fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines
3) adversely affect habitat critical to the survival of an ecological community
4) 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
5) 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
6) 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
7) interfere with the recovery of an ecological community.

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

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

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

1) lead to a long-term decrease in the size of an important population of a species
2) reduce the area of occupancy of an important population
3) fragment an existing important population into two or more populations
4) adversely affect habitat critical to the survival of a species
5) disrupt the breeding cycle of an important population
6) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
7) result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
8) introduce disease that may cause the species to decline, or
9) interfere substantially with the recovery of the species.

An important population as determined by the EPBC Act is a population of a vulnerable species that is likely to be key source populations either for breeding or dispersal, is likely to be necessary for maintaining genetic diversity, or is at or near the limit of the species range. The Grey-headed Flying-fox exists as one interconnected population along the east coast of Australia. Therefore, it is considered an important population for the purposes of this assessment.

4.5 Impact summary

A summary of potential impacts that have been addressed in this report are presented in Table 4.6

Table 4.6 Summary of impacts

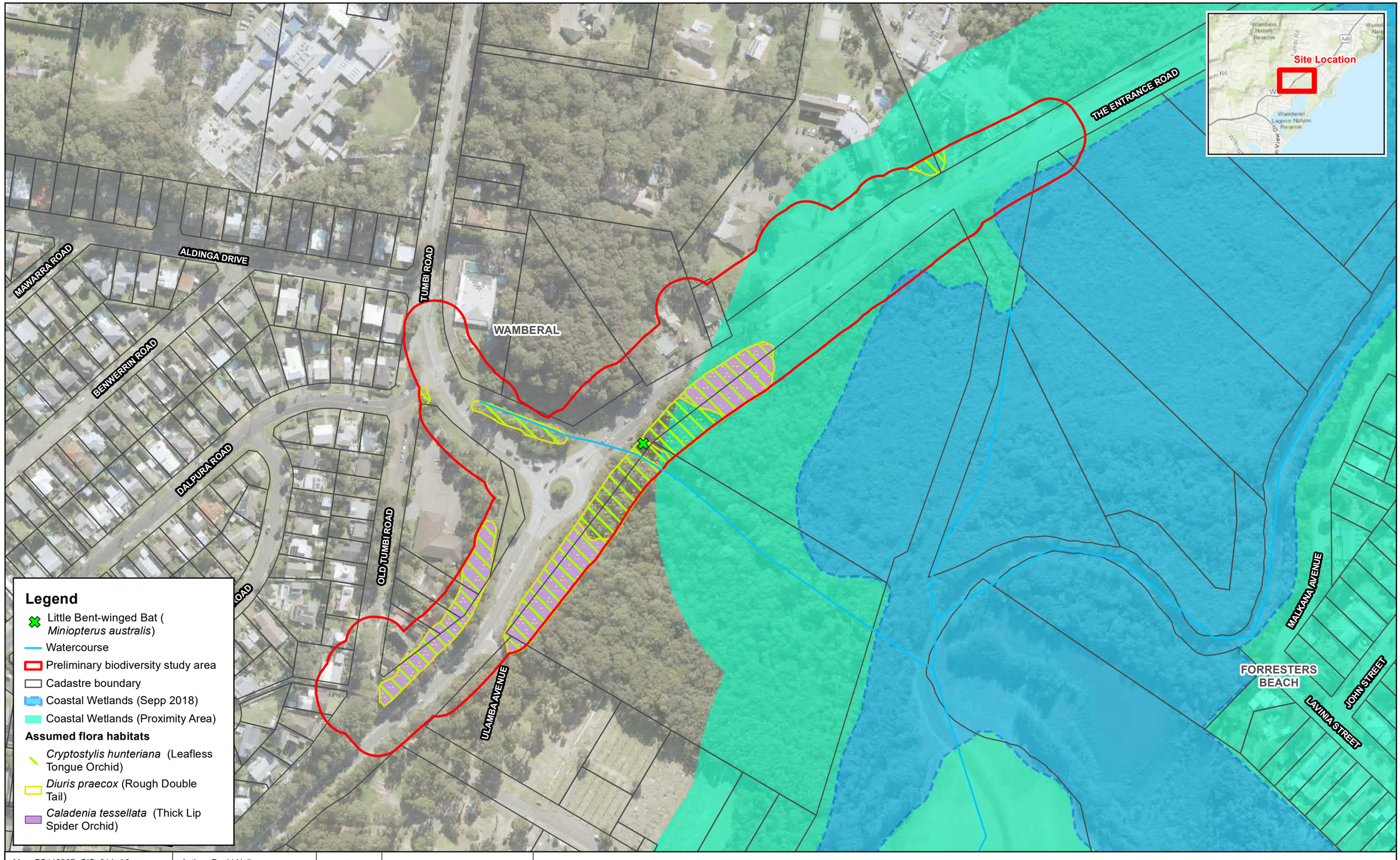
Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?	Confidence in assessment
Removal of native vegetation	Native vegetation	Direct	0.48 ha	Long term	• Clearing of native vegetation	Known
	Swamp Sclerophyll Forest on Coastal Floodplain	Direct	0.09 ha	Long term	• Clearing of native vegetation	Known
Removal of threatened fauna habitat	Applicable to the following Threatened species: *Crinia tinnula* (Wallum Froglet) *Callocephalon fimbriatum* (Gang-Gang Cockatoo) *Daphoenositta chrysoptera* (Varied Sittella) *Falsistrellus tasmaniensis* (Eastern False Pipistrelle) *Glossopsitta pusilla* (Little Lorikeet) *Lathamus discolor* (Swift Parrot) *Lophoictinia isura* (Square-tailed Kite) *Micronomus norfolkensis* (Eastern Freetail-bat) *Miniopterus australis* (Little Bent-winged Bat) *Miniopterus orianae oceanensis* (Large Bent-winged Bat) *Ninox strenua* (Powerful Owl)	Direct	0.48 ha	Long term	• Clearing of native vegetation • Bushrock removal • Loss of hollow-bearing trees • Loss or degradation (or both) of sites used for hill-topping by butterflies • Removal of dead wood and dead trees	Known

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?	Confidence in assessment
	Petaurus norfolcensis (Squirrel Glider) *Pteropus poliocephalus* (Grey-headed Flying-fox)					
Removal of threatened flora	*Caladenia tessellata* (Thick Lip Spider Orchid) *Cryptostylis hunteriana* (Leafless Tongue Orchid) *Diuris praecox* (Rough Double Tail) *Rhodamnia rubescens* (Scrub Turpentine)	Direct	<0.3 ha	n/a	• Clearing of native vegetation	Assumed to be present based on suitable habitats. Note the known *Rhodamnia rubescens* is to be retained and protected.
Aquatic impacts	Applicable to a 1st order ephemeral stream	Direct / indirect	Site based	Short term	• Instream structures and other mechanisms that alter natural flow	Known
Injury and mortality of fauna	Applicable to less mobile or sedentary fauna	Direct	Site based	Short term	n/a	Known
Wildlife connectivity and habitat fragmentation	Applicable to less mobile or sedentary fauna	Direct / indirect	Local	Long term	• Clearing of native vegetation	Known
Edge effects on adjacent native vegetation and habitat	Swamp Sclerophyll Forest on Coastal Floodplain	Indirect	Local	Lome term	• Clearing of native vegetation • Invasion and establishment of exotic vines and scramblers • Invasion, establishment and spread of *Lantana camara* • Invasion of native plant communities by Bitou bush and Boneseed (*Chrysanthemoides monilifera*) • Invasion of native plant communities by exotic perennial grasses • Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants.	Known

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?	Confidence in assessment
Invasion and spread of weeds	Swamp Sclerophyll Forest on Coastal Floodplain	Indirect	Local / Regional	Long term	• Invasion and establishment of exotic vines and scramblers • Invasion and establishment of Scotch broom (*Cytisus scoparius*) • Invasion of native plant communities by African Olive (*Olea europaea* L. subsp. *cuspidata)* • Invasion, establishment and spread of *Lantana camara* • Invasion of native plant communities by Bitou bush and Boneseed *(Chrysanthemoides monilifera*) • Invasion of native plant communities by exotic perennial grasses • Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	Known
Invasion and spread of pests	Applicable to all flora and fauna species and habitat	Indirect	Local / Regional	Long term	• Competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*) • Competition and habitat degradation by feral goats (*Capra hircus*) • Herbivory and environmental degradation caused by feral deer • Invasion and establishment of the cane toad (*Bufo marinus*) • Predation and hybridisation of feral dogs (*Canis lupus familiaris*) • Predation by the European red fox (*Vulpes vulpes*) • Predation by the feral cat (*Felis catus*) • Predation by Plague Minnow or Mosquito Fish *(Gambusia holbrooki*)	Known

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?	Confidence in assessment
					• Predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*)	
Invasion and spread of pathogens and disease	Applicable to all flora and fauna species and habitat	Indirect	Local / Regional	Long term	• Infection of native plants by *Phytophthora cinnamomi* • Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae • Infection by psittacine circoviral (beak and feather) disease affecting endangered psittacine species and populations • Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	Known
Groundwater dependent ecosystems	Swamp Sclerophyll Forest on Coastal Floodplain	Indirect - operational	Local	Long term	• Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	Known
Changes to hydrology	Swamp Sclerophyll Forest on Coastal Floodplain	Direct/ indirect	Local	Long term	• Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	Known
Noise, light and vibration	Applicable to all fauna species	Direct/ indirect	Local	Long term	N/A	Known

Figure 4.1 outlines potential impacts to occur to biodiversity within the study area.



Map: PS118997_GIS_014_A2	Author: David.Naiken
Date: 14-May-20	Approved by: Mark.Stables

0 30 60 m

1:2,500

Coordinate system: GDA 1994 MGA Zone 56
Scale ratio correct when printed at A3

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community © Department Finance, Services and Innovation 2019

Central Coast Highway and Tumbi Road intersection upgrade, Wamberal

Figure 4.1
Impacts on Biodiversity Values

5 Avoid, minimise and mitigate impacts

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

1. Avoid and minimise impacts as the highest priority
2. Mitigate impacts where avoidance is not feasible or practicable in the circumstance
3. Offset where residual, significant unavoidable impacts would occur.

5.1 Avoidance and minimisation

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

A Preliminary Biodiversity Investigation (PEI) (Roads and Maritime 2019) was prepared during the early stages of concept design development which identified the occurrence of Wamberal Lagoon Nature Reserve and SEPP Coastal Wetland as areas of high biodiversity value that should be avoided. By avoiding these biodiversity values for the proposal, a project REF was deemed to be the best approach for assessment.

The primary method to avoid impacts is to locate activities away from areas of known or potential high biodiversity value. In identifying suitable work sites, the first preference is to locate existing cleared and disturbed areas that have good access, are not within immediate proximity to waterways, and that support good site management practices (for example, management of material stockpiles). Proposal compound sites will be proposed in highly disturbed areas to avoid impacts to biodiversity, wherever possible. Design refinements would be undertaken in the concept design and detailed design phase to reduce the scope of the overall impact to biodiversity.

5.2 Mitigation measures

Once all practicable steps to avoid or minimise impacts have been implemented at the detailed design phase, mitigation measures would be implemented to lessen the potential ecological impacts of the proposal. Mitigation measures are to be undertaken during the construction and operational phases. The Roads and Maritime (now Transport) guidelines and procedures identify a range of mitigation techniques to be applied, including managing the vegetation clearing process, re-establishment of native vegetation at the end of a project, weed management, provision of supplementary fauna habitat (such as nest boxes for appropriate species), and installation of erosion and sediment controls as appropriate.

The following mitigation measures as outlined in the Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects (NSW Roads and Traffic Authority, 2011) are recommended for implementation (see Table 5.1). The NSW DPI (Fisheries) document *Policy and Guidelines for fish habitat conservation and management (2013 update)* (Department of Primary Industries, 2013) has also been used.

Table 5.1 Proposed mitigation measures

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
Removal of native vegetation	Native vegetation removal will be minimised through detailed design.	Detailed design	Effective	The predicted residual impact to native vegetation species habitat is estimated at up to 0.48 ha.
	Pre-clearing surveys will be undertaken in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Prior to construction	Effective	
	Vegetation removal will be undertaken in accordance with *Guide 4: Clearing of vegetation and removal of bushrock* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective	
	Native vegetation will be re-established in accordance with *Guide 3: Re-establishment of native vegetation* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Post construction	Effective	
	The unexpected species find procedure is to be followed under *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the proposal site.	During construction	Proven	
Removal of threatened species habitat and habitat features	Habitat removal will be minimised through detailed design.	Detailed design	Effective	The predicted residual impact to threatened species habitat is estimated at up to 0.48 ha of habitat.
	Habitat removal will be undertaken in accordance with *Guide 4: Clearing of vegetation and removal of bushrock* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective	
	Habitat will be replaced or re-instated in accordance with *Guide 5: Re-use of woody debris and bushrock* and *Guide 8: Nest boxes* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) or any updated approaches to tree hollow replacement such as relocated hollows or created hollows.	During construction	Proven	
	The unexpected species find procedure is to be followed under *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) if threatened fauna, not assessed in the biodiversity assessment, are identified in the proposal site.	During construction	Proven	

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
Removal of threatened plants	Pre-clearing surveys will be undertaken in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Proven	No residual impact is anticipated
	The unexpected species find procedure is to be followed under *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) if threatened flora species, not assessed in the biodiversity assessment, are identified in the proposal site.	During construction	Proven	
Aquatic impacts	Aquatic habitat will be protected in accordance with *Guide 10: Aquatic habitats and riparian zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) and Section 3.3.2 *Standard precautions and mitigation measures* of the *Policy and guidelines for fish habitat conservation and management Update 2013* (DPI (Fisheries NSW) 2013).	During construction	Effective	Minor, localised, modification to already highly disturbed habitat
Groundwater dependent ecosystems	Interruptions to water flows associated with groundwater dependent ecosystems will be minimised through detailed design.	Detailed design	Effective	As per PCT impacts
Changes to hydrology	Changes to existing surface water flows will be minimised through detailed design.	Detailed design	Effective	No residual impact is anticipated
Fragmentation of identified habitat corridors	Connectivity measures will be implemented in accordance with the *Wildlife Connectivity Guidelines for Road Projects* (RTA 2011).	Detailed design, during construction and post construction	Effective	No residual impact is anticipated
Edge effects on adjacent native vegetation and habitat	Exclusion zones will be set up at the limit of clearing in accordance with *Guide 2: Exclusion zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective	No residual impact is anticipated
Injury and mortality of fauna	Fauna will be managed in accordance with *Guide 9: Fauna handling* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective	The mitigation measures should be effective, but injury or death may still occur
Invasion and spread of weeds	Weed species will be managed in accordance with *Guide 6: Weed management* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective	None as the proposed control measures are known to be effective

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
Invasion and spread of pests	Pest species will be managed within the proposal site.	During construction	Effective	None expected
Invasion and spread of pathogens and disease	Pathogens will be managed in accordance with *Guide 2: Exclusion zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective	None as the proposed control measures are known to be effective
Noise, light and vibration	Artificial light impacts will be minimised where practicable taking into account minimum luminescence requirements for an urban road as outlined in the Australian Standards through detailed design.	Detailed design	Effective	Impacts from noise and light spill would remain

6 Offset strategy

6.1 Quantification of impacts

Although efforts have been made to avoid, minimise and mitigate potential ecological impacts from the proposal, some residual impacts would occur. This biodiversity assessment identifies that the proposal is not likely to have a significant impact on any threatened biodiversity listed under the BC Act or EPBC Act (see Section 4.4 and Appendix C). In this instance, and due to the Strategic Assessment, the EPBC Act environmental offsets policy does not apply.

Transport would provide biodiversity offsets or where offsets are not reasonable or feasible, supplementary measures for impacts that exceed the thresholds in Table 6.1.

Table 6.1 Transport offset thresholds

Description of activity or impact	Consider offsets or supplementary measures	Does the proposal trigger an offset
Activities in accordance with Transport for NSW Services Environmental assessment procedure: Routine and Minor Works (RTA 2011)	No	No
Works on cleared land, plantations, exotic vegetation where there are no threatened species or habitat present	No	No
Works involving clearing of vegetation planted as part of a road corridor landscaping program (this includes where threatened species or species comprising listed ecological communities have been used for landscaping purposes)	No	No
Works involving clearing of national or NSW listed critically endangered ecological communities (CEEC)	Where there is any clearing of a CEEC in moderate to good condition	No
Works involving clearing of nationally listed threatened ecological community (TEC) or nationally listed threatened species habitat	Where clearing >1 ha of a TEC or habitat in moderate to good condition	No
Works involving clearing of NSW endangered or vulnerable ecological community	Where clearing > 5 ha or where the ecological community is subject to an SIS	No
Works involving clearing of NSW listed threatened species habitat where the species is a species credit species as defined in the OEH Threatened Species Profile Database (TSPD)	Where clearing > 1ha or where the species is the subject of an SIS	No
Works involving clearing of NSW listed threatened species habitat and the species is an ecosystem credit species as defined in OEH's Threatened Species Profile Database (TSPD)	Where clearing > 5ha or where the species is the subject of an SIS	No
Type 1 or Type 2 key fish habitats (as defined by NSW Fisheries)	Where there is any net loss of habitat	No

Implementation of the Roads and Maritime Services *Guideline for Biodiversity Offsets* (November 2016) indicates that offsets are not required for this proposal as the impacts do not exceed biodiversity offset thresholds.

7 Conclusion

There were three PCTs identified in the study area based on floristic composition, geological substrate, and landscape position. These are:

- PCT 1589 - Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast
- PCT 1625 - Red Bloodwood -Sydney Peppermint - *Podocarpus spinulosus* shrubby open forest of the southern Central Coast
- PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast

In addition, two non-native vegetation types were assigned to a miscellaneous ecosystem class, being:

- Miscellaneous ecosystem – landscape plantings
- Miscellaneous ecosystem – highly disturbed areas with no or limited native vegetation

One threatened ecological community was recorded within the study area being, Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions. This threatened ecological community is listed as Endangered under the BC Act although it is not listed under the EPBC Act.

One plant of the threatened flora species, *Rhodamnia rubescens* (Scrub Turpentine), listed as Critically Endangered under the BC Act, was recorded within the study area. This species was recorded within Wamberal Lagoon Nature Reserve and will not be directly and is unlikely to be affected by any indirect impacts.

Assumed presence of *Caladenia tessellata* (Thick Lip Spider Orchid), *Cryptostylis hunteriana* (Leafless Tongue Orchid) and *Diuris praecox* (Rough Double Tail) is based on associated vegetation being present within the study area and because surveys were conducted outside the known flowering period for these species. The area of assumed habitat that will be impacted by the proposal is <0.3 hectares. Additional surveys in the correct season could provide more detailed information on the actual presence or absence of these species and has been recommended.

Field surveys recorded two threatened fauna species within the study area, being:

- *Miniopterus australis* (Little Bent-winged Bat)
- *Pteropus poliocephalus* (Grey-headed Flying-fox)

Likelihood of occurrence assessments identified an additional 11 threatened fauna species as having a moderate or higher likelihood of occurrence within the study area, being:

- *Crinia tinnula* (Wallum Froglet)
- *Callocephalon fimbriatum* (Gang-Gang Cockatoo)
- *Daphoenositta chrysoptera* (Varied Sittella)
- *Falsistrellus tasmaniensis* (Eastern False Pipistrelle)
- *Glossopsitta pusilla* (Little Lorikeet)
- *Lathamus discolor* (Swift Parrot)
- *Lophoictinia isura* (Square-tailed Kite)
- *Micronomus norfolkensis* (Eastern Freetail-bat)
- *Miniopterus orianae oceanensis* (Large Bent-winged Bat)
- *Ninox strenua* (Powerful Owl)
- *Petaurus norfolcensis* (Squirrel Glider)

The key impacts of the proposal include the removal of 0.48 hectares of native vegetation and associated habitat, including:

- 0.09 ha of Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (BC Act: listed as endangered).

Fauna injury or death has the greatest potential to occur during construction when vegetation clearing would occur, and the extent of this impact would be proportionate to the extent of vegetation that is cleared. Indirect / operational impacts including a minor increase in habitat isolation. Invasion and spread of weeds, invasion and spread of pests, and invasion and spread of pathogens and disease are a risk with a proposal of this type. Noise, light and vibration would be increased during construction and operation. Significant impacts to aquatic ecosystems are unlikely to occur because of the proposal.

The overall outcome of the tests of significance and EPBC Act assessments of significance (see Appendix C) indicate that there is a high level of certainty that the impacts to threatened biodiversity are unlikely to be significant.

Minimisation of biodiversity impacts would occur at the concept design and detailed design phases. However, mitigation measures would need to be implemented during the construction and operational phases to further lessen the potential ecological impacts of the proposal. The Roads and Maritime *Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects* (NSW Roads and Traffic Authority, 2011) identify a range of mitigation techniques to be applied and these techniques must be implemented during construction. Due to the presence of the endangered ecological community and adjoining sensitive wetland areas within Wamberal Lagoon Nature Reserve, exclusion zones would be established to delineate the works limit boundary to ensure no accidental impacts occur.

Although efforts have been made to avoid, minimise and mitigate potential ecological impacts from the proposal, some residual impacts would occur. This biodiversity assessment identifies that the proposal is not likely to have a significant impact on any threatened biodiversity listed under the BC Act or EPBC Act (see Section 4.4 and Appendix C). In this instance, and due to the Strategic Assessment, the EPBC Act environmental offsets policy does not apply. It is however Transport for NSW policy that biodiversity offsets (or where offsets are not reasonable or feasible, supplementary measures) would be provided for impacts that exceed predetermined thresholds. The Roads and Maritime Services Guideline for Biodiversity Offsets (November 2016) indicates that offsets are not required for this proposal as the impacts do not exceed biodiversity offset thresholds.

Further targeted surveys should be considered in spring for *Caladenia tessellata* (Thick Lip Spider Orchid), *Cryptostylis hunteriana* (Leafless Tongue Orchid) and *Diuris praecox* (Rough Double Tail).

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Appendix A – Species recorded

A1 - Recorded flora

Family	Scientific name	Common Name	Threat status		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	RM
			BC Act	EPBC Act									
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower				x			x	x	x	x	
Aceraceae	*Acer palmatum**	Japanese Maple											
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair									x		x
Alliaceae	*Agapanthus praecox subsp. orientalis**	Agapanthus							x				x
Amaranthaceae	*Amaranthus viridis**	Green Amaranth											x
Anacardiaceae	*Schinus molle var. areira**	Pepper Corn											x
Anthericaceae	*Tricoryne elatior*	Yellow Autumn-lily							x				x
Apiaceae	*Centella asiatica*	Pennywort			x				x				
Apiaceae	*Hydrocotyle bonariensis**	A Pennywort											x
Apiaceae	*Hydrocotyle sibthorpiodes*	-							x				x
Apiaceae	*Hydrocotyle tripartita*												x
Apocynaceae	*Araujia sericifera**	Moth Vine											x
Apocynaceae	*Marsdenia rostrata*	Common Milk Vine					x		x				
Apocynaceae	*Parsonsia straminea*	Common Silkpod			x	x	x	x	x		x	x	
Apocynaceae	*Tylophora barbata*	Bearded Tylophora				x						x	
Apocynaceae	*Vinca major**	Periwinkle											x
Araceae	*Alocasia brisbanensis**	Cunjevoi											x
Araceae	*Gymnostachys anceps*	Settler's Flax							x			x	
Araceae	*Monstera deliciosa**	Fruit Salad Plant											x
Araliaceae	*Polyscias sambucifolia subsp. Long leaflets*	-					x	x					
Arecaceae	*Archontophoenix cunninghamiana*	Bangalow Palm											x
Arecaceae	*Livistona australis*	Cabbage Palm						x			x	x	
Arecaceae	*Phoenix canariensis**	Canary Island Date Palm										x	
Arecaceae	*Syagrus romanzoffiana**	Cocos palm										x	x

Family	Scientific name	Common Name	Threat status		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	RM
			BC Act	EPBC Act									
Asparagaceae	*Asparagus aethiopicus**	Asparagus Fern, Sprengeri Fern			x	x			x	x	x	x	
Asparagaceae	*Asparagus plumosus**	Climbing Asparagus Fern				x						x	
Asteraceae	*Ageratina adenophora**	Crofton Weed											x
Asteraceae	*Aster subulatus**	Wild Aster								x			
Asteraceae	*Bidens pilosa**	Cobbler's Pegs								x			
Asteraceae	*Chrysanthemoides monilifera subsp. rotundata**	Bitou Bush											x
Asteraceae	*Conyza sumatrensis**	Tall fleabane											x
Asteraceae	*Coreopsis lanceolata**	Coreopsis											x
Asteraceae	*Gamochaeta spicata**	-											x
Asteraceae	*Hypochaeris radicata**	Catsear							x	x			
Asteraceae	*Lagenifera stipitata*	Blue Bottle-daisy						x	x				
Asteraceae	*Ozothamnus diosmifolius*	Everlasting											
Asteraceae	*Senecio madagascariensis**	Fireweed											
Asteraceae	*Soliva sessilis**	Bindii											
Asteraceae	*Sonchus oleraceus**	Common Sowthistle								x			
Asteraceae	*Taraxacum officinale**	Dandelion								x			x
Berberidaceae	*Nandina domestica**	Sacred Bamboo											x
Bignoniaceae	*Jacaranda mimosifolia**	Jacaranda											x
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine			x	x	x					x	
Cactaceae	*Opuntia sp.**	-											x
Caprifoliaceae	*Lonicera japonica**	Japanese Honeysuckle							x				
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak					x						
Casuarinaceae	*Casuarina glauca*	Swamp Oak						x					
Celastraceae	*Denhamia silvestris*	Narrow-leaved Orangebark									x		
Commelinaceae	*Commelina cyanea*	Native Wandering Jew							x	x			
Commelinaceae	*Tradescantia fluminensis**	Wandering Jew											x
Convolvulaceae	*Dichondra repens*	Kidney Weed				x			x		x	x	

Family	Scientific name	Common Name	Threat status		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	RM
			BC Act	EPBC Act									
Convolvulaceae	*Ipomoea indica**	Blue Morning Glory									x		x
Cyperaceae	*Baumea juncea*	-						x					
Cyperaceae	*Cyathochaeta diandra*	-					x						
Cyperaceae	*Cyperus eragrostis**	Umbrella Sedge											x
Cyperaceae	*Cyperus involucratus**	Umbrella Sedge											x
Cyperaceae	*Gahnia clarkei*	Tall Saw-sedge			x			x			x	x	
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge					x					x	
Cyperaceae	*Lepidosperma longitudinale*	Pithy sword-sedge			x						x		
Cyperaceae	*Ptilothrix deusta*	-					x						
Cyperaceae	*Schoenus melanostachys*	A Bog Rush					x				x		
Davalliaceae	*Nephrolepis cordifolia**	Fishbone Fern											x
Dicksoniaceae	*Calochlaena dubia*	Dicksoniaceae											x
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower											
Dilleniaceae	*Hibbertia dentata*	Twining Guinea Flower							x			x	
Dilleniaceae	*Hibbertia empetrifolia subsp. empetrifolia*	-					x						
Dilleniaceae	*Hibbertia scandens*	Climbing Guinea Flower										x	
Dioscoreaceae	*Dioscorea transversa*	Native Yam				x	x					x	
Ebenaceae	*Diospyros australis*	Black Plum											x
Epacridaceae	*Acrotriche divaricata*	-											x
Epacridaceae	*Epacris microphylla*	-						x					
Epacridaceae	*Epacris pulchella*	NSW Coral Heath						x					
Epacridaceae	*Leucopogon juniperinus*	Prickly Beard-heath											x
Epacridaceae	*Monotoca elliptica*	Tree Broom-heath						x					
Euphorbiaceae	*Breynia oblongifolia*	Coffee Bush			x	x	x	x	x			x	
Euphorbiaceae	*Glochidion ferdinandi var. ferdinandi*	Cheese Tree			x	x	x	x	x	x	x	x	
Euphorbiaceae	*Phyllanthus gunnii*	-										x	
Euphorbiaceae	*Triadica sebifera**	Chinese Tallowood											x

Family	Scientific name	Common Name	Threat status		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	RM
			BC Act	EPBC Act									
Fabaceae (Caesalpinioideae)	*Senna pendula**	Easter Cassia			x	x	x				x	x	
Fabaceae (Faboideae)	*Aotus ericoides*	Aotus											x
Fabaceae (Faboideae)	*Desmodium gunnii*	Slender tick trefoil				x			x				
Fabaceae (Faboideae)	*Erythrina x sykesii**	Coral Tree											
Fabaceae (Faboideae)	*Glycine clandestina*	-				x	x						
Fabaceae (Faboideae)	*Glycine microphylla*	-							x				
Fabaceae (Faboideae)	*Glycine tabacina*	-							x	x			
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla											x
Fabaceae (Faboideae)	*Kennedia rubicunda*	Dusky Coral-pea								x			
Fabaceae (Faboideae)	*Platylobium formosum*	Handsome Flat-pea					x						
Fabaceae (Faboideae)	*Trifolium repens**	White Clover							x	x			
Fabaceae (Mimosoideae)	*Acacia floribunda*	White Sally											x
Fabaceae (Mimosoideae)	*Acacia irrorata subsp. irrorata*	Green Wattle											x
Fabaceae (Mimosoideae)	*Acacia longifolia subsp. longifolia*	Sydney Golden Wattle				x	x	x					
Fabaceae (Mimosoideae)	*Acacia prominens*	Gosford Wattle											x
Fabaceae (Mimosoideae)	*Acacia suaveolens*	Sweet Wattle						x					
Fabaceae (Mimosoideae)	*Paraserianthes lophantha subsp. lophantha**	Crested Wattle											x
Flacourtiaceae	*Scolopia braunii*	Flintwood											x
Fumariaceae	*Fumaria muralis subsp. muralis**	Wall Fumitory											x
Geraniaceae	*Geranium homeanum*	-											x
Geraniaceae	*Geranium solanderi*	Cutleaf Cranesbill											x
Haloragaceae	*Gonocarpus micranthus subsp. micranthus*	-						x					
Juncaceae	*Juncus usitatus*	Common Rush							x				x
Lauraceae	*Cassytha glabella f. glabella*	Slender Devil's Twine					x						

Family	Scientific name	Common Name	Threat status		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	RM
			BC Act	EPBC Act									
Lauraceae	*Cassytha pubescens*	Common Devil's Twine						x		x			
Lauraceae	*Cinnamomum camphora**	Camphor Laurel											x
Liliaceae	*Lilium formosanum**	Tiger Lily											x
Lindsaeaceae	*Lindsaea linearis*	Screw Fern					x						
Lobeliaceae	*Lobelia alata*	Angled Lobelia						x					
Lobeliaceae	*Lobelia purpurascens*	Whiteroot			x	x		x	x		x	x	
Lomandraceae	*Lomandra filiformis subsp. filiformis*	-								x			
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush			x	x	x	x	x	x	x	x	
Lomandraceae	*Lomandra multiflora*	Many-flowered Mat-rush											
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry				x	x		x		x	x	
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling Lily			x	x	x		x	x	x	x	
Malvaceae	*Abutilon gandifolium**	Hairy Indian Mallow											x
Malvaceae	*Modiola caroliniana**	Red-flowered Mallow								x			
Malvaceae	*Pavonia hastata**	-											x
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne								x			
Meliaceae	*Melia azedarach*	Meliaceae									x	x	
Meliaceae	*Synoum glandulosum subsp. glandulosum*	Scentless Rosewood										x	x
Menispermaceae	*Stephania japonica var. discolor*	Snake Vine										x	x
Myrsinaceae	*Anagallis arvensis**	Scarlet/Blue Pimpernel								x			
Myrsinaceae	*Myrsine variabilis*	Mutton Wood											x
Myrtaceae	*Acmena smithii*	Lilly Pilly				x							
Myrtaceae	*Angophora floribunda*	Rough-barked Apple							x				
Myrtaceae	*Callistemon citrinus*	Crimson Bottlebrush											x
Myrtaceae	*Callistemon linearis*	Narrow-leaved Bottlebrush						x					
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush			x	x		x	x		x		
Myrtaceae	*Callistemon sp. (Cultivar)**	-											x
Myrtaceae	*Corymbia gummifera*	Red Bloodwood					x						

Family	Scientific name	Common Name	Threat status		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	RM
			BC Act	EPBC Act									
Myrtaceae	*Corymbia maculata*	Spotted Gum				x			x	x	x	x	
Myrtaceae	*Eucalyptus paniculata subsp. paniculata*	Grey Ironbark				x	x		x	x	x	x	
Myrtaceae	*Eucalyptus pilularis*	Blackbutt								x			
Myrtaceae	*Eucalyptus piperita*	Sydney Peppermint					x						
Myrtaceae	*Eucalyptus resinifera subsp. resinifera*	Red Mahogany			x	x				x	x	x	
Myrtaceae	*Eucalyptus umbra*	Broad-leaved White Mahogany							x				
Myrtaceae	*Kunzea ambigua*	Tick Bush						x					
Myrtaceae	*Leptospermum laevigatum*	Coast Teatree											x
Myrtaceae	*Leptospermum polygalifolium subsp. cismontanum*	-				x	x	x					
Myrtaceae	*Melaleuca bracteata 'planted ornamental'**	Black Tea-tree											x
Myrtaceae	*Melaleuca ericifolia*	Swamp Paperbark											x
Myrtaceae	*Melaleuca linariifolia*	Snow-in-Summer			x	x					x		
Myrtaceae	*Melaleuca nodosa*	Ball Honeymyrtle			x	x	x	x	x		x		
Myrtaceae	*Melaleuca quinquenervia*	Broad-leaved Paperbark											x
Myrtaceae	*Melaleuca sieberi*	-											x
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree			x		x		x		x		
Myrtaceae	*Melaleuca thymifolia*	-						x					
Myrtaceae	*Rhodamnia rubescens*	Scrub Turpentine	**CE**								x		
Myrtaceae	*Syncarpia glomulifera subsp. glomulifera*	Turpentine				x	x		x	x		x	
Myrtaceae	*Syzygium luehmannii 'planted ornamental'**	Small-leaved Lilly Pilly											x
Ochnaceae	*Ochna serrulata**	Mickey Mouse Plant			x	x				x	x	x	
Oleaceae	*Ligustrum lucidum**	Large-leaved Privet										x	
Oleaceae	*Ligustrum sinense**	Small-leaved Privet									x		
Oleaceae	*Notelaea longifolia f. longifolia*	Mock Olive			x	x	x		x		x	x	
Orchidaceae	*Cryptostylis erecta*	Tartan Tongue Orchid					x	x					
Oxalidaceae	*Oxalis corniculata**	Creeping Oxalis								x			

Family	Scientific name	Common Name	Threat status		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	RM
			BC Act	EPBC Act									
Oxalidaceae	*Oxalis exilis*	Slender xalis						x					
Oxalidaceae	*Oxalis latifloia**	-											x
Passifloraceae	*Passiflora edulis**	Common Passionfruit				x			x			x	
Phormiaceae	*Dianella caerulea var. producta*	Blue Flax lily			x	x	x	x	x	x	x	x	
Pittosporaceae	*Pittosporum revolutum*	Rough Fruit Pittosporum				x	x					x	
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum			x	x	x		x		x	x	
Plantaginaceae	*Plantago lanceolata**	Lamb's Tongues							x				
Poaceae	*Andropogon virginicus**	Whisky Grass											x
Poaceae	*Axonopus fissifolius**	Narrow-leaved Carpet Grass							x	x			
Poaceae	*Briza maxima**	Quaking Grass							x				
Poaceae	*Cenchrus clandestinus**	Kikuyu Grass											x
Poaceae	*Chloris gayana**	Rhodes Grass											x
Poaceae	*Cynodon dactylon*	Common Couch								x			
Poaceae	*Digitaria parviflora*	Small-flowered Finger Grass				x							
Poaceae	*Digitaria sanguinalis**	Summer Grass, Crab Grass								x			
Poaceae	*Echinopogon caespitosus var. caespitosus*	Tufted Hedgehog Grass							x				
Poaceae	*Ehrharta erecta**	Panic Veldtgrass							x	x			
Poaceae	*Entolasia marginata*	Bordered Panic			x	x			x	x	x	x	
Poaceae	*Entolasia stricta*	Wiry Panic			x	x	x	x	x		x	x	
Poaceae	*Eragrostis curvula**	African Lovegrass											
Poaceae	*Hemarthria uncinata*	Matgrass						x					
Poaceae	*Imperata cylindrica*	Blady Grass			x	x	x	x	x	x		x	
Poaceae	*Isachne globosa*	Swamp Millet											x
Poaceae	*Microlaena stipoides var. stipoides*	-						x	x	x		x	
Poaceae	*Oplismenus aemulus*	-							x				
Poaceae	*Oplismenus imbecillis*	Creeping Beard Grass			x	x		x	x		x	x	
Poaceae	*Panicum maximum var. maximum**	Guinea Grass											x

Family	Scientific name	Common Name	Threat status		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	RM
			BC Act	EPBC Act									
Poaceae	*Panicum simile*	Two-colour Panic			x	x			x				
Poaceae	*Paspalidium distans*	-			x	x		x			x	x	
Poaceae	*Paspalum dilatatum**	Paspalum							x	x			x
Poaceae	*Paspalum urvillei**	Vasey Grass											x
Poaceae	*Poa affinis*	-				x			x			x	
Poaceae	*Poa annua**	Winter Grass							x				
Poaceae	*Setaria parviflora**	-								x			
Poaceae	*Setaria pumila**	Pale Pigeon Grass											
Poaceae	*Sporobolus africanus**	Parramatta Grass								x			
Poaceae	*Stenotaphrum secundatum**	Buffalo Grass											x
Poaceae	*Tetrarrhena juncea*	Wiry Ricegrass					x						
Poaceae	*Themeda triandra*	Kangaroo Grass						x					
Polygalaceae	*Polygala myrtifolia**	Myrtle-leaf Milkwort								x			
Polygonaceae	*Persicaria decipiens*	Slender Knotweed											x
Proteaceae	*Banksia integrifolia*	Coastal Banksia											x
Proteaceae	*Banksia oblongifolia*	Fern-leaved Banksia						x					
Proteaceae	*Banksia spinulosa var. collina*	Hairpin Banksia					x	x					
Proteaceae	*Grevillea robusta**	Silky Oak											x
Proteaceae	*Hakea teretifolia*	Dagger Hakea						x					
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung							x			x	
Ranunculaceae	*Clematis aristata*	Old Man's Beard										x	
Restionaceae	*Lepyrodia scariosa*	Scale Rush						x					
Rhamnaceae	*Alphitonia excelsa*	Red Ash											x
Rosaceae	*Rubus hillii*	Molucca Ramble										x	
Rubiaceae	*Gynochthodes jasminoides*	Sweet Morinda				x					x	x	
Rubiaceae	*Opercularia diphylla*	-					x						
Rutaceae	*Citrus x limon**	Lemon											x
Rutaceae	*Murraya paniculata**	Orange Jessamine											x

Family	Scientific name	Common Name	Threat status		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	RM
			BC Act	EPBC Act									
Sapindaceae	*Cupaniopsis anacardioides*	Tuckeroo				x						x	
Sapindaceae	*Dodonaea triquetra*	Large-leaf Hop-bush											
Sapindaceae	*Guioa semiglauca*	-									x	x	
Smilacaceae	*Smilax australis*	Lawyer Vine				x	x					x	
Smilacaceae	*Smilax glyciphylla*	Sweet Sarsparilla				x	x						
Solanaceae	*Solanum mauritianum**	Wild Tobacco Bush											x
Sterculiaceae	*Brachychiton acerifolius**	Illawarra Flame Tree										x	
Strelitziaceae	*Strelitzia nicolai**	Bird of Paradise											x
Uvulariaceae	*Schelhammera undulata*	Lilac Lily				x			x			x	
Verbenaceae	*Lantana camara**	Lantana			x	x		x			x	x	
Verbenaceae	*Verbena bonariensis**	Purpletop											x
Verbenaceae	*Verbena officinalis**	Common Verbena											x
Violaceae	*Viola hederacea*	Ivy-leaved Violet							x				
Vitaceae	*Cayratia clematidea*	Slender Grape										x	
Xanthorrhoeaceae	*Xanthorrhoea latifolia subsp. latifolia*	-					x						
Xanthorrhoeaceae	*Xanthorrhoea resinosa subsp. resinosa*	A Grasstree								x		x	
Zamiaceae	*Macrozamia communis*	Burrawang											
Zamiaceae	*Macrozamia reducta*	A Burrawang				x							

A2 - Vegetation integrity plot data
Q1

Q1			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 09/03/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast (Type variant - Intact)			28	24	6	3	9	3	0	3	4	4
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			170.2	**142.2**	54	21	51.6	3.1	0	12.5	**28**	28
*Asparagus aethiopicus**	14	80	HT									14
Breynia oblongifolia	1	30	SG			1						
Callistemon salignus	10	8	TG		10							
Centella asiatica	0.3	20	FG					0.3				
Dianella caerulea var. producta	2	40	FG					2				
Entolasia marginata	4	80	GG				4					
Entolasia stricta	6	100	GG				6					
Eucalyptus resinifera subsp. resinifera	1	1	TG		1							
Gahnia clarkei	12	70	GG				12					
Geitonoplesium cymosum	0.1	1	OG							0.1		
Glochidion ferdinandi var. ferdinandi	1	10	TG		1							
Imperata cylindrica	0.6	20	GG				0.6					
*Lantana camara**	6	50	HT									6
Lepidosperma longitudinale	12	60	GG				12					
Lobelia purpurascens	0.8	50	FG					0.8				
Lomandra longifolia	5	60	GG				5					
Melaleuca linariifolia	1	1	TG		1							
Melaleuca nodosa	15	40	TG		15							
Melaleuca styphelioides	26	80	TG		26							
Notelaea longifolia f. longifolia	2	10	SG			2						
*Ochna serrulata**	2	20	HT									2
Oplismenus imbecillis	10	300	GG				10					
Pandorea pandorana	0.4	50	OG							0.4		
Panicum simile	1	40	GG				1					
Parsonsia straminea	12	60	OG							12		
Paspalidium distans	1	40	GG				1					
Pittosporum undulatum	18	70	SG			18						
*Senna pendula**	6	50	HT									6

Easting	356041
Northing	6301700
Orientation	240
Plot size	20 x 20, 20 x 50
1Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	Yes
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	1
Length logs (m)	10
1Attributes 1x1 plot (%)	
Litter (%)	66

Q2

Q2			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 10/03/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 1590 - Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Intact)			48	42	7	9	9	6	0	11	6	5
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			152.4	121.2	66	17.7	24.9	4.8	0	7.8	31.2	31.1
Acacia longifolia subsp. longifolia	0.5	2	SG			0.5						
Acmena smithii	1	1	TG		1							
*Asparagus aethiopicus**	23	200	HT									23
*Asparagus plumosus**	0.1	1	HT									0.1
Breynia oblongifolia	1	6	SG			1						
Callistemon salignus	1	3	TG		1							
Corymbia maculata	9	2	TG		9							
Cupaniopsis anacardioides	0.1	1	SG			0.1						
Desmodium gunnii	0.4	10	FG					0.4				
Dianella caerulea var. producta	0.7	30	FG					0.7				
Dichondra repens	0.8	50	FG					0.8				
Digitaria parviflora	0.1	3	GG				0.1					
Dioscorea transversa	0.3	5	OG							0.3		
Entolasia marginata	2	70	GG				2					
Entolasia stricta	3	90	GG				3					
Eucalyptus paniculata subsp. paniculata	22	8	TG		22							
Eucalyptus resinifera subsp. resinifera	7	2	TG		7							
Eustrephus latifolius	0.6	20	OG							0.6		
Geitonoplesium cymosum	0.6	20	OG							0.6		
Glochidion ferdinandi var. ferdinandi	8	20	TG		8							
Glycine clandestina	0.1	5	OG							0.1		
Gynochthodes jasminoides	0.4	20	OG							0.4		
Imperata cylindrica	0.4	10	GG				0.4					
*Lantana camara**	4	50	HT									4
Leptospermum polygalifolium subsp. cismontanum	2	8	SG			2						
Lobelia purpurascens	0.8	80	FG					0.8				
Lomandra longifolia	12	60	GG				12					
Macrozamia reducta	0.1	1	OG							0.1		
Melaleuca linariifolia	0.1	1	SG			0.1						
Melaleuca nodosa	4	30	SG			4						
Notelaea longifolia f. longifolia	6	30	SG			6						
*Ochna serrulata**	3	30	HT									3
Oplismenus imbecillis	5	200	GG				5					
Pandorea pandorana	1	20	OG							1		
Panicum simile	0.2	20	GG				0.2					
Parsonsia straminea	4	30	OG							4		

Easting	356039
Northing	6301718
Orientation	25
Plot size	20 x 20, 20 x 50
1 Attributes 20x50m plot	
Stem classes	
80+	0
50-79	4
30-49	Yes
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	1
Length logs (m)	49
1 Attributes 1x1 plot (%)	
Litter (%)	67

Q2 (cont.)

Paspalidium distans	2	80	GG				2								
*Passiflora edulis**	0.1	1	EX								0.1				
Pittosporum revolutum	1	10	SG			1									
Pittosporum undulatum	3	20	SG			3									
Poa affinis	0.2	8	GG				0.2								
Pseuderanthemum variabile	2	200	FG					2							
Schelhammera undulata	0.1	1	FG					0.1							
*Senna pendula**	1	4	HT									1			
Smilax australis	0.2	5	OG							0.2					
Smilax glyciphylla	0.1	1	OG							0.1					
Syncarpia glomulifera subsp. glomulifera	18	6	TG		18										
Tylophora barbata	0.4	6	OG							0.4					

Q3

Q3			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 10/03/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 1625 - Red Bloodwood -Sydney Peppermint - Podocarpus spinulosus shrubby open forest of the southern Central Coast (Intact)			43	42	6	12	8	3	2	11	1	1
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			129.9	**129.3**	62	25.1	27.6	1.7	1.6	11.3	**0.6**	0.6
Acacia longifolia subsp. longifolia	2	5	SG			2						
Allocasuarina torulosa	3	2	TG		3							
Banksia spinulosa var. collina	3	15	SG			3						
Breynia oblongifolia	0.8	6	SG			0.8						
Cassytha glabella f. glabella	0.3	20	OG							0.3		
Corymbia gummifera	15	5	TG		15							
Cryptostylis erecta	0.3	40	FG					0.3				
Cyathochaeta diandra	6	50	GG				6					
Dianella caerulea var. producta	0.6	30	FG					0.6				
Dioscorea transversa	0.2	5	OG							0.2		
Entolasia stricta	3	80	GG				3					
Eucalyptus paniculata subsp. paniculata	1	1	TG		1							
Eucalyptus piperita	25	15	TG		25							
Eustrephus latifolius	0.1	3	OG							0.1		
Geitonoplesium cymosum	0.4	10	OG							0.4		
Glochidion ferdinandi var. ferdinandi	6	30	TG		6							
Glycine clandestina	0.1	5	OG							0.1		
Hibbertia empetrifolia subsp. empetrifolia	0.1	1	SG			0.1						
Imperata cylindrica	1	50	GG				1					
Lepidosperma laterale	1	20	GG				1					
Leptospermum polygalifolium subsp. cismontanum	2	20	SG			2						
Lindsaea linearis	0.8	200	EG						0.8			
Lomandra longifolia	4	50	GG				4					
Marsdenia rostrata	0.6	5	OG							0.6		
Melaleuca nodosa	6	20	SG			6						
Melaleuca styphelioides	1	1	SG			1						
Notelaea longifolia f. longifolia	4	40	SG			4						
Opercularia diphylla	0.8	40	FG					0.8				
Pandorea pandorana	2	60	OG							2		
Parsonsia straminea	5	60	OG							5		
Pittosporum revolutum	3	10	SG			3						
Pittosporum undulatum	2	10	SG			2						
Platylobium formosum	1	12	SG			1						
Polyscias sambucifolia subsp. Long leaflets	0.2	8	SG			0.2						
Pteridium esculentum	0.8	10	EG						0.8			
Ptilothrix deusta	10	500	GG				10					
Schoenus melanostachys	2	30	GG				2					
*Senna pendula**	0.6	5	HT									0.6
Smilax australis	1	20	OG							1		
Smilax glyciphylla	0.8	5	OG							0.8		
Syncarpia glomulifera subsp. glomulifera	12	6	TG		12							
Tetrarrhena juncea	0.6	20	GG				0.6					
Xanthorrhoea latifolia subsp. latifolia	0.8	10	OG							0.8		

Easting	356135
Northing	6301775
Orientation	220
Plot size	20 x 20, 20 x 50
1 Attributes 20x50m plot	
Stem classes	
80+	0
50-79	4
30-49	Yes
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	0
Length logs (m)	49
1 Attributes 1x1 plot (%)	
Litter (%)	61

Q4

Q4			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 10/03/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast (Melaleuca nodosa variant - Intact)			40	39	3	15	11	7	0	3	1	1
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			134.4	133.4	47	25.7	53.8	2.8	0	4.1	1	1
Acacia longifolia subsp. longifolia	0.8	2	SG			0.8						
Acacia suaveolens	0.1	1	SG			0.1						
Banksia oblongifolia	3	10	SG			3						
Banksia spinulosa var. collina	1	4	SG			1						
Baumea juncea	10	500	GG				10					
Breynia oblongifolia	0.8	15	SG			0.8						
Callistemon linearis	1	3	SG			1						
Callistemon salignus	0.1	1	SG			0.1						
Cassytha pubescens	2	30	OG							2		
Casuarina glauca	2	10	TG		2							
Cryptostylis erecta	0.1	5	FG					0.1				
Dianella caerulea var. producta	1	30	FG					1				
Entolasia stricta	15	100	GG				15					
Epacris microphylla	2	20	SG			2						
Epacris pulchella	1	5	SG			1						
Gahnia clarkei	2	15	GG				2					
Glochidion ferdinandi var. ferdinandi	3	40	TG		3							
Gonocarpus micranthus subsp. micranthus	0.6	50	FG					0.6				
Hakea teretifolia	2	10	SG			2						
Hemarthria uncinata	2	80	GG				2					
Imperata cylindrica	0.4	10	GG				0.4					
Kunzea ambigua	2	5	SG			2						
Lagenifera stipitata	0.1	10	FG					0.1				
*Lantana camara**	1	5	HT									1
Leptospermum polygalifolium subsp. cismontanum	10	50	SG			10						
Lepyrodia scariosa	0.4	10	GG				0.4					
Livistona australis	0.1	1	OG							0.1		
Lobelia alata	0.1	2	Fg					0.1				
Lobelia purpurascens	0.8	40	FG					0.8				
Lomandra longifolia	8	70	GG				8					
Melaleuca nodosa	42	100	TG		42							
Melaleuca thymifolia	0.1	1	SG			0.1						
Microlaena stipoides var. stipoides	5	80	GG				5					
Monotoca elliptica	1	3	SG			1						
Oplismenus imbecillis	0.4	10	GG				0.4					
Oxalis exilis	0.1	1	FG					0.1				
Parsonsia straminea	2	20	OG							2		
Paspalidium distans	0.6	20	GG				0.6					
Polyscias sambucifolia subsp. Long leaflets	0.8	5	SG			0.8						
Themeda triandra	10	100	GG				10					

Easting	356257
Northing	6301861
Orientation	55
Plot size	20 x 20, 20 x 50
1 Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	No
20-29	No
10-19	Yes
5-9	Yes
<5	Yes
Hollows	0
Length logs (m)	0
1 Attributes 1x1 plot (%)	
Litter (%)	20

Q5

Q5			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 11/03/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 1589 - Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast (Modified)			56	43	6	7	10	13	0	7	13	6
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			164	**139.7**	57.6	12.5	39.8	21.7	0	8.1	**24.3**	20.3
*Agapanthus praecox subsp. orientalis**	1	20	EX								1	
Angophora floribunda	9	4	TG		9							
*Asparagus aethiopicus**	1	10	HT									1
*Axonopus fissifolius**	15	100	HT									15
Breynia oblongifolia	0.8	4	SG			0.8						
*Briza maxima**	0.4	30	EX								0.4	
Callistemon salignus	0.6	1	SG			0.6						
Centella asiatica	3	100	FG					3				
Commelina cyanea	0.5	20	FG					0.5				
Corymbia maculata	1	1	TG		1							
Desmodium gunnii	2	80	FG					2				
Dianella caerulea var. producta	0.7	10	FG					0.7				
Dichondra repens	5	200	FG					5				
Echinopogon caespitosus var. caespitosus	0.8	30	GG				0.8					
*Ehrharta erecta**	2	80	HT									2
Entolasia marginata	0.4	10	GG				0.4					
Entolasia stricta	0.4	10	GG				0.4					
Eucalyptus paniculata subsp. paniculata	22	3	TG		22							
Eucalyptus umbra	5	2	TG		5							
Eustrephus latifolius	0.4	10	OG							0.4		
Geitonoplesium cymosum	0.4	10	OG							0.4		
Glochidion ferdinandi var. ferdinandi	0.6	6	TG		0.6							
Glycine microphylla	5	200	OG							5		
Glycine tabacina	2	50	OG							2		
Gymnostachys anceps	0.1	1	FG					0.1				
Hibbertia dentata	0.1	1	OG							0.1		
Hydrocotyle sibthorpiodes	3	100	FG					3				
*Hypochaeris radicata**	0.8	40	EX								0.8	
Imperata cylindrica	0.4	10	GG				0.4					
Juncus usitatus	0.2	10	HT									0.2
Lagenifera stipitata	0.1	5	FG					0.1				
Lobelia purpurascens	3	100	FG					3				
Lomandra longifolia	0.8	10	GG				0.8					
*Lonicera japonica**	2	20	HT									2
Marsdenia rostrata	0.1	1	OG							0.1		
Melaleuca nodosa	1	1	SG			1						
Melaleuca styphelioides	8	3	SG			8						
Microlaena stipoides var. stipoides	20	500	GG				20					
Notelaea longifolia f. longifolia	1	2	SG			1						

Easting	355952
Northing	6301711
Orientation	350
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	0
50-79	3
30-49	Yes
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	0
Length logs (m)	17
Attributes 1x1 plot (%)	
Litter (%)	16

Q5 (Cont.)

Oplismenus aemulus	0.6	20	GG				0.6								
Oplismenus imbecillis	15	200	GG				15								
Panicum simile	1	20	GG				1								
Parsonsia straminea	0.1	1	OG							0.1					
*Paspalum dilatatum**	0.1	5	HT									0.1			
*Passiflora edulis**	0.1	1	EX								0.1				
Persoonia linearis	1	1	SG			1									
Pittosporum undulatum	0.1	1	SG			0.1									
*Plantago lanceolata**	0.6	30	EX								0.6				
Poa affinis	0.4	10	GG				0.4								
*Poa annua**	1	50	EX								1				
Pseuderanthemum variabile	1	80	FG					1							
Schelhammera undulata	0.2	20	FG					0.2							
Syncarpia glomulifera subsp. glomulifera	20	7	TG		20										
Tricoryne elatior	0.1	1	FG					0.1							
*Trifolium repens**	0.1	5	EX								0.1				
Viola hederacea	3	100	FG					3							

Q6

Q6			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 12/03/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 1590 - Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Modified)			39	20	6	0	7	3	0	4	19	5
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			103.9	**55.2**	39.1	0	13.9	1	0	1.2	**48.7**	16.5
*Anagallis arvensis**	0.1	10	EX								0.1	
*Asparagus aethiopicus**	0.4	2	HT									0.4
*Aster subulatus**	0.1	2	EX								0.1	
*Axonopus fissifolius**	1	30	HT									1
*Bidens pilosa**	0.1	5	EX								0.1	
Cassytha pubescens	0.2	1	OG							0.2		
Commelina cyanea	0.1	1	FG					0.1				
Corymbia maculata	22	4	TG		22							
Cynodon dactylon	10	100	GG				10					
Dianella caerulea var. producta	0.4	10	FG					0.4				
*Digitaria sanguinalis**	5	70	EX								5	
*Ehrharta erecta**	5	100	HT									5
Entolasia marginata	0.1	2	GG				0.1					
Eucalyptus paniculata subsp. paniculata	5	1	TG		5							
Eucalyptus pilularis	1	1	TG		1							
Eucalyptus resinifera subsp. resinifera	6	1	TG		6							
Geitonoplesium cymosum	0.1	2	OG							0.1		
Glochidion ferdinandi var. ferdinandi	0.1	3	TG		0.1							
Glycine tabacina	0.8	70	OG							0.8		
*Hypochaeris radicata**	0.8	50	EX								0.8	
Imperata cylindrica	0.2	10	GG				0.2					
Kennedia rubicunda	0.1	2	OG							0.1		
Lomandra filiformis subsp. filiformis	0.1	3	GG				0.1					
Lomandra longifolia	0.4	8	GG				0.4					
Microlaena stipoides var. stipoides	3	60	GG				3					
*Modiola caroliniana**	0.1	3	EX								0.1	
*Ochna serrulata**	0.1	2	HT									0.1
*Oxalis corniculata**	0.1	3	EX								0.1	
*Paspalum dilatatum**	10	100	HT									10
*Polygala myrtifolia**	4	40	EX								4	
Pseuderanthemum variabile	0.5	60	FG					0.5				
*Setaria parviflora**	5	100	EX								5	
*Sida rhombifolia**	0.4	10	EX								0.4	
*Sonchus oleraceus**	0.8	20	EX								0.8	
*Sporobolus africanus**	15	200	EX								15	
Syncarpia glomulifera subsp. glomulifera	5	2	TG		5							
*Taraxacum officinale**	0.6	40	EX								0.6	
*Trifolium repens**	0.1	3	EX								0.1	
Xanthorrhoea resinosa subsp. resinosa	0.1	1	GG				0.1					

Easting	355880
Northing	6301523
Orientation	205
Plot size	20 x 20, 20 x 50
1Attributes 20x50m plot	
Stem classes	
80+	1
50-79	3
30-49	Yes
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	2
Length logs (m)	0
1Attributes 1x1 plot (%)	
Litter (%)	34

Q7

Q7			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 12/03/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast (Type variant - Intact)			38	33	6	7	9	5	1	5	5	5
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			156.6	151.5	32.2	44.3	54.2	3.3	0.1	17.4	5.1	5.1
Adiantum aethiopicum	0.1	1	EG						0.1			
*Asparagus aethiopicus**	0.6	5	HT									0.6
Callistemon salignus	1	1	SG			1						
Corymbia maculata	16	6	TG		16							
Denhamia silvestris	0.1	1	SG			0.1						
Dianella caerulea var. producta	1	20	FG					1				
Dichondra repens	0.4	30	FG					0.4				
Entolasia marginata	0.6	20	GG				0.6					
Entolasia stricta	0.8	30	GG				0.8					
Eucalyptus paniculata subsp. paniculata	1	1	TG		1							
Eucalyptus resinifera subsp. resinifera	12	3	TG		12							
Eustrephus latifolius	0.8	10	OG							0.8		
Gahnia clarkei	15	100	GG				15					
Geitonoplesium cymosum	0.6	20	OG							0.6		
Glochidion ferdinandi var. ferdinandi	0.8	10	TG		0.8							
Guioa semiglauca	3	2	OG							3		
Gynochthodes jasminoides	3	50	OG							3		
*Ipomoea indica**	0.4	10	HT									0.4
*Lantana camara**	4	30	GG				4					
Lepidosperma longitudinale	20	100	GG				20					
*Ligustrum sinense**	0.1	1	HT									0.1
Livistona australis	1	1	FG					1				
Lobelia purpurascens	0.4	20	FG					0.4				
Lomandra longifolia	10	60	GG				10					
Melaleuca linariifolia	0.1	1	SG			0.1						
Melaleuca nodosa	15	20	SG			15						
Melaleuca styphelioides	25	30	SG			25						
Melia azedarach	0.4	3	TG		0.4							
Notelaea longifolia f. longifolia	2	15	TG		2							
*Ochna serrulata**	3	40	HT									3
Oplismenus imbecillis	3	100	GG				3					
Parsonsia straminea	10	50	OG							10		
Paspalidium distans	0.6	20	GG				0.6					
Pittosporum undulatum	3	20	SG			3						
Pseuderanthemum variabile	0.5	40	FG					0.5				
Rhodamnia rubescens	0.1	1	SG			0.1						
Schoenus melanostachys	0.2	10	GG				0.2					
*Senna pendula**	1	20	HT									1

Easting	355952
Northing	6301617
Orientation	40
Plot size	20 x 20, 20 x 50
1Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	Yes
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	0
Length logs (m)	16.5
1Attributes 1x1 plot (%)	
Litter (%)	64

Q8

Q8			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 02/03/20			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 1590 - Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (Intact)			57	47	8	7	11	6	0	15	9	6
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			146.3	**109.7**	75.9	5.8	12.3	2.8	0	12.9	**36.4**	35.4
*Asparagus aethiopicus**	1	10	HT									1
*Asparagus plumosus**	0.4	2	HT									0.4
*Brachychiton acerifolius**	0.2	1	TG									
Breynia oblongifolia	1	10	SG			1						
Cayratia clematidea	0.4	20	OG							0.4		
Clematis aristata	0.2	5	OG							0.2		
Corymbia maculata	10	3	TG		10							
Cupaniopsis anacardioides	0.4	60	TG		0.4							
Dianella caerulea var. producta	0.2	10	FG					0.2				
Dichondra repens	0.5	100	FG					0.5				
Dioscorea transversa	0.2	10	OG							0.2		
Entolasia marginata	0.2	10	GG				0.2					
Entolasia stricta	0.8	30	GG				0.8					
Eucalyptus paniculata subsp. paniculata	13	4	TG		13							
Eucalyptus resinifera subsp. resinifera	22	8	TG		22							
Eustrephus latifolius	2	40	OG							2		
Gahnia clarkei	0.1	1	GG				0.1					
Geitonoplesium cymosum	0.8	20	OG							0.8		
Glochidion ferdinandi var. ferdinandi	8	30	TG		8							
Guioa semiglauca	4	5	TG		4							
Gymnostachys anceps	0.8	20	FG					0.8				
Gynochthodes jasminoides	3	50	OG							3		
Hibbertia dentata	0.1	1	OG							0.1		
Hibbertia scandens	0.4	10	OG							0.4		
Imperata cylindrica	0.4	30	GG				0.4					
*Lantana camara**	25	100	HT									25
Lepidosperma laterale	0.2	10	GG				0.2					
*Ligustrum lucidum**	1	1	HT									1
Livistona australis	0.1	1	OG							0.1		
Lobelia purpurascens	0.4	50	FG					0.4				
Lomandra longifolia	2	40	GG				2					
Melia azedarach	0.5	5	TG		0.5							
Microlaena stipoides var. stipoides	1	50	GG				1					
Notelaea longifolia f. longifolia	0.8	5	SG			0.8						
*Ochna serrulata**	4	80	HT									4
Oplismenus imbecillis	7	200	GG				7					
Pandorea pandorana	0.6	10	OG							0.6		
Parsonsia straminea	2	40	OG							2		

Easting	355912
Northing	6301562
Orientation	60
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	0
50-79	6
30-49	Yes
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	0
Length logs (m)	23.5
Attributes 1x1 plot (%)	
Litter (%)	82

Q8 (Cont.)

Paspalidium distans	0.4	20	GG				0.4							
*Passiflora edulis**	0.8	5	EX								0.8			
Persoonia linearis	0.4	1	SG			0.4								
*Phoenix canariensis**	0.1	1	EX								0.1			
Phyllanthus gunnii	0.8	5	SG			0.8								
Pittosporum revolutum	0.4	2	SG			0.4								
Pittosporum undulatum	2	20	SG			2								
Poa affinis	0.1	5	GG				0.1							
Pseuderanthemum variabile	0.8	80	FG					0.8						
Rubus hillii	0.1	1	OG							0.1				
Schelhammera undulata	0.1	15	FG					0.1						
*Senna pendula**	4	60	HT									4		
Smilax australis	0.2	5	OG							0.2				
Stephania japonica var. discolor	0.8	20	OG							0.8				
*Syagrus romanzoffiana**	0.1	1	EX								0.1			
Syncarpia glomulifera subsp. glomulifera	18	15	TG		18									
Synoum glandulosum subsp. glandulosum	0.4	5	SG			0.4								
Tylophora barbata	2	70	OG							2				
Xanthorrhoea resinosa subsp. resinosa	0.1	1	GG				0.1							

A3 - Recorded fauna

Scientific Name	Common Name	Native (N) or Introduced (I)	BC Act Status[1]	EPBC Act Status[2]
Reptiles				
Lampropholis delicata	Garden Skink	N		
Birds				
Acanthiza lineata	Striated Thornbill	N		
Acanthiza pusilla	Brown Thornbill	N		
Acanthorhynchus tenuirostris	Eastern Spinebill	N		
Anthochaera carunculata	Red Wattlebird	N		
Anthochaera chrysoptera	Little Wattlebird	N		
Cacatua sanguinea	Little Corella	N		
Corvus coronoides	Australian Raven	N		
Cracticus nigrogularis	Pied Butcherbird	N		
Cracticus torquatus	Grey Butcherbird	N		
Eopsaltria australis	Eastern Yellow Robin	N		
Glossopsitta concinna	Musk Lorikeet	N		
Grallina cyanoleuca	Magpie-lark	N		
Malurus cyaneus	Superb Fairy-wren	N		
Manorina melanocephala	Noisy Miner	N		
Meliphaga lewinii	Lewin's Honeyeater	N		
Ocyphaps lophotes	Crested Pigeon	N		
Oriolus sagittatus	Olive-backed Oriole	N		
Pachycephala pectoralis	Golden Whistler	N		
Psophodes olivaceus	Eastern Whipbird	N		
Rhipidura albiscapa	Grey Fantail	N		
Sericornis frontalis	White-browed Scrubwren	N		
Threskiornis molucca	White Ibis	N		
Trichoglossus moluccanus	Rainbow Lorikeet	N		
Vanellus miles	Masked Lapwing	N		
Mammals				
Antechinus stuartii	Brown Antechinus	N		
Rattus fuscipes	Bush Rat	N		
Trichosurus vulpecula	Common Brushtail Possum	N		
Wallabia bicolor	Swamp Wallaby	N		
Miniopterus australis	Little Bent-winged Bat	N	**V**	
Pteropus poliocephalus	Grey-headed Flying-fox	N	**V**	**V**

1. BC Act status: threatened species status under the *Biodiversity Conservation Act 2016*
2. EPBC Act status: threatened species status under the Environment Protection and Biodiversity Conservation Act 1999.

Appendix B – Habitat assessment table

Likelihood of occurrence criteria

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey
High	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (ie. for breeding or important life cycle periods such as winter flowering resources), has been recorded recently in the locality (10km) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the study area. Species 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 (ie. for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
Low	It is unlikely that the species inhabits the study area and has not been recorded recently in the locality (10km). It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent (ie. for breeding or important life cycle periods such as winter flowering resources) on available habitat. Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
None	Suitable habitat is absent from the study area.

Habitat assessment table – threatened flora

Common Name (*Scientific Name*)	BC Act	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence	Significant impact assessment required?
Acacia bynoeana Bynoes Wattle	E1	V	Occurs south of Dora Creek-Morisset area to Berrima and the Illawarra region and west to the Blue Mountains. It grows mainly in heath and dry sclerophyll forest on sandy soils (Harden, 2002). Seems to prefer open, sometimes disturbed sites such as trail margins and recently burnt areas. Typically occurs in association with *Corymbia gummifera, Eucalyptus haemastoma, E. gummifera, E. parramattensis, E. sclerophylla, Banksia serrata and Angophora bakeri* (Department of Planning Industry and Environment, 2020).	PMST	Moderate – although not recorded within the locality associated vegetation occurs within the study area in the form of PCT 1589.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.

Common Name (*Scientific Name*)	BC Act	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence	Significant impact assessment required?
Acacia pubescens Downy Wattle	V	V	Restricted to the Sydney Region from Bilpin to the Georges River and also at Woodford where it usually grows in open sclerophyll forest and woodland on clay soils. Typically it occurs at the intergrade between shales and sandstones in gravely soils often with ironstones (Harden, 2002 (Department of Planning Industry and Environment, 2020).	PMST	Low – no associated vegetation has been recorded from the study area. This species is mostly restricted to the Cumberland Plain within Western Sydney.	No – species is considered unlikely to occur within the study area.
Caladenia tessellata Thick Lip Spider Orchid	E1	V	Occurs south of Swansea where it grows on clay loam or sandy soils. Prefers low open forest with a heathy or sometimes grassy understorey. Within NSW, currently known from two disjunct areas; one population near Braidwood on the Southern Tablelands and three populations in the Wyong area on the Central Coast. Previously known also from Sydney and South Coast areas (Bernhardt,1993, Department of Planning Industry and Environment, 2020).	PMST	Moderate – on the Central Coast this species is known from three population in the Wyong area. Associated vegetation occurs in the form of PCT 1589.	Yes – assumed present. Surveys were conducted outside the known flowering period for this orchid species and as such the presence absence of this species cannot be confirmed. As such, a precautionary approach has been taken and the species is assumed present based on associated habitat.
Chamaesyce psammogeton Sand Spurge	E1	-	Small herb that forms mats to 1m across. It grows on dunes and sea strandlines. Leaves are smooth, to 30mm long and 15mm wide. Tiny flower-heads are surrounded by white leaf-like bracts. Found sparsely along the coast from south of Jervis Bay to QLD and Lord Howe Island. Grows on fore-dunes, pebbly strandlines and exposed headlands, often with Spinifex and Prickly Couch. Flowering in spring and summer (Department of Planning Industry and Environment, 2020)	BioNet - 10 PlantNet	Low – a population of this species is known to occur in the locality on an incipient foredune at Spoon Bay Beach. No associated habitat is recorded within the study area and as such this species is considered unlikely.	No – species is considered unlikely to occur within the study area.
Cryptostylis hunteriana Leafless Tongue Orchid	V	V	Occurs south from the Gibraltar Range, chiefly in coastal districts but also extends on to tablelands. Grows in swamp-heath and drier forest on sandy soils on granite & sandstone. Occurs in small, localised colonies most often on the flat plains close to the coast but also known from some mountainous areas growing in moist depressions and swampy habitats (Department of Planning Industry and Environment, 2020).	PMST	Moderate – although not recorded within the locality associated vegetation occurs within the study area in the form of PCT 1589 and PCT 1716.	Yes – assumed present. Surveys were conducted outside the known flowering period for this orchid species and as such the presence absence of this species cannot be confirmed. As such, a precautionary approach has been taken and the species is assumed present based on associated habitat.

Common Name (*Scientific Name*)	BC Act	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence	Significant impact assessment required?
Cynanchum elegans White-flowered Wax Plant	E1	E	Occurs from the Gloucester district to the Wollongong area and inland to Mt Dangar where it grows in rainforest gullies, scrub and scree slopes. This species typically occurs at the ecotone between dry subtropical forest/woodland communities (Department of Planning Industry and Environment, 2020).	PMST	Low – this species has not recorded in the locality and no associated PCTs or preferred habitat was recorded within the study area.	No – species is considered unlikely to occur within the study area.
Diuris praecox Rough Double Tail	V	V	Occurs in coastal and near-coastal districts from Ourimbah to Nelson Bay where it grows in sclerophyll forest often on hilltops or slopes.	PMST, PlantNet, BioNet - 112	Moderate – recorded within the locality and associated vegetation occurs within the study area in the form of PCT 1589 and PCT 1716.	Yes – assumed present. Surveys were conducted outside the known flowering period for this orchid species and as such the presence absence of this species cannot be confirmed. As such, a precautionary approach has been taken and the species is assumed present based on associated habitat.
Eucalyptus camfieldii Heart-leaved Stringybark	V	V	Occurs in scattered locations within a restricted distribution in a narrow band with the most northerly records in the Raymond Terrace area south to Waterfall. Grows in poor coastal country in shallow sandy soils overlying Hawkesbury sandstone, in coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas (Department of Planning Industry and Environment, 2020).	PMST, PlantNet, BioNet - 29	Moderate – this species is known to occur within the locality with a population occurring to the north of the study area at Forrester Beach. No associated habitat is recorded within the study area and as such this species is considered unlikely. Despite the lack of associated habitat species was still the target of field survey with all eucalypt stringybark check against diagnostics for *Eucalyptus camfieldi*	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.

Common Name (*Scientific Name*)	BC Act	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence	Significant impact assessment required?
Eucalyptus oblonga population at Bateau Bay, Forresters Beach and Tumbi Umbi in the Wyong local government area	E2	-	Narrow-leaved Stringybark (family Myrtaceae) is a tree to 15 m high with persistent, grey to red-brown, stringy bark on the trunk and larger branches. The species occurs from Gosford to the Appin and Waterfall districts. The disjunct outlier population at Bateau Bay, Forresters Beach and Tumbi Umbi includes occurrences on the Patonga Claystone Formation and derived soils, corresponding to the Woodburys Bridge Soil Landscape. Here it is at the eastern limit of the species' range and is of significant conservation value because elsewhere the species occurs on sandstone. The population of *Eucalyptus oblonga* consists of about 20 trees. Normally found on in dry open forest with infertile sandy soils on sandstone. The population at Bateau Bay occurs on coastal sands. (Department of Planning Industry and Environment, 2020).	BioNet - 18	Moderate – this species is known to occur within the locality with a population occurring to the north of the study area at Bateau Bay. No associated habitat is recorded within the study area and as such this species is considered unlikely. Despite the lack of associated habitat species was still the target of field survey with all eucalypt stringybark check against diagnostics for *Eucalyptus oblonga.*	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.
Genoplesium baueri Yellow Gnat-orchid, Bauer's Midge Orchid	E1	E	Grows in dry sclerophyll forest and moss gardens over sandstone. The species has been recorded from locations between Ulladulla and Port Stephens. About half the records were made before 1960 with most of the older records being from northern Sydney suburbs. The species has been recorded at locations now likely to be within the following conservation reserves: Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments (Department of Planning Industry and Environment, 2020).	PMST	Low – this species has not recorded in the locality and no associated PCTs or preferred habitat was recorded within the study area.	No – species is considered unlikely to occur within the study area.

Common Name (*Scientific Name*)	BC Act	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence	Significant impact assessment required?
Grammitis stenophylla Narrow-leaf Finger Fern	E	-	The Narrow-leaf Finger Fern is a little fern, growing in small colonies, with hanging or erect fronds. Occurs in eastern Queensland and eastern NSW. In NSW it has been found on the south, central and north coasts and as far west as Mount Kaputar National Park near Narrabri. Moist places, usually near streams, on rocks or in trees, in rainforest and moist eucalypt forest (Department of Planning Industry and Environment, 2020).	PlantNet	Low – recorded within the locality although no associated PCTs or preferred habitat was recorded within the study area.	No – species is considered unlikely to occur within the study area.
Grevillea parviflora subsp. parviflora Small-flower Grevillea	V	V	Mainly known from the Prospect area (but now extinct there) and lower Georges River to Camden, Appin and Cordeaux Dam areas, with a disjunct population near Putty, Cessnock and Cooranbong. Grows in heath or shrubby woodland in sandy or light clay soils usually over thin shales (Department of Planning Industry and Environment, 2020).	PMST	Moderate – although not recorded within the locality associated vegetation occurs within the study area in the form of PCT 1589.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.
Melaleuca biconvexa Biconvex Paperbark	V	V	Occurs as disjunct populations in coastal New South Wales from Jervis Bay to Port Macquarie, with the main concentration of records is in the Gosford/Wyong area. Grows in damp places, often near streams, or low-lying areas on alluvial soils of low slopes or sheltered aspects Department of Planning Industry and Environment, 2020).	PMST, PlantNet, BioNet - 77	High – this species is known to occur within the locality and associated habitat occurs in the form of PCT 1589 and PCT 1716.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.
Persicaria elatior Tall Knotweed	V	V	Occurs infrequently in coastal regions where it grows in damp places especially beside streams and lakes. Also occasionally occurs in swamp forest or associated with disturbance (Department of Planning Industry and Environment, 2020).	PMST	Moderate – this species is not known to occur within the locality although associated habitat occurs in the form of PCT 1716.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.
Persoonia hirsuta Hairy Geebung	E1	E	The species occurs in small populations distributed from Singleton in the north, along the east coast to Bargo in the south and the Blue Mountains in the west. It is found in dry sclerophyll open forest, woodland and health on sandstone, growing in sandy soils (Department of Planning Industry and Environment, 2020).	PMST	Low – this species has not recorded in the locality and no associated PCTs or preferred habitat was recorded within the study area.	No – species is considered unlikely to occur within the study area.

Common Name (*Scientific Name*)	BC Act	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence	Significant impact assessment required?
Prostanthera askania Tranquillity Mintbush	E	E	Occurs over a very restricted geographic range (of less than 12 km) in the upper reaches of creeks that flow into Tuggerah Lake or Brisbane Water within the Wyong and Gosford local government areas. Occurs adjacent to, but not immediately in, drainage lines on flat to moderately steep slopes formed on Narrabeen sandstone and alluvial soils derived from it. These communities are generally tall forests with a mesic understorey; Sydney Blue Gum Eucalyptus saligna and Turpentine *Syncarpia glomulifera* are usually present, though canopy species present can be highly variable (Department of Planning Industry and Environment, 2020).	BioNet - 4	Low – recorded within the locality although no associated PCTs or preferred habitat was recorded within the study area.	No – species is considered unlikely to occur within the study area.
Pultenaea glabra Smooth Bush-Pea	V	V	This species is primarily associated with riparian or swamp habitat areas in the mid to upper altitudes of the central Blue Mountains on sandstone derived soils. Grows in swamp margins, hillslopes, gullies and creekbanks and occurs within dry sclerophyll forest and tall damp heath on sandstone (Department of Planning Industry and Environment, 2020).	PMST	Low – this species has not recorded in the locality and no associated PCTs or preferred habitat was recorded within the study area.	No – species is considered unlikely to occur within the study area.
Pultenaea maritima Coast Headland Pea	V	-	In NSW, this species has been recorded from Newcastle to Byron Bay on 16 headlands. Occurs in grasslands, shrublands and heath on exposed coastal headlands and adjoining low coastal heath. Clay or sandy loam over sandstone at altitude 5-30m. Associated with *Banksia integrifolia* and *Themeda triandra*. Flowers from (June) August to March (Department of Planning Industry and Environment, 2020).	BioNet - 14	Low – recorded within the locality although no associated PCTs or preferred habitat was recorded within the study area.	No – species is considered unlikely to occur within the study area.

Common Name (*Scientific Name*)	BC Act	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence	Significant impact assessment required?
Rhizanthella slateri Eastern Australian Underground Orchid	V	E	Flowers from September to November. Little is known about the preferred habitat of this species, but apparently prefers Sclerophyll forest with a reasonably deep layer of organic litter. *Rhizanthella slateri* is restricted to New South Wales where it is currently known from 14 populations including Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. The *Rhizanthella slateri* population in the Great Lakes Local Government Area (LGA) occurs at the known northern limit of the species' range and is disjunct from other known populations of the species (Department of Planning Industry and Environment, 2020).	PMST	Low – this species has not recorded in the locality and no associated PCTs or preferred habitat was recorded within the study area.	No – species is considered unlikely to occur within the study area.
Rhodamnia rubescens Scrub Turpentine	CE	-	Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils. Occurs in coastal districts north from Batemans Bay in New South Wales, approximately 280 km south of Sydney, to areas inland of Bundaberg in Queensland. Populations of R. rubescens typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 m a.s.l. in areas with rainfall of 1,000-1,600 mm (Department of Planning Industry and Environment, 2020).	PlantNet BioNet - 65	Recorded – a single individual of this species was recorded in PCT 1716.	Yes – based on the presence of a single individual.
Rhodomyrtus psidioides Native Guava	CE	-	Pioneer species found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest often near creeks and drainage lines. Occurs from Broken Bay, approximately 90 km north of Sydney, New South Wales, to Maryborough in Queensland. Populations are typically restricted to coastal and sub-coastal areas of low elevation however the species does occur up to c. 120 km inland in the Hunter and Clarence River catchments and along the Border Ranges in NSW (Department of Planning Industry and Environment, 2020).	BioNet - 4	Low – recorded within the locality although no associated PCTs or preferred habitat was recorded within the study area.	No – species is considered unlikely to occur within the study area.

Common Name (*Scientific Name*)	BC Act	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence	Significant impact assessment required?
Rutidosis heterogama Heath Wrinklewort	V	V	Grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides Department of Planning Industry and Environment, 2020).	PMST	Moderate – although not recorded within the locality associated vegetation occurs within the study area in the form of PCT 1589.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.
Senecio spathulatus Coast Groundsel	E	-	Occurs in Nadgee Nature Reserve (Cape Howe) and between Kurnell in Sydney and Myall Lakes National Park (with a possible occurrence at Cudmirrah) where it grows on primary dunes Department of Planning Industry and Environment, 2020).	BioNet - 5 PlantNet	Low – recorded within the locality although no associated PCTs or preferred habitat was recorded within the study area.	No – species is considered unlikely to occur within the study area.
Syzygium paniculatum Magenta Lilly Pilly	E	V	Occurs between Bulahdelah and St Georges Basin where it grows in subtropical and littoral rainforest on sandy soils or stabilized dunes near the sea. On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the Central Coast, Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities Department of Planning Industry and Environment, 2020).	BioNet - 18 PMST	Low – a population of this species is known to occur in the locality within littoral rainforest vegetation in the Wamberal Lagoon Nature reserve. No associated habitat is recorded within the study area and as such this species is considered unlikely.	No – species is considered unlikely to occur within the study area.
Tetratheca juncea Black-eyed Susan	V	V	Occurs in coastal districts from Bulahdelah to Port Macquarie where it grows in dry sclerophyll forest and occasionally swampy heath in sandy, low nutrient soils with a dense understorey of grasses. Specifically, it is known to occur within Coastal Plains Smooth-barked Apple Woodland and Coastal Plains Scribbly Gum Woodland Department of Planning Industry and Environment, 2020).	BioNet – 1 PlantNet PMST	Low – recorded within the locality although no associated PCTs or preferred habitat was recorded within the study area.	No – species is considered unlikely to occur within the study area.

Common Name (*Scientific Name*)	BC Act	EPBC Act	Habitat requirements	Number of records (source)	Likelihood of occurrence	Significant impact assessment required?
Thesium australe Austral toadflax	V	V	Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Grows in association with *Themeda triandra* and (less frequently) with *Poa* spp. Department of Planning Industry and Environment, 2020).	PMST	Moderate – although not recorded within the locality associated vegetation occurs within the study area in the form of PCT 1589.	No - although a candidate species, it was not recorded in the study area during targeted surveys and is therefore considered unlikely to occur or be affected by the Proposal.
Wilsonia backhousei Narrow-leaved Wilsonia	V	-	In NSW Narrow-leaf Wilsonia is found on the coast between Mimosa Rocks National Park and Wamberal north of Sydney (Nelson's Lake, Potato Point, Sussex Inlet, Wowly Gully, Parramatta River at Ermington, Clovelly, Voyager Point, Wollongong and Royal National Park). It grows in all southern states. This is a species of the margins of salt marshes and lakes. Flowering occurs in spring and summer (Department of Planning Industry and Environment, 2020).	BioNet - 1	Low – a population of this species is known to occur in the locality within the Wamberal Lagoon Nature reserve. This species grows in saltmarsh vegetation and no associated habitat is recorded within the study area and as such this species is considered unlikely.	No – species is considered unlikely to occur within the study area.

1. Listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 – X = Extinct, CE = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory.
2. Listed under the NSW Biodiversity Conservation Act 2016 – E4 = Critically Endangered, E1 = Endangered Species, E2 = Endangered Population, V = Vulnerable.
3. Bionet = OEH Bionet Atlas of NSW Wildlife, EPBC Protected Matters Search Tool = Department of Environment and Energy's EPBC Protected Matters Search Tool and PlantNet = Royal Botanic Gardens PlantNet Spatial Search.

Habitat assessment table – threatened fauna

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Invertebrates							
Petalura gigantea	Giant Dragonfly	-	E1	Found in permanent wetlands, both coastal and upland from moss Vale northwards to southern Queensland (Department of Environment and Conservation, 2005b).	BioNet	Low – no mossy open wetlands with suitable sedge dominated area occur within the study area or its vicinity.	No
Fish							
Epinephelus daemelii	Black Rockcod	V	V[4]	The Black Rockcod is found in warm temperate and subtropical parts of the south-western Pacific. Adult Black Rockcod can grow to 2 m in length and at least 80 kg in weight, but it is more common to see smaller fish (up to 1m/30kg).	PMST	Low – the study area does not contain estuarine habitats or is immediately adjacent to those habitats.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Macquaria australasica	Macquarie Perch	E	E[4]	Macquarie Perch are found in the Murray-Darling Basin (particularly upstream reaches) of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW, including the Hawkesbury/Nepean and Shoalhaven catchments. Macquarie Perch are found in both river and lake habitats; especially the upper reaches of rivers and their tributaries. It prefers clear water and deep, rocky holes with lots of cover. As well as aquatic vegetation, additional cover may comprise of large boulders, debris and overhanging banks. Spawning occurs just above riffles (shallow running water). (Department of the Environment, 2016b) (Department of Primary Industries, 2016).	PMST	Low – no suitable habitats within or immediately adjacent to suitable habitats.	No
Prototroctes maraena	Australian Grayling	V	E[4]	Occurs in streams and rivers on the eastern and southern flanks of the Great Dividing Range, from Sydney, southwards to the Otway Ranges of Victoria and in Tasmania. The species is found in fresh and brackish waters of coastal lagoons, from Shoalhaven River in NSW to Ewan Ponds in South Australia. The Australian Grayling is diadromous, spending part of its lifecycle in freshwater and at least part of the larval and/or juvenile stages in coastal seas. Adults (including pre spawning and spawning adults) inhabit cool, clear, freshwater streams with gravel substrate and areas alternating between pools and riffle zones such as the Tambo River, which is also known to have granite outcrops. The species has also been associated with clear, gravel-bottomed habitats in the Mitchell and Wonnangatta Rivers (Victoria) and in a muddy-bottomed, heavily silted habitat in the Tarwin River (Victoria). The species has been found over 100 km upstream from the sea.	PMST	Low – no suitable habitats within or immediately adjacent to suitable habitats.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Amphibians							
Crinia tinnula	Wallum Froglet	-	V	Occurs along coast from south-eastern Queensland to Sydney. Mostly associated with swamps, dams and flooded roadside ditches, usually in heathland, where it is confined to acid, paperbark swamps and sedge swamps of the 'wallum' country. Males call any time of year. Breed in late winter (Anstis, 2002, NSW National Parks and Wildlife Service, 2002).	BioNet	**Moderate** – suitable habitat present, at the edges of the study area, may occur under suitable climatic conditions.	**Yes**
Heleioporus australiacus	Giant Burrowing Frog	V	V	Exists as two distinct populations: a northern population on the sandstone geology of the Sydney Basin, from Wollemi National Park in the north, south to Jervis Bay; and a southern population in disjunct pockets from about Narooma south into eastern Victoria. In the northern population there is a marked preference for sandstone ridgetop habitat and broader upland valleys where the frog is associated with small headwater and slow flowing to intermittent creeklines. The vegetation is typically woodland, open woodland and heath and may be associated with 'hanging swamp' seepage lines and where small pools form from collected water. Also observed occupying artificial ponded structures such as fire dams, gravel 'borrows', detention basins and box drains that have naturalised and are surrounded by undisturbed habitat. In the southern population, records appear to be associated with Devonian igneous and sedimentary formations and Ordovician metamorphics and are generally from more heavily timbered areas. It is absent from areas that have been cleared for agriculture or for urban development. Breed in summer and autumn in burrows in the banks of small creeks (Cogger, 2000, NSW National Parks and Wildlife Service, 2001).	PMST	Low – no suitable habitat identified within the study area.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Litoria aurea	Green and Golden Bell Frog	V	E1	This species occurs in fragment patches near coastal locations from Vic to south of the NSW-QLD border. For breeding it utilises a wide range of waterbodies, including both natural and man-made structures, such as marshes, dams and stream sides, and ephemeral wetlands. It is found in small pockets of habitat in otherwise developed areas and can occur in disturbed sites. There is a clear preference for sites with a complexity of vegetation structure and terrestrial habitat attributes which include extensive grassy areas and an abundance of shelter sites such as rocks, logs, tussock forming vegetation and other cover used for foraging and shelter. Over-wintering shelter sites may be adjacent to or some distance away from breeding sites but the full range of possible habitat used is not yet well understood (Department of Environment and Conservation, 2004, Department of Environment and Conservation, 2005a).	BioNet PMST	Low –No suitable habitat identified within the study area, due to chytrid risk. Closest recent (2018) records at Terrigal, no records within the study area or its vicinity.	No
Litoria brevipalmata	Green-thighed Frog	-	V	Green-thighed Frogs occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain (Department of Environment and Climate Change, 2009) . Breeding occurs following heavy rainfall in late spring and summer, with frogs aggregating around grassy semi-permanent ponds and flood-prone grassy areas. The frogs are thought to forage in leaf-litter. Isolated localities along the coast and ranges from the NSW central coast to south-east Queensland.	BioNet	Low – No suitable habitat identified within the study area. No records within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Litoria littlejohni	Littlejohn's Tree Frog	V	V	Has a distribution that includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest (90 km north of Sydney) south to Buchan in Victoria. The majority of records are from within the Sydney Basin Bioregion with only scattered records south to the Victorian border and this species has not been recorded in southern NSW within the last decade. Records are isolated and tend to be at high altitude. This species breeds in the upper reaches of permanent streams and in perched swamps. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground.	PMST	Low – No suitable habitat identified within the study area. No records within the study area or its wider locality.	No
Mixophyes balbus	Stuttering Frog	V	E1	Occurs along the east coast of Australia from southern Queensland to north-eastern Victoria. Considered to have disappeared from Victoria and to have undergone considerable range contraction in NSW, particularly in south-east NSW. It is the only *Mixophyes* species that occurs in south-east NSW and in recent surveys it has only been recorded at three locations south of Sydney. The Dorrigo region, in north-east NSW, appears to be a stronghold for this species. Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor.	PMST	Low – no suitable habitat identified within the study area.	No
Mixophyes iteratus	Giant Barred Frog	E	V	Terrestrial species which occurs in rainforests, Antarctic beech or wet sclerophyll forests. Feeds on insects and smaller frogs (Cogger, 2000). The species is associated with permanent flowing drainages, from shallow rocky rainforest streams to slow-moving rivers in lowland open forest. It is not known to utilise still water areas (NSW Scientific Committee, 1999). More prevalent at lower altitudes and in larger streams than its congeners, although has been recorded up to 1000 metres asl. (NSW National Parks and Wildlife Service, 1999c).	PMST	Low – no suitable habitat identified within the study area.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Pseudophryne australis	Red-crowned Toadlet		V	A brown to black frog with a bright red orange triangle on the head. Length is approx.. 30mm. The toadlet has restricted distribution, it is confined to the Sydney basin form Pokolbin in the north. Inhabits wet drainage lines below sandstone ridges that often have shale lenses or cappings. Shelters under rocks amongst masses of dune vegetation or thick piles of leaf litter.	BioNet	Low – no suitable habitat identified within the study area.	No
Reptiles							
Hoplocephalus bungaroides	Broad-headed Snake	V	E1	The Broad-headed Snake is largely confined to Triassic and Permian sandstones. Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges. Moves from the sandstone rocks to shelters in hollows in large trees within 200m of escarpments in summer.	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No
Hoplocephalus stephensii	Stephen's Banded Snake	-	V	Found in coastal areas from Gosford district to southern QLD. Arboreal snake usually encountered in the wetter sclerophyll or rainforests which occur within its range (Cogger, 2000).	BioNet	Low – marginal suitable habitat present, due to very small extent, but presence cannot be entirely discounted.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Birds							
Actitis hypoleucos	Common Sandpiper	M		The Common Sandpiper frequents a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity. It is mostly encountered along muddy margins or rocky shores and rarely on mudflats. It has been recorded in estuaries and deltas of streams, banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. The muddy margins utilised by the species are often narrow, and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags (Geering et al., 2007, Higgins and Davies, 1996). Roost sites are typically on rocks or in roots or branches of vegetation, especially mangroves. The species is known to perch on posts, jetties, moored boats and other artificial structures, and to sometimes rest on mud or 'loaf' on rocks (Higgins and Davies, 1996).	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No
Anous stolidus	Common Noddy	M		The Common Noddy is found in tropical and sub-tropical seas off the west, north and east coasts of Australia, from the Abrolhos Islands in WA to the islands of the Great Barrier Reef in Qld, as well as Norfolk and Lord Howe Islands. Some are seen almost annually in NSW as far south as Sydney. It also ranges across tropical parts of the Pacific, Indian and Atlantic Oceans. The Common Noddy is found on offshore tropical islands, often in large colonies of more than 100,000 nests (Birdlife Australia, 2020).	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Anthochaera phrygia (syn. Xanthomyza phrygia)	Regent Honeyeater	CE	CE	Occurs mostly in box-ironbark forests and woodland and prefers wet, fertile sites such as along creek flats, broad river valleys and foothills. Riparian forests with *Casuarina cunninghamiana* and *Amyema cambagei* are important for feeding and breeding. Spotted Gum and Swamp Mahogany forests are also important feeding areas in coastal areas. Important food trees include *Eucalyptus sideroxylon* (Mugga Ironbark), *E. albens* (White Box), *E. melliodora* (Yellow Box) and *E. leucoxylon* (Yellow Gum) (Garnett and Crowley, 2000).	BioNet PMST	Low – although vegetation on site contains winter foraging resources (Spotted Gum, *C. maculata*) for the Regent Honeyeater, there are no records within the study area or its general vicinity to suggest it uses resources associated with the study area.	No
Apus pacificus	Fork-tailed Swift	M	-	In NSW, the species is recorded in all regions. Many records occur east of the Great Divide. The Fork-tailed Swift is almost exclusively aerial with them foraging and roosting aerially.	PMST BioNet	Low – may occur in aerial habitats over the study area on a seasonal basis but unlikely to use terrestrial habitats associated with the study area.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Arenaria interpres	Ruddy Turnstone	M	-	Occurs at beaches and coasts with exposed rock, stony or shell beaches, mudflats, exposed reefs and wave platforms (Morcombe, 2003).	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No
Botaurus poiciloptilus	Australasian Bittern	E	E1	Occurs in shallow, vegetated freshwater or brackish swamps. Requires permanent wetlands with tall dense vegetation, particularly bulrushes and spikerushes. When breeding, pairs are found in areas with a mixture of tall and short sedges but will also feed in more open territory. (Garnett and Crowley, 2000, NSW National Parks and Wildlife Service, 2002).	PMST BioNet	Low – no suitable habitat identified within the study area or its vicinity.	No
Burhinus grallarius	Bush Stone-curlew	-	E1	Found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the southeast it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber. In coastal areas, structurally similar elements of tidal and estuarine communities (*Casuarina* woodlands, saltmarsh and mangroves) provide suitable habitat. Nesting sites are frequently located in relatively open areas, where ground cover is extremely low and/or sparse including native vegetation and mown lawns, ploughed paddocks and paddocks cut for hay, dirt and gravel roads, seaweed on sand beach, playing fields, and vacant lots. (Office of Environment & Heritage, 2015a).	BioNet	Low – no suitable habitat identified within the study area or its vicinity.	No
Calidris acuminata	Sharp-tailed Sandpiper	M	-	Occurs in a variety of habitats: tidal mudflat, mangrove swamps, saltmarshes, shallow fresh, brackish, salt inland swamps and lakes; flooded and irrigated paddocks, sewage farms and commercial saltfields (Pizzey and Knight, 2007).	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Calidris alba	Sanderling	M	-	The Sanderling occurs in coastal areas around Australia. Inland records have occurred in most states of singles or small groups, birds probably on migration. In Australia, the species is almost always found on the coast, mostly on open sandy beaches exposed to open sea-swell, and also on exposed sandbars and spits, and shingle banks, where they forage in the wave-wash zone and amongst rotting seaweed. Sanderlings also occur on beaches that may contain wave-washed rocky outcrops. Less often the species occurs on more sheltered sandy shorelines of estuaries, inlets and harbours. Rarely, they are recorded in near-coastal wetlands, such as lagoons, hypersaline lakes, salt ponds and samphire flats. There are rare inland records from sandy shores of ephemeral brackish lakes and brackish river-pools (Higgins and Davies, 1997).	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No
Calidris canutus	Red Knot	E, M		In Australasia the Red Knot mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. They are occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps. They rarely use inland lakes or swamps.	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No
Calidris ferruginea	Curlew Sandpiper	CE, M	E1	Occurs in inter-tidal mudflats of estuaries, lagoons, mangrove channels and also around lakes, dams, floodwaters and flooded saltbush surrounding inland lakes (Morcombe, 2003).	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Calidris melanotos	Pectoral Sandpiper	M		In Australasia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species frequents coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. It is usually found in coastal or near coastal habitat but occasionally further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. It has also been recorded in swamp overgrown with lignum. They forage in shallow water or soft mud at the edge of wetlands (Higgins and Davies, 1996).	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No
Calidris ruficollis	Red-necked Stint	M		Mostly found in coastal areas, including sheltered inlets, bays lagoons and estuaries. They also occur in shallow wetlands near the coast or inland, including lakes, waterholes and dams (Higgins, 1996). They forage in mudflats, shallow water, sandy open beaches, flooded paddocks and in samphire feeding along the edges. The species roosts on sheltered beaches, spits, banks or islets, of sand, mud, coral or shingle. Occasionally they roost on exposed reefs or shoals (Higgins, 1996) and amongst seaweed, mud and cowpats (Hobbs, 1961). During high tides they may also use sand dunes and claypans.	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No
Calidris tenuirostris	Great Knot	CE, M	V	Generally, a coastal species found on tidal mudflats and sandy ocean shores. A migratory species visiting Australian waters between September and March (Pizzey and Knight, 2007).	BioNet, PMST	Low – no suitable habitat identified within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Charadrius bicinctus	Double-banded Plover	M		The Double-banded Plover is found on littoral, estuarine and fresh or saline terrestrial wetlands and also saltmarsh, grasslands and pasture. It occurs on muddy, sandy, shingled or sometimes rocky beaches, bays and inlets, harbours and margins of fresh or saline terrestrial wetlands such as lakes, lagoons and swamps, shallow estuaries and rivers. It is sometimes associated with coastal lagoons, inland salt lakes, exposed seagrass beds, exposed reefs and rock platforms and coastal sand dunes (Marchant and Higgins, 1993).	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No
Callocephalon fimbriatum	Gang-Gang Cockatoo	-	V	The Gang-gang Cockatoo is distributed from southern Victoria through south- and central-eastern New South Wales. In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. It occurs regularly in the Australian Capital Territory. It is rare at the extremities of its range, with isolated records known from as far north as Coffs Harbour and as far west as Mudgee. In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas. May also occur in sub-alpine Snow Gum (Eucalyptus pauciflora) woodland and occasionally in temperate rainforests. Favours old growth forest and woodland attributes for nesting and roosting. Nests are located in hollows that are 10 cm in diameter or larger and at least 9 m above the ground in eucalypts.	BioNet	**Moderate** – no recent records of this species in the vicinity of the study area, but due to mobility and potential foraging resources on site, cannot be discounted.	**Yes**

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Calyptorhynchus lathami	Glossy Black-Cockatoo	-	V	The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (*Allocasuarina littoralis*) and Forest Sheoak (*A. torulosa*) are important foods. Inland populations feed on a wide range of sheoaks, including Drooping Sheoak, *Allocasuarina diminuta*, and *A. gymnathera*. Belah is also utilised and may be a critical food source for some populations. In the Riverina, birds are associated with hills and rocky rises supporting Drooping Sheoak, but also recorded in open woodlands dominated by Belah (*Casuarina cristata*). Feeds almost exclusively on the seeds of several species of she-oak (Casuarina and Allocasuarina species), shredding the cones with the massive bill. Dependent on large hollow-bearing eucalypts for nest sites.	BioNet	Low – scant foraging resources and no breeding resources within the study area and its vicinity.	No
Charadrius mongolus	Lesser Sand Plover	E, M	V	Migratory bird that migrates from the northern hemisphere to coastal areas of northern and east coast of Australia (Garnett and Crowley, 2000). The species is almost strictly coastal during the non-breeding season, preferring sandy beaches, mudflats of coastal bays and estuaries, sand-flats and dunes near the coast, occasionally frequenting mangrove mudflats (IUCN Redlist entry).	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Cuculus opatus (syn. Cuculus saturatus)	Oriental Cuckoo, Himalayan Cuckoo	M		A non-breeding migrant to Australia, it often inhabits rainforest, vine thickets, wet sclerophyll forest and open woodland and sometimes occurs in mangroves, wooded swamps and as vagrants in gardens (Higgins, 1999). The population trend appears to be stable (BirdLife International, 2009).	PMST	Low – a very rare vagrant to the wider locality, which is unlikely to be dependent on habitat identified within the study area.	No
Daphoenositta chrysoptera	Varied Sittella	-	V	The Varied Sittella inhabits most of mainland Australia except the treeless deserts and open grasslands. It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. The Varied Sittella feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees, and from small branches and twigs in the tree canopy. It builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years (Office of Environment & Heritage, 2016e).	Bionet	**Moderate** – suitable habitat identified within the study area, which may occur within the home ranges of local individuals.	**Yes**
Dasyornis brachypterus	Eastern Bristlebird	E	E1	The habitat of the Eastern Bristlebird is characterised by low dense vegetation. Fire is a feature of all areas where known populations occur. Given the poor flight ability of the species it is thought that few individuals survive the passage of fire, survival is dependant on the availability of fire refuges and recolonisation may be relatively slow. The bird is cryptic and camouflaged and rarely seen but may be detected by its distinctive, loud calls. Confined to NSW/Queensland border region, Illawarra region and NSW/Victorian border region (NSW National Parks and Wildlife Service, 1997).	PMST	Low – no suitable habitat identified in the study area and not extant in locality.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Ephippiorhynchus asiaticus	Black-necked Stork	-	E1	Widespread in coastal and subcoastal northern and eastern Australia, as far south as central NSW (although vagrants may occur further south or inland, well away from breeding areas). In NSW, the species becomes increasingly uncommon south of the Clarence Valley, and rarely occurs south of Sydney. Since 1995, breeding has been recorded as far south as Bulahdelah. Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries. Usually forage in water 5-30cm deep for vertebrate and invertebrate prey. Eels regularly contribute the greatest biomass to their diet, but they feed on a wide variety of animals, including other fish, frogs and invertebrates (such as beetles, grasshoppers, crickets and crayfish). (Office of Environment & Heritage, 2014a)	Bionet	Low – no suitable habitat identified within the study area or its vicinity.	No
Gallinago hardwickii	Latham's Snipe	M	-	Occurs in freshwater or brackish wetlands generally near protective vegetation cover. This species feeds on small invertebrates, seeds and vegetation. It migrates to the northern hemisphere to breed (Garnett and Crowley, 2000).	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Glossopsitta pusilla	Little Lorikeet		V	The Little Lorikeet is a small green lorikeet with black bill and red patch on forehead and throat. The underside is yellow-green. Immatures are duller with less red on face and brown bill. Found in forests, woodland, treed areas along watercourses and roads. Forages mainly on flowers, nectar and fruit. Found along coastal east Australia from Cape York in Queensland down east coast and round to South Australia. Uncommon in southern Victoria (Higgins, 1999).	Bionet	**Moderate** – no records within the vicinity of the study area. However, there is suitable foraging habitat identified within the study area and due to the species' mobility it may occur intermittently.	**Yes**
Grantiella picta	Painted Honeyeater	V	V	Lives in dry forests and woodlands. Primary food is the mistletoes in the genus *Amyema*, though it will take some nectar and insects. Its breeding distribution is dictated by presence of mistletoes which are largely restricted to older trees. Less likely to be found in in strips of remnant box-ironbark woodlands, such as occur along roadsides and in windbreaks, than in wider blocks (Garnett and Crowley, 2000).	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No
Haematopus fuliginosus	Sooty Oystercatcher	-	V	The Sooty Oystercatcher is found on rocky headlands, rock shelves, exposed reefs with rock pools, beaches and muddy estuaries (Marchant and Higgins, 1993). The species forages on exposed intertidal rocky shorelines at low tide (Garnett and Crowley, 2000). It breeds almost exclusively on offshore islands, and occasionally on isolated promontories during spring and summer. They nest on the ground in amongst rocks, seaweed, shells and pebbles (Marchant and Higgins, 1993).	BioNet	Low – no suitable habitat identified within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Haematopus longirostris	Australian Pied Oystercatcher	-	E1	The species is distributed around the entire Australian coastline, although it is most common in coastal Tasmania and parts of Victoria, such as Corner Inlet. In NSW the species is thinly scattered along the entire coast, with fewer than 200 breeding pairs estimated to occur in the State. Favours intertidal flats of inlets and bays, open beaches and sandbanks. Forages on exposed sand, mud and rock at low tide, for molluscs, worms, crabs and small fish. Nests mostly on coastal or estuarine beaches although occasionally they use saltmarsh or grassy areas.	BioNet	Low – no suitable habitat identified within the study area or its vicinity.	No
Haliaeetus leucogaster	White-bellied Sea-Eagle	M	V	Occurs in coastal areas including islands, estuaries, inlets, large rivers, inland lakes and reservoirs. Builds a huge nest of sticks in tall trees near water, on the ground on islands or on remote coastal cliffs (Pizzey and Knight, 2007).	Bionet	Low – although this species is considered likely to occur over the study area intermittently, there is no suitable foraging or nesting habitat within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Hieraaetus morphnoides	Little Eagle		V	The Little Eagle is distributed throughout the Australian mainland occupying habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring. Prey includes birds, reptiles and mammals, with the occasional large insect and carrion. Preys on birds, reptiles and mammals, occasionally adding large insects and carrion. Most of its former native mammalian prey species in inland NSW are extinct and rabbits now form a major part of the diet (Marchant and Higgins, 1993, Office of Environment & Heritage, 2015c).	Bionet	Low – locally sparse and marginal habitat identified within the study area.	No
Hirundapus caudacutus	White-throated Needletail	V, M	-	Widespread in eastern and south-eastern Australia. In eastern Australia, it is recorded in all coastal regions of Queensland and NSW, extending inland to the western slopes of the Great Divide and occasionally onto the adjacent inland plains. It is almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. Because they are aerial, it has been stated that conventional habitat descriptions are inapplicable, but there are, nevertheless, certain preferences exhibited by the species. Although they occur over most types of habitat, they are probably recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland. They also commonly occur over heathland, but less often over treeless areas, such as grassland or swamps. When flying above farmland, they are more often recorded above partly cleared pasture, plantations or remnant vegetation at the edge of paddocks. In coastal areas, they are sometimes seen flying over sandy beaches or mudflats and often around coastal cliffs and other areas with prominent updraughts, such as ridges and sand-dunes (Department of the Environment and Energy, 2019).	PMST BioNet	Low – species likely to utilise aerial habitats above the study area on a seasonal basis, but it is unlikely to occur within terrestrial habitats within the study area	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Hydropogne caspia	Caspian Tern	M		The Caspian Tern is found in sheltered coastal embayments preferring sandy or muddy margins. Also found in near-coastal or inland terrestrial wetlands. It forages in open wetlands, preferring sheltered shallow water near the margins. It usually breeds in low islands, cays, spits, banks, ridges, beaches of sand or shell, terrestrial wetlands and stony or rocky islets or banks and occasionally among beach-cast debris above the high-water mark or at artificial sites, including islands in reservoirs, or on dredge-spoil. Generally roosting occurs on bare exposed sand or shell spits, banks or shores. (Higgins and Davies, 1996).	Bionet	Low – no suitable habitat identified within the study area or its vicinity.	No
Ixobrychus flavicollis	Black Bittern		V	Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves (Office of Environment and Heritage, 2020).	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No
Lathamus discolor	Swift Parrot	CE	E1	Breeding occurs in Tasmania, majority migrates to mainland Australia in autumn, over-wintering, particularly in Victoria and central and eastern NSW, but also south-eastern Queensland as far north as Duaringa. Until recently it was believed that in New South Wales, swift parrots forage mostly in the western slopes region along the inland slopes of the Great Dividing Range but are patchily distributed along the north and south coasts including the Sydney region, but new evidence indicates that the forests on the coastal plains from southern to northern NSW are also extremely important. In mainland Australia it is semi-nomadic, foraging in flowering eucalypts in eucalypt associations, particularly box-ironbark forests and woodlands. Preference for sites with highly fertile soils where large trees have high nectar production, including along drainage lines and isolated rural or urban remnants, and for sites with flowering Acacia pycnantha, is indicated. Sites used vary from year to year. (Garnett and Crowley, 2000),(Swift Parrot Recovery Team, 2001).	Bionet PMST	**Moderate** – study area contains winter flowering tree species, which may be used by this species intermittently on a seasonal basis.	**Yes**

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Limosa lapponica baueri	Bar-tailed Godwit, (Western Alaskan subspecies).	V, M		The Bar-tailed Godwit (both subspecies combined) has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria. The migratory Bar-tailed Godwit (western Alaskan) does not breed in Australia. Occurs mainly in coastal habitats in coastal habitats which include large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It also has been recorded in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms and coral reef-flats (BirdLife Australia, 2020).	PMST Bionet	Low – no suitable habitat identified within the study area or its vicinity.	No
Limosa lapponica menzbieri	Bar-tailed Godwit (Eastern Siberian subspecies)	CE, M		The Bar-tailed Godwit (both subspecies combined) has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria. The migratory Bar-tailed Godwit (western Alaskan) does not breed in Australia. Occurs mainly in coastal habitats in coastal habitats which include large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It also has been recorded in coastal sewage farms and saltworks, salt lakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms and coral reef-flats.	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No
Limosa limosa	Black-tailed Godwit	M	V	This species is a migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer. Usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. Further inland, can be found on mudflats and in water less than 10cm deep, around muddy lakes and swamps.	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Lophoictinia isura	Square-tailed Kite	-	V	The Square-tailed Kite ranges along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by March. Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. In arid north-western NSW, has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland. Is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage.	WSP	**High** – highly mobile, local records and suitable habitat within the study area.	**Yes**
Merops ornatus	Rainbow Bee-eater	M		The Rainbow Bee-eater is distributed across much of mainland Australia occurring mainly in open forests (usually dominated by eucalypts) and woodlands, shrublands, and in various cleared or semi-cleared habitats.	PMST Bionet	Low – may occasionally occur over the study area during migratory movements, but there is no suitable habitat for this species to establish breeding territories within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Monarcha melanopsis	Black-faced Monarch	M	-	Occurs in rainforests, eucalypt woodlands, coastal scrubs, damp gullies in rainforest, eucalypt forest and in more open woodland when migrating (Pizzey and Knight, 2007).	PMST	**Moderate** – may occur within the study area during migratory movements or post-breeding dispersals, but unlikely to establish breeding territories within the study area or its vicinity.	No
Monarcha trivirgatus	Spectacled Monarch	M	-	Occurs in the understorey of mountain/lowland rainforests, thickly wooded gullies and waterside vegetation. Migrates to NE NSW in summer to breed (Pizzey and Knight, 2007).	PMST	Low – rare locally and unlikely to occur within the study area or its vicinity. Very rare and accidental occurrences cannot be entirely discounted.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Motacilla flava	Yellow Wagtail	M	-	This species occurs in a range of habitats including estuarine habitats such as sand dunes, mangrove forests and coastal saltmarshes. This species also occurs in open grassy areas including disturbed sites such as sports grounds and has been recorded on the edges of wetlands, swamps, lakes and farm dams. This species migrates from Asia to Australia in spring-summer. It has been recorded in the estuarine areas of the Hunter River in Newcastle NSW and in QLD and the north of NT and WA (Higgins et al., 2006).	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No
Myiagra cyanoleuca	Satin Flycatcher	M		Widespread in eastern Australia. In Queensland, it is widespread but scattered in the east. In NSW, they are widespread on and east of the Great Divide and sparsely scattered on the western slopes, with very occasional records on the western plains. In Victoria, the species is widespread in the south and east, in the area south of a line joining Numurkah, Maldon, the northern Grampians, Balmoral and Nelson. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. Satin Flycatchers mainly inhabit eucalypt forests, often near wetlands or watercourses. They generally occur in moister, taller forests, often occurring in gullies. They also occur in eucalypt woodlands with open understorey and grass ground cover, and are generally absent from rainforest. In south-eastern Australia, they occur at elevations of up to 1400 m above sea level, and in the ACT, they occur mainly between 800 m above sea level and the tree-line (Department of the Environment, 2016d, Pizzey and Knight, 2007).	PMST	Low – rare locally and unlikely to occur within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Ninox connivens	Barking Owl	-	V	The Barking Owl is found throughout continental Australia except for the central arid regions. Although common in parts of northern Australia, the species has declined greatly in southern Australia and now occurs in a wide but sparse distribution in NSW. Core populations exist on the western slopes and plains and in some northeast coastal and escarpment forests. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile riparian soils. Preferentially hunts small arboreal mammals such as Squirrel Gliders and Common Ringtail Possums, but when loss of tree hollows decreases these prey populations the owl becomes more reliant on birds, invertebrates and terrestrial mammals such as rodents and rabbits. Requires very large permanent territories in most habitats due to sparse prey densities. Monogamous pairs hunt over as much as 6000 hectares, with 2000 hectares being more typical in NSW habitats.	Bionet	Low – study area is unlikely to be important to this species locally, but accidental occurrences cannot be entirely discounted.	No
Ninox strenua	Powerful Owl	-	V	A sedentary species with a home range of approximately 1000 hectares it occurs within open *Eucalypt*, *Casuarina* or *Callitris* pine forest and woodland. It often roosts in denser vegetation including rainforest of exotic pine plantations. Generally, feeds on medium-sized mammals such as possums and gliders but will also eat birds, flying-foxes, rats and insects. Prey are generally hollow dwelling and require a shrub layer and owls are more often found in areas with more old trees and hollows than average stands (Garnett and Crowley, 2000).	WSP	**Moderate** – the study area is unlikely to be important to this species locally, but it likely falls within the home ranges of local individuals.	**Yes**

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Numenius madagascariensis	Eastern Curlew	M, CE		Inhabits coastal estuaries, mangroves, mud flats and sand pits. It is a migratory shorebird which generally inhabits sea and lake shore mud flats, deltas and similar areas, where it forages for crabs and other crustaceans, clam worms and other annelids, molluscs, insects and other invertebrates. Its migration route ranges from its wintering grounds in Australia to its breeding grounds in northern China, Korea and Russia (Pizzey and Knight, 2007).	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No
Numenius phaeopus	Whimbrel	M	-	Migrates to Taiwan, Philippines, PNG, and a race breeding in NE Siberia is found on the north and south-eastern coastlines of Australia. Juveniles arrive to Australia from spring to early summer. Usually only juveniles remain in Australia but very occasionally adults in breeding plumage may be seen in Australian winters (Pizzey and Knight, 2007). Whimbrels are found mainly on the coast, on tidal and estuarine mudflats, especially near mangroves. They are sometimes found on beaches and rocky shores (BirdLife Australia, 2020).	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No
Pandion haliaetus cristatus	Eastern Osprey	M	V	Eastern Ospreys are found right around the Australian coastline, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. There are a handful of records from inland areas. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water.	PMST Bionet	Low – no suitable habitat identified within the study area.	No
Pluvialis fulva	Pacific Golden Plover	M	-	Prefers sandy, muddy or rocky shores, estuaries and lagoons, reefs, saltmarsh, and or short grass in paddocks and crops. The species is usually coastal, including offshore islands; rarely far inland. Often observed on beaches and mudflats, sandflats and occasionally rock shelves, or where these substrates intermingle; harbours, estuaries and lagoons.	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Pluvialis squatarola	Grey Plover	M	-	In non-breeding grounds in Australia, Grey Plovers occur almost entirely in coastal areas, where they usually inhabit sheltered embayments, estuaries and lagoons with mudflats and sandflats, and occasionally on rocky coasts with wave-cut platforms or reef-flats, or on reefs within muddy lagoons. They also occur around terrestrial wetlands such as near-coastal lakes and swamps, or salt-lakes. The species is also very occasionally recorded further inland, where they occur around wetlands or salt-lakes (Marchant and Higgins, 1993). They usually forage on large areas of exposed mudflats and beaches and occasionally in pasture and on muddy margins of inland wetlands (Marchant and Higgins, 1993). They usually roost in sandy areas, such as on unvegetated sandbanks or sand-spits on sheltered beaches or other sheltered environments (Jaensch et al., 1988, Pegler, 1983).	Bionet	Low – no suitable habitat identified within the study area or its vicinity.	No
Ptilinopus magnificus	Wompoo Fruit-dove	-	V	Occurs in rainforests, monsoon forests, adjacent eucalypt forests, fruiting trees on scrubby creeks or in open country (Garnett and Crowley, 2000).	Bionet	Low – no suitable habitat identified within the study area or its vicinity.	No
Ptilinopus superbus	Superb Fruit Dove	-	V	Occurs primarily from north-eastern Qld to north-eastern NSW. It is much less common further south. Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees.	Bionet	Low – no suitable habitat identified within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Rhipidura rufifrons	Rufous Fantail	M	-	Occurs in a range of habitats including the undergrowth of rainforests/wetter eucalypt forests/gullies, monsoon forests paperbarks, sub-inland and coastal scrubs, mangroves, watercourses, parks and gardens. When migrating they may also be recorded on farms, streets and buildings. Migrates to SE Australia in October-April to breed, mostly in or on the coastal side of the Great Dividing Range (Pizzey and Knight, 2012).	PMST	**High** – may occur within the study area during migratory movements or post-breeding dispersals, and there is sufficient suitable habitat to establish breeding territories within the study area.	No
Rostratula australis (syn. R. benghalensis)	Australian Painted Snipe	VM	E1	Inhabits shallow, vegetated, temporary or infrequently filled wetlands, including where there are trees such as *Eucalyptus camaldulensis* (River Red Gum), *E. populnea* (Poplar Box) or shrubs such as *Muehlenbeckia florulenta* (Lignum) or *Sarcocornia quinqueflora* (Samphire). Feeds at the water's edge and on mudlflats on seeds and invertebrates, including insects, worms, molluscs and crustaceans. Males incubate eggs in a shallow scrape nest (Garnett and Crowley, 2000).	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No
Sterna hirundo	Common Tern	M	-	A non-breeding migrant to Australia, occurring mainly on the east coast and inhabiting marine, pelagic and coastal habitats. Mostly oceanic but often recorded in bays, harbours and estuaries and occasionally in coastal wetlands. Roosting occurs on unvegetated intertidal sandy ocean beaches, shores of estuaries, lagoons and sand bars (Higgins and Davies, 1996).	BioNet	Low – no suitable habitat identified within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Stictonetta naevosa	Freckled Duck	-	V	In most years this species appears to be nomadic between ephemeral inland and coastal wetlands. In dry years they congregate on permanent wetlands while in wet years they breed prolifically and disperse widely, generally towards the coast. In inland eastern Australia, they generally occur in brackish to hyposaline wetlands that are densely vegetated with Lignum (Muehlenbeckia cunninghamii) within which they build their nests (Garnett and Crowley, 2000).	BioNet	Low – no suitable habitat identified within the study area or its vicinity.	No
Tringa brevipes	Grey-tailed Tattler	M		Often found on sheltered coasts with reefs, rock platforms or with intertidal mudflats. It is also found at intertidal rocky, coral or stony reefs, platforms and islets that are exposed at low tide. It has also been found in embayments, estuaries and coastal lagoons, especially fringed with mangroves. It is rarely seen on open beaches and occasionally found around near-coastal wetlands, such as lagoons, lakes and ponds in sewage farms and saltworks. Inland records for the species are rare (Higgins and Davies, 1996). The species forages in shallow water, hard intertidal substrates, rock pools, intertidal mudflats, mangroves, banks of seaweed and among rocks and coral rubble, over which water may surge. The species roosts in mangroves, dense stands of shrubs, snags, rocks, beaches, reefs, artificial structures (sea walls, oyster racks), occasionally in near-coastal saltworks and sewage ponds and rarely on sandy beaches or sand banks (Higgins and Davies, 1996, Rogers, 1999).	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No
Tringa nebularia	Common Greenshank	M		Occurs in a range of inland and coastal environments. Inland, it occurs in both permanent and temporary wetlands, billabongs, swamps, lakes floodplains, sewage farms, saltworks ponds, flooded irrigated crops. On the coast, it occurs in sheltered estuaries and bays with extensive mudflats, mangrove swamps, muddy shallows of harbours and lagoons, occasionally rocky tidal ledges. It generally prefers wet and flooded mud and clay rather than sand (Morcombe, 2003).	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Tringa stagnatilis	Marsh Sandpiper	M		Occurs in coastal and inland wetlands (salt or fresh water), estuarine and mangrove mudflats, beaches, shallow or swamps, lakes, billabongs, temporary floodwaters, sewage farms and saltworks ponds.	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No
Tyto novaehollandiae	Masked Owl	-	V	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution. Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-range of 500 to 1000 hectares.	Bionet	Low – marginal habitat identified within the study area and its vicinity.	No
Tyto tenebricosa	Sooty Owl	-	V	Occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. Territories are occupied permanently. Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Roosts by day in the hollow of a tall forest tree or in heavy vegetation; hunts by night for small ground mammals or tree-dwelling mammals such as the Common Ringtail Possum (Pseudocheirus peregrinus) or Sugar Glider (Petaurus breviceps). Nests in very large tree-hollows.	Bionet	Low – no suitable habitat identified within the study area or its vicinity.	No
Xenus cinereus	Terek Sandpiper	M	V	Recorded on coastal mudflats, lagoons, creeks and estuaries. Favours mudbanks and sandbanks located near mangroves but may also be observed on rocky pools and reefs, and occasionally up to 10km inland around brackish pools.	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Mammals							
Cercartetus nanus	Eastern Pygmy-possum	-	V	The Eastern Pygmy-possum is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extends from the coast, to inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes. Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable.	Bionet	Low – no suitable habitat identified within the study area or its vicinity.	No
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Occurs in moderately wooded habitats, mainly in areas with extensive cliffs and caves and roosts in caves, mine tunnels and the abandoned, bottle-shaped mud nests of Fairy Martins (Churchill, 1998, Office of Environment and Heritage, 2011). Breeding habitat (maternity roosts) is located in roof domes in sandstone caves (Office of Environment and Heritage, 2011). Thought to forage below the forest canopy for small flying insects (Churchill, 1998).	PMST	Low – no local records and suitable habitat not identified within the study area.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Dasyurus maculatus maculatus	Spotted-Tailed Quoll	E	V	Occurs from the Bundaberg area in south-east Queensland, south through NSW to western Victoria and Tasmania. In NSW, it occurs on both sides of the Great Dividing Range and north-east NSW represents a national stronghold (NSW National Parks and Wildlife Service, 1999c). Occurs in wide range of forest types, although appears to prefer moist sclerophyll and rainforest forest types, and riparian habitat. Most common in large unfragmented patches of forest. It has also been recorded from dry sclerophyll forest, open woodland and coastal heathland, and despite its occurrence in riparian areas, it also ranges over dry ridges. Nests in rock caves and hollow logs or trees. Feeds on a variety of prey including birds, terrestrial and arboreal mammals, small macropods, reptiles and arthropods (NSW National Parks and Wildlife Service, 1999b, NSW National Parks and Wildlife Service, 1999c).	Bionet PMST	Low – no suitable habitat identified within the study area or its vicinity.	No
Falsistrellus tasmaniensis	Eastern False Pipistrelle	-	V	The Eastern False Pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania. Prefers moist habitats, with trees taller than 20 m. Generally, roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	Bionet	**Moderate** – rare locally with no recent records, no records in the vicinity of the study area. Due to mobility and potential foraging and roosting habitat cannot be discounted.	**Yes**

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Micronomus norfolkensis	Eastern Free-tailed Bat	-	V	The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW. Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures (Churchill, 2008). Also known to roost and breed in the hollows of mangroves, and travelling considerable distances to forage (Anna McConville, 2013).	Bionet	**Moderate** – records rare locally with no records in the vicinity of the study area. Potential foraging and roosting habitat identified within the study area and its vicinity.	**Yes**
Miniopterus australis	Little Bent-winged Bat	-	V	Distributed along the east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Found in moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally, found in well-timbered areas. Roosts in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats(Office of Environment & Heritage, 2014b).	Bionet	**Recorded** – Foraging habitat within the study area, but no roosting habitat.	**Yes**

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Miniopterus orianae oceanensis	Large Bent-winged Bat	-	V	Eastern Bentwing-bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Hunt in rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, Melaleuca forests and open grasslands(Office of Environment & Heritage, 2016a).	Bionet	**High** – potential foraging habitat identified within the study area and records within its vicinity. Likely to forage within the study area, but no roosting habitat present.	**Yes**
Myotis macropus	Southern Myotis	-	V	Found in most habitat types in association with streams and permanent waterways usually at low elevations in flat or undulating landscapes from northern areas of Western Australia, and the Northern Territory, down the entire east coast and the southern coast of Australia to just west of the Victoria/South Australia border and inland along the Murray River. Roosts in caves, tree hollows, in clumps of dense vegetation (e.g. Pandanus), mines, tunnels, under bridges, road culverts and stormwater drains often in abandoned, intact Fairy Martin nests. Roost sites are strongly associated with bodies of water where this species commonly feeds on aquatic insects, shrimp and small fish at the water surface, however, aerial foraging for other insects is also known(Churchill, 2008). Breeding habitat likely to coincide with roosting habitat (Office of Environment & Heritage, 2016d).	Bionet	Low – marginal habitat identified within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Petaurus norfolcensis	Squirrel Glider	-	V	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey. Require abundant tree hollows for refuge and nest sites. Diet varies seasonally and consists of Acacia gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein.	BioNet	**Moderate** – although there is a relatively low number of hollows within the study area, there is sufficient shelter and foraging habitats to support local individuals.	**Yes**
Petauroides volans	Greater Glider	V	-	The Greater Glider has a restricted distribution in eastern Australia, from the Windsor Tableland in north Queensland to central Victoria, with an elevated range from sea level to 1200m above sea level. The species is largely restricted to eucalypt forests and woodlands, with a diet comprising of eucalypt leaves and occasional flowers. It is found in abundance in montane eucalypt forest with relatively old trees and an abundance of hollows. It also favours forests with a diversity of eucalypts to cater for seasonal variation in food abundance (Department of the Environment, 2015).	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Petaurus australis	Yellow-bellied Glider	-	V	The Yellow-bellied Glider is found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. Extract sap by incising (or biting into) the trunks and branches of favoured food trees, often leaving a distinctive 'V'-shaped scar. Very mobile and occupy large home ranges between 20 to 85 ha to encompass dispersed and seasonally variable food resources.	BioNet	Low – no suitable habitat identified within the study area or its vicinity.	No
Petrogale penicillata	Brush-tailed Rock-wallaby	V	E1	Occurs in inland and sub-coastal south eastern Australia where it inhabits rock slopes. It prefers rocks which receive sunlight for a considerable part of the day. Windblown caves, rock cracks or tumbled boulders are used for shelter. Occur in small groups or "colonies" each usually separated by hundreds of metres (NSW National Parks and Wildlife Service, 2003a).	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Phascolarctos cinereus	Koala	V	V	The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. Inhabits eucalypt woodlands and forests. Koalas Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. The preferred tree species vary widely on a regional and local basis. Some preferred species include Forest Red Gum *Eucalyptus tereticornis*, Grey Gum *E. punctata*. In coastal areas, Tallowwood *E. microcorys* and Swamp Mahogany *E. robusta* are important food species, while in inland areas White Box *E. albens*, Bimble Box *E. populnea* and River Red Gum *E. camaldulensis* are favoured (NSW National Parks and Wildlife Service, 1999a, NSW National Parks and Wildlife Service, 2003b, Office of Environment & Heritage, 2016b). Hawks Nest and Tea Gardens Population and population in the Pittwater LGA listed as Endangered under the NSW TSC Act(Office of Environment & Heritage, 2016c, Office of Environment & Heritage, 2013).	Bionet PMST	Low – no suitable habitat identified within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Potorous tridactylus	Long-nosed Potoroo	V	V	The long-nosed potoroo is found on the south-eastern coast of Australia, from Queensland to eastern Victoria and Tasmania, including some of the Bass Strait islands. There are geographically isolated populations in western Victoria. In NSW it is generally restricted to coastal heaths and forests east of the Great Dividing Range, with an annual rainfall exceeding 760mm. Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature. The fruit-bodies of hypogeous (underground-fruiting) fungi are a large component of the diet of the Long-nosed Potoroo. They also eat roots, tubers, insects and their larvae and other soft-bodied animals in the soil. Individuals are mainly solitary, non-territorial and have home range sizes ranging between 2-5 ha.	Bionet PMST	Low – no suitable habitat identified within the study area or its vicinity.	No
Pseudomys novaehollandiae	New Holland Mouse	V	-	The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes. Due to the largely granivorous diet of the species, sites where the New Holland Mouse is found are often high in floristic diversity, especially leguminous perennials (Department of the Environment, 2016c) (Office of Environment & Heritage, 2014c).	PMST	Low – no suitable habitat identified within the study area or its vicinity.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Occurs in the coastal belt from Rockhampton in central Queensland to Melbourne in Victoria. However, only a small proportion of this range is used at any one time, as the species selectively forages where food is available. As a result, patterns of occurrence and relative abundance within its distribution vary widely between seasons and between years. At a local scale, the species is generally present intermittently and irregularly. At a regional scale, broad trends in the distribution of plants with similar flowering and fruiting times support regular annual cycles of migration. Whilst Brisbane, Newcastle, Sydney and Melbourne are occupied continuously, elsewhere, during spring, Grey-headed Flying-foxes are uncommon south of Nowra and widespread in other areas of their range. The species is widespread throughout their range in summer, whilst in autumn it occupies coastal lowlands and is uncommon inland. In winter, the species congregates in coastal lowlands north of the Hunter Valley and is occasionally found on the south coast of NSW (associated with flowering Spotted Gum *Corymbia maculata*) and on the northwest slopes (generally associated with flowering White Box *Eucalyptus albens* or Mugga Ironbark *E. sideroxylon*). Occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines (Office of Environment & Heritage, 2015b) (Department of the Environment, 2016a).	Bionet PMST	**Recorded** – a diverse range of suitable seasonal foraging habitat identified within the study area, with an abundance of local records. Species observed foraging on Red Mahogany blossom (*Eucalyptus resinifera* ssp. *resinifera*).	**Yes**

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat		V	This species is widespread through tropical Australia and migrates to southern Australia in summer. Occurs in eucalypt forest where it feeds above the canopy and in mallee or open country where it feeds closer to the ground. Generally, a solitary species but sometimes found in colonies of up to 10. It roosts and breeds in tree hollows but has also been recorded roosting under exfoliating bark, in burrows of terrestrial mammals, in soil cracks and under slabs of rock and in the nests of bird and sugar gliders (Churchill, 2008, Office of Environment & Heritage, 2014d).	Bionet	Low – rare locally, no records within the study area or its vicinity, although accidental records cannot be entirely discounted.	No
Scoteanax rueppellii	Greater Broad-nosed Bat	-	V	The preferred hunting areas of this species include tree-lined creeks and the ecotone of woodlands and cleared paddocks but it may also forage in rainforest. Typically, it forages at a height of 3-6 metres but may fly as low as one metre above the surface of a creek. It feeds on beetles, other large, slow-flying insects and small vertebrates. It generally roosts in tree hollows but has also been found in the roof spaces of old buildings (Churchill, 2008)	Bionet	Low – marginal habitat identified within the study area and its vicinity, with local records associated with forested ranges.	No

Scientific name	Common Name	EPBC Act[1]	BC Act[2]	Habitat	Data source[3]	Likelihood of occurrence	Significant impact assessment required?
Vespadelus troughtoni	Eastern Cave Bat	-	V	The Eastern Cave Bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals. Occasionally found along cliff-lines in wet eucalypt forest and rainforest.	Bionet	Low – very rare locally with scant records in the region. There are no suitable roosting habitats for this species in the vicinity of the site.	No

Appendix C – Test of significance

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

Assessment of habitat to be impacted upon by the Proposal found that there is potential within the study area for threatened biodiversity to occur. The following species have been assessed as part of this Proposal:

- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Threatened terrestrial orchids
  - *Caladenia tessellata* (Thick Lip Spider Orchid)
  - *Cryptostylis hunteriana* (Leafless Tongue Orchid)
  - *Diuris praecox* (Rough Double Tail)
- *Rhodamnia rubescens* (Scrub Turpentine)
- Wallum Froglet
- Gang-Gang Cockatoo
- Varied Sittella
- Little Lorikeet and Swift Parrot
- Square-tailed Kite
- Powerful Owl
- Squirrel Glider
- Cave-dwelling microchiropteran bats
  - Little Bent-winged Bat
  - Large Bent-winged Bat
- Hollow-dwelling microchiropteran bats
  - Eastern False Pipistrelle
  - Eastern Freetail-bat
- Grey-headed Flying-fox

For threatened biodiversity under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999) significance assessments have been completed in accordance with the *Matters of National Environmental Significance, Significant Impact Guidelines 1.1* (Department of Environment, 2013). Species listed under both the BC Act and the EPBC Act has been assessed using both assessment guidelines separately.

The following assessments were undertaken to consider impacts of works associated with the Proposal upon threatened species, populations or communities with a moderate or greater likelihood of occurring within the proposal footprint.

Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Status

Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions is listed as an Endangered Ecological Community under the BC Act. This ecological community is not a listed threatened entity under the EPBC Act.

Specific impacts

Intact condition patches of PCT 1717 within the study area are considered consistent with the Swamp Sclerophyll Forest threatened ecological community) as they conform with the following locality, floristics, landscape and geological characteristics of Swamp Sclerophyll Forest as detailed in the NSW Scientific Committee Final Determination (NSW Scientific Committee, 2011):

- Occurred on sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains at elevations below 20 m
- Community occurred as an open forest and low scrub that contain characteristic species representative of Swamp Sclerophyll Forest as listed under Paragraph 1 of the NSW Scientific Determination.
- Occurred within the Central Coast LGA within the Sydney Basin IBRA bioregion

Impacts have been restricted to < 0.1 ha (0.09 ha) of PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast – Type variant intact.

Section 7.3 Test of Significance

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

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **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**

The proposed activity has been designed to avoid and minimise impacts to Wamberal Lagoon Nature Reserve and as such direct impacts on the local occurrence of Swamp Sclerophyll Forest on Coastal Floodplain has been reduced to < 0.1 ha. This impact is restricted to the edge of a larger patch and is unlikely 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.

- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

The proposed activity will impact (< 0.1 ha) a fringing edge area of Swamp Sclerophyll Forest on Coastal Floodplain and is unlikely 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

In relation to the habitat of a threatened species, population or ecological community:

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

The proposed activity will remove or alter approximately < 0.1 ha of PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast – Type variant intact (Swamp Sclerophyll Forest on Coastal Floodplain).

- **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**

The extent of habitat to be removed represents a very small (< 0.1 ha) proportion of potential habitat available within the surrounding landscape. Owing to the relatively small extent of potential habitat impacts and that impacts are restricted to the edge of an existing patch; areas of habitat are considered unlikely to become fragmented or isolated from other areas of habitat because of the proposed activity.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The extent of habitat that may be impacted represents a small proportion (< 0.1 ha) of extent to Swamp Sclerophyll Forest on Coastal Floodplain within the surrounding landscape. Owing to the relatively small extent of habitat impact and that impacts are restricted to the edge of an existing patch, the importance of the habitat to be removed, modified, fragmented or isolated is considered unlikely to significantly affect the long-term survival of this ecological community in the locality.

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 study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to Swamp Sclerophyll Forest on Coastal Floodplain, the proposal is consistent with one key threatening process under the BC Act, being clearing of native vegetation. The extent of native vegetation clearing, and habitat removal associated with the proposed works, is considered very small (< 0.1 ha) in terms of the available habitat for this ecological community within the surrounding landscape.

Conclusion

The extent of native vegetation clearing, and habitat removal associated with the proposal, is very small (0.09ha) in terms of the available habitat for this ecological community within the surrounding landscape. The potential loss of habitat for Swamp Sclerophyll Forest on Coastal Floodplain is considered unlikely to be significant to the maintenance of this ecological community locally, and therefore the proposed works are considered unlikely to have a significant impact upon this Swamp Sclerophyll Forest on Coastal Floodplain, which might lead to its extinction locally.

Threatened terrestrial orchids

Status

- *Caladenia tessellata* (Thick Lip Spider Orchid) is listed as Endangered under the BC Act and Vulnerable under the EPBC Act.
- *Cryptostylis hunteriana* (Leafless Tongue Orchid) is listed as Vulnerable under the BC Act and EPBC Act.
- *Diuris praecox* (Rough Double Tail) is listed as Vulnerable under the BC Act and EPBC Act.

Specific impact

No threatened orchid species have been recorded within the study area although given associated habitats for these species occur and that surveys were completed outside the recognised seasonal flower period assumed presence has been adopted for these species. An overview of potential impact for each species is presented in the table below.

Species	Potential occurrence	Impacted by proposal?	Impact (ha/ individuals)
Caladenia tessellata (Thick Lip Spider Orchid)	Assumed present	Yes – potential habitat PCT 1589	0.20 ha
Cryptostylis hunteriana (Leafless Tongue Orchid)	Assumed present	Yes – potential habitat PCT 1589 & 1716	0.29 ha
Diuris praecox (Rough Double Tail)	Assumed present	Yes – potential habitat PCT 1589 & 1716	0.29 ha

The potential impact on threatened terrestrial orchid assumed habitat will be < 0.3 hectares and restricted to edge areas of vegetation adjacent to the existing Central Coast Highway.

Section 7.3 Test of Significance

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 proposed activity is unlikely to significantly affect processes such as pollination, seed dispersal and recruitment which could affect the breeding of any population of these species in the study area. It is unknown whether a viable population of any of these species exists within the study area.

If present, these species would exist as small, likely isolated populations. Due to the very small area of habitat to be removed (< 0.3 ha) and the lack of records near the study area, the proposed activity is considered unlikely to place these species at risk of extinction.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

Not applicable

- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable

In relation to the habitat of a threatened species, population or ecological community: the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The proposed activity will remove or alter about < 0.3 hectares of assumed habitat for these threatened terrestrial orchid species.

- **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**

The extent of habitat to be removed represents a very small (< 0.3 ha) proportion of potential habitat available within the surrounding landscape. Owing to the relatively small extent of potential habitat impacts and that impacts are restricted to the edge of an existing patch; areas of habitat are considered unlikely to become fragmented or isolated from other areas of habitat because of the proposed activity.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The extent of habitat that may be impacted represents a small proportion (< 0.3 hectare) of extent to threatened terrestrial orchid habitat within the surrounding landscape. Owing to the relatively small extent of habitat impact and that impacts are restricted to the edge of an existing patch, the importance of the habitat to be removed, modified, fragmented or isolated is considered unlikely to significantly affect the long-term survival of this ecological community in the locality.

- **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 study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to threatened terrestrial orchids, the proposed activity is consistent with one key threatening process under the BC Act, being clearing of native vegetation. The extent of native vegetation clearing, and habitat removal associated with the proposed activity, is considered small (< 0.3 ha) in terms of the available habitat for these species within the surrounding landscape.

Conclusion

These species were not recorded during surveys. The proposed activity will result in the clearing of < 0.3 ha of potential habitat for these species. Although some terrestrial orchid species are known to both occur locally and persist in disturbed sites, the proposed activity is restricted to the edge area of a large patch of habitat and there are larger extents of available habitat within the surrounding locality. Given the limited extent of habitat for the threatened species of plant that will be affected by the proposed activity, the impact on these species is unlikely to be significant.

EPBC Act Significance assessment

Caladenia tessellata (Thick Lip Spider Orchid), *Cryptostylis hunteriana* (Leafless Tongue Orchid) and *Diuris praecox* (Rough Double Tail) are listed as Vulnerable under the EPBC Act.

The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, 2013). Under the Act, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

Is this part of an important population?

Caladenia tessellata (Thick Lip Spider Orchid), *Cryptostylis hunteriana* (Leafless Tongue Orchid) and *Diuris praecox* (Rough Double Tail) were not recorded within the study area. However, surveys undertaken for this study were also not conducted during these species flowering period. As no individuals were recorded within the study area, and given the proposed action is limited to edge areas of habitat, it is considered unlikely to contain an 'important population' of these species.

This location is not at the limit of these species known range. It is considered unlikely that the proposed action will significantly impact these species ability to reproduce. Considering the number of records within the wider locality and the way these species reproduce, it is considered unlikely that any individuals found within the study area would be necessary for maintaining genetic diversity regionally.

Therefore, it is considered unlikely that any *Caladenia tessellata* (Thick Lip Spider Orchid), *Cryptostylis hunteriana* (Leafless Tongue Orchid) and *Diuris praecox* (Rough Double Tail) individuals present within the study area would represent members of an important population under the definition of the EPBC Act.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in one or more of the following:

- **Lead to a long-term decrease in the size of an important population of a species**

Not applicable.

- **Reduce the area of occupancy of an important population**

Not applicable.

- **Fragment an existing important population into two or more populations**

Not applicable.

- **Adversely affect habitat critical to the survival of a species**

No critical habitat is listed for this species under the EPBC Act.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal

- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment Water Heritage and the Arts, 2009).

Due to the current mitigation measures being implemented, the small extent of assumed habitat being removed that is limited to existing edge areas, and abundance of potential habitat for this species in the surrounding vegetation, it is unlikely that the proposed action will significantly impact upon this species. Therefore, the habitat that is to be removed is not considered to represent habitat critical to the survival of *Caladenia tessellata* (Thick Lip Spider Orchid), *Cryptostylis hunteriana* (Leafless Tongue Orchid) and *Diuris praecox* (Rough Double Tail).

- **Disrupt the breeding cycle of an important population**

Not applicable.

- **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

Not applicable.

- **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**

The Proposal has limited potential to spread weeds, through heavy machinery during and post construction works. Mitigation measures have been provided to minimise the likelihood of weed spread. The vegetation to be cleared is unlikely to be harmful to this species, due to its absence from the vicinity of the proposed action.

- **Introduce disease that may cause the species to decline**

No, there are no known diseases associated with *Caladenia tessellata* (Thick Lip Spider Orchid), *Cryptostylis hunteriana* (Leafless Tongue Orchid) and *Diuris praecox* (Rough Double Tail), and it is unlikely that this species would be affected by the introduction of plant pathogens, due to the unlikelihood of it occurring near the proposed action.

- **Interfere substantially with the recovery of the species**

No recovery plans have been prepared for *Caladenia tessellata* (Thick Lip Spider Orchid), *Cryptostylis hunteriana* (Leafless Tongue Orchid) and *Diuris praecox* (Rough Double Tail). The study area has not been identified as important habitat for the recovery of the species and it is considered unlikely that the proposed action would substantially interfere with the overall recovery of these species.

Conclusion

These species were not recorded during surveys although surveys undertaken for this study were also not conducted during these species flowering period. The proposed action will result in the clearing of < 0.3 ha of potential habitat for these species. Although some terrestrial orchid species are known to both occur locally and persist in disturbed sites, the proposed activity is restricted to the edge area of a large patch of habitat and there are greater extents of available habitat within the surrounding locality. Given this, the study area is considered unlikely to contain an 'important population' of these species.

This study area is not at the limit of these species known range. It is considered unlikely that the proposed works will significantly impact these species ability to reproduce. Due to the relatively small amount of habitat to be removed when compared to the abundance of habitat for this species in the surrounding vegetation, it is considered unlikely the project will adversely impact on the survival of these species.

Rhodamnia rubescens (Scrub Turpentine)

Status

Rhodamnia rubescens (Scrub Turpentine) is listed as an Endangered Ecological Community under the BC Act. This species is not a listed threatened entity under the EPBC Act.

Specific impact

A single individual of *Rhodamnia rubescens* (Scrub Turpentine) was recorded from the study area within PCT 1716 - Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast. The individual recorded was in a juvenile age class, about 50 centimetres in height with 4 or 5 small branches. Given the young age class of the individual no seed production or propagation within the study area is considered likely. Evidence of Myrtle Rust infection was also observed.

The proposed activity has been designed to avoid all direct and indirect impact to this recorded individual. Impacts from the proposed activity will be limited to the removal of < 0.3 ha of potential habitat. Mitigation measures will be implemented to ensure any indirect edge effects are minimised.

Section 7.3 Test of Significance

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 proposed activity is unlikely to significantly affect processes such as pollination, seed dispersal and recruitment which could affect the breeding of a population of these species in the study area. The individual recorded within the study area was in a juvenile age class, about 50 centimetres in height with 4 or 5 small branches. Given the young age class of the individual no seed production or propagation within the study area is considered likely.

The proposed action will not result in any direct impact to known individual *Rhodamnia rubescens* (Scrub Turpentine) plants and is limited to the removal of < 0.3 ha of potential habitat. Given this, the proposed activity is considered unlikely 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.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

Not applicable

- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable

In relation to the habitat of a threatened species, population or ecological community: the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The proposed action will not result in any direct impact to known individual *Rhodamnia rubescens* (Scrub Turpentine) plants and is limited to the removal of < 0.3 ha of potential habitat.

- **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**

The extent of potential habitat to be removed represents a very small (< 0.3 ha) proportion of potential habitat available within the surrounding landscape. Owing to the relatively small extent of potential habitat impacts and that impacts are restricted to the edge of an existing patch; areas of habitat are considered unlikely to become fragmented or isolated from other areas of habitat because of the proposed activity.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The extent of potential habitat that may be impacted represents a small proportion (< 0.3 hectare) of extent to *Rhodamnia rubescens* (Scrub Turpentine) habitat within the surrounding landscape. Owing to the relatively small extent of habitat impact and that impacts are restricted to the edge of an existing patch, the importance of the habitat to be removed, modified, fragmented or isolated is considered unlikely to significantly affect the long-term survival of this ecological community in the locality.

- **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 study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to *Rhodamnia rubescens* (Scrub Turpentine), the proposed activity is consistent with one key threatening process under the BC Act, being clearing of native vegetation. The extent of native vegetation clearing, and habitat removal associated with the proposed activity, is considered small (< 0.3 ha) in terms of the available habitat for these species within the surrounding landscape.

In respect to Myrtle Rust, the recorded native vegetation types within the study area and broader locality have been identified

Conclusion

No impact to any known individuals of *Rhodamnia rubescens* (Scrub Turpentine) will occur because of the proposed activity. Impact to this species is limited to the clearing of < 0.3 ha of potential habitat although this habitat is considered unlikely to be important as there are larger extents of available habitat within the surrounding locality. Based on the test outlined above, the proposed activity is considered unlikely to significantly affect *Rhodamnia rubescens* (Scrub Turpentine), or its habitats.

Wallum Froglet

Status

The Wallum Froglet (*Crinia tinnula*) is listed as Vulnerable under the BC Act. The Wallum Froglet has been assessed due to the species use of melaleuca wetland habitats, which occur within northern sections of the study area.

Specific impact

Fauna habitat assessments undertaken within the study area assessed that wetland communities with potential to represent habitat for the Wallum Froglet occur to the east of the study area and enter it at its northern extremity. The proposal will result in the disturbance 0.09ha of wooded wetland habitats, which may provide potential breeding habitats for this species under suitable climatic conditions.

Section 7.3 Test of Significance

In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

A total of 0.09ha of melaleuca wetland habitats, representing potential habitat for the Wallum Froglet, may be adversely affected by the proposed works. Although the proposed works may represent the loss of potential foraging habitat, such resources within the study area are only a very small marginal component of locally occurring resources that are accessible to this species. Therefore, the proposed works are considered unlikely to impact these species such that a viable local or intermittent seasonal population would be placed at a significant risk of extinction.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

Not applicable.

- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

In relation to the habitat of a threatened species, population or ecological community: the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The proposal will remove or alter approximately 0.09ha of melaleuca wetland habitats that provide potential foraging habitat for this species.

- **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**

The extent of potential habitat to be removed represents a very small (0.09ha) proportion of potential habitat available within the surrounding landscape. Owing to the relatively small extent of potential habitat impacts, the proposal is assessed as unlikely to significantly affect the long-term survival of the Wallum Froglet in habitats adjacent to the study area.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The extent of potential habitat that may be impacted represents a small proportion (0.09ha) of habitat available to the Wallum Froglet within the surrounding landscape. Owing to the relatively small extent of habitat impact, the proposal is unlikely to affect the long-term survival of the Wallum Froglet.

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 study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to the Wallum Froglet, the proposal is consistent with one key threatening process under the BC Act, being clearing of native vegetation. The extent of native vegetation clearing, and habitat removal associated with the proposed works, is considered very small (0.09ha) in terms of the available habitat for this species within the surrounding landscape.

Conclusion
The extent of native vegetation clearing, and habitat removal associated with the proposal, is very small (0.09ha) in terms of the available habitat for this species within the surrounding landscape. The potential loss of habitat for the Wallum Froglet is not considered to be significant in regard to the maintenance of this species locally, and therefore the proposed works are unlikely to have a significant impact upon this species, which might lead to its extinction locally.

Gang-Gang Cockatoo

Status

The Gang-Gang Cockatoo (*Callocephalon fimbriatum*) is listed as Vulnerable under the BC Act. The Gang-Gang Cockatoo has been assessed due to its use of melaleuca wetland habitats, which occur within northern sections of the study area.

Specific Impacts

Fauna habitat assessments undertaken within the study area assessed that forested communities with potential to represent habitat for the Gang-Gang Cockatoo occur along the boundaries of the study area. There are no hollows of sufficient size within the study area to represent breeding opportunities for the Gang-Gang Cockatoo, therefore the study area is only likely to represent seasonal foraging opportunities for Gang-Gang Cockatoo populations in the wider locality. The proposal will result in the disturbance 0.48ha of wooded habitats, which may provide potential foraging habitats for this species.

Section 7.3 Test of Significance

In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

A total of 0.48ha of wooded habitat, representing potential habitat for the Gang-Gang Cockatoo, may be adversely affected by the proposed works. Although the proposed works may represent the loss of potential foraging habitat, such resources within the study area are only a very small marginal component of locally occurring resources that are accessible to this species. Therefore,

the proposed works are considered unlikely to impact these species such that a viable local or intermittent seasonal population would be placed at a significant risk of extinction.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

Not applicable.

- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

In relation to the habitat of a threatened species, population or ecological community: the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The proposal will remove or alter approximately 0.48ha of wooded habitats that provide potential foraging habitat for this species.

- **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**

The extent of potential habitat to be removed represents a very small proportion (0.48ha) of potential habitat available within the surrounding landscape for Gang-Gang cockatoos. Owing to the relatively small extent of potential habitat impacts, the proposal is assessed as unlikely to significantly affect the long-term survival of local Gang-Gang Cockatoo populations.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The extent of potential habitat that may be impacted represents a small proportion (0.48ha) of habitat available to the Gang-Gang Cockatoo within the surrounding landscape. Owing to the relatively small extent of habitat impact, the proposal is unlikely to affect the long-term survival of the Gang-Gang Cockatoo in the local area.

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 study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to the Gang-Gang Cockatoo, the proposal is consistent with one key threatening process under the BC Act, being clearing of native vegetation. The extent of native vegetation clearing, and habitat removal associated with the proposed works, is considered very small (0.48ha) in terms of the available habitat for this species within the surrounding landscape.

Conclusion

The extent of native vegetation clearing, and habitat removal associated with the proposal, is very small in terms of the available habitat for this species within the surrounding landscape. The potential loss of 0.48ha of wooded habitat for the Gang-Gang Cockatoo is not considered to be significant in regard to the maintenance of this species locally, and therefore the proposed works are unlikely to have a significant impact upon this species, which might lead to its extinction locally.

Varied Sittella

Status

The Varied Sittella (*Daphoenositta chrysoptera*) is listed as Vulnerable under the BC Act. The Varied Sittella has been assessed due to its use of wooded habitats, which occur widely along the boundaries of the study area.

Specific Impacts

Fauna habitat assessments undertaken within the study area assessed that wetland communities with potential to represent habitat the Varied Sittella occur to the east of the study area and enter it at its northern extremity. The proposal will result in the disturbance 0.48ha of wooded habitats, which may provide potential foraging habitats for this species.

Section 7.3 Test of Significance

In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

A total of 0.48 ha of habitat, representing potential habitat for the Varied Sittella, may be adversely affected by the proposed works. Although the proposed works may represent the loss of potential foraging habitat, such resources within the study area are only a very small marginal component of locally occurring resources that are accessible to this species. Therefore, the proposed works are considered unlikely to impact these species such that a viable local population would be placed at a significant risk of extinction.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

Not applicable.

- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

In relation to the habitat of a threatened species, population or ecological community: the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The proposal will remove or alter approximately 0.48ha of wooded habitats that provide potential foraging habitat for this species.

- **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**

The extent of potential habitat to be removed represents a very small proportion (0.48ha) of potential habitat available within the surrounding landscape. Owing to the relatively small extent of potential habitat impacts, the proposal is assessed as unlikely to significantly affect the long-term survival of the Varied Sittella in habitats adjacent to the study area.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The extent of potential habitat that may be impacted represents a small proportion of habitat available to the Varied Sittella within the surrounding landscape. Owing to the relatively small extent of habitat impact, the proposal is unlikely to affect the long-term survival of the Varied Sittella.

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 study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to the Varied Sittella, the proposal is consistent with one key threatening process under the BC Act, being clearing of native vegetation. The extent of native vegetation clearing, and habitat removal associated with the proposed works, is considered very small (0.48ha) in terms of the available habitat for this species within the surrounding landscape.

Conclusion
The extent of native vegetation clearing, and habitat removal associated with the proposal, is very small (0.48ha) in terms of the available habitat for this species within the surrounding landscape. The potential loss of habitat for the Varied Sittella is not considered to be significant in regard to the maintenance of this species locally, and therefore the proposed works are unlikely to have a significant impact upon this species, which might lead to its extinction locally.

Swift Parrot and Little Lorikeet

Status

The Swift Parrot (*Lathamus discolor*) is listed as Endangered under the BC Act and Critically Endangered under the EPBC Act.

The Little Lorikeet (*Glossopsitta pusilla*) is listed as Vulnerable under the BC Act.

Both species have been assessed together, due to their shared dependence on the blossom resources of myrtaceous canopy trees and their nomadic habits to access those foraging resources, which occur widely along the boundaries of the study area.
While the Little Lorikeet is likely to breed locally, the Swift Parrot, which only breeds in Tasmania, is only present on the mainland between April and September to seek nectar resources from winter flowering events.

Specific Impacts

Fauna habitat assessments undertaken within the study area assessed that wooded vegetation communities with potential to represent habitat for the Little Lorikeet and Swift Parrot occur widely

along the boundaries of the study area. The proposal will result in the disturbance 0.48ha of wooded habitats, which may provide potential foraging habitats for these species.

Section 7.3 Test of Significance

In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

A total of 0.48 ha of wooded habitats, representing potential foraging habitat for the Little Lorikeet and Swift Parrot and very marginal breeding opportunities for Little Lorikeet, may be adversely affected by the proposed works. Although the proposed works may represent the loss of wooded habitat, the loss of such resources within the study area is only a very small marginal component of locally occurring resources that are accessible to these species. Therefore, the proposed works are considered unlikely to impact these species such that a viable local or intermittent seasonal population would be placed at a significant risk of extinction.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

Not applicable.

- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

In relation to the habitat of a threatened species, population or ecological community: the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The proposal will remove or alter approximately 0.48ha of wooded habitats that provide potential foraging habitat for these species.

- **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**

The extent of potential habitat to be removed represents a very small proportion of wooded habitat available within the surrounding landscape. Owing to the relatively small extent of potential habitat impacts, the proposal is assessed as unlikely to significantly affect the long-term survival of the Swift Parrot or Little Lorikeet in habitats adjacent to or within the study area.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The extent of potential habitat to be removed represents a very small proportion (0.48ha) of wooded habitat available within the surrounding landscape. Owing to the relatively small extent of potential habitat impacts, the proposal is assessed as unlikely to significantly affect the quality of habitat for the Swift Parrot or Little Lorikeet in habitats adjacent to or within the study area.

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 study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to the Swift Parrot or Little Lorikeet, the proposal is consistent with one key threatening process under the BC Act, being clearing of native vegetation. The extent of native vegetation clearing (0.48ha), associated with the proposed works, is considered very small in terms of the available habitat for these species within the surrounding landscape.

Conclusion
The extent of native vegetation clearing, and habitat removal associated with the proposal, is very small (0.48ha) in terms of the available habitat for this species within the surrounding landscape. The potential loss of habitat for the Swift Parrot or Little Lorikeet is not considered to be significant in regard to the maintenance of these species locally, and therefore the proposed works are unlikely to have a significant impact upon these species, which might lead to its extinction locally.

EPBC Act Significance assessment – Swift Parrot

The Swift Parrot is listed as Endangered under the BC ACT and Critically Endangered under the EPBC Act. The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, 2013). Under the Act, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

Is this part of an important population?

Swift Parrots occur across a range of wooded habitats where their favoured foods, eucalypt blossom and lerp occur. They breed in Tasmania and disperse to different area across the South-eastern mainland in association with blossom availability. Swift Parrots migrate as far as southeast Queensland and use habitats from the coast to those on the western slopes of the Great Dividing Range.

The study area does not represent breeding habitat for Swift Parrots and does not occur at or near the limit of the species range, but individuals, which might use the site, may be important to the maintenance of genetic diversity. Therefore, a population of Swift Parrot in the study area is considered likely to be important, to the Swift Parrot population.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in one or more of the following:

Lead to a long-term decrease in the size of an important population of a species

The loss of 0.48ha of wooded habitat in the study area is unlikely to 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

The loss of 0.48ha of wooded habitat in the study area is considered unlikely to significantly reduce the area of occupancy of an important population.

Fragment an existing important population into two or more populations

The loss of 0.48ha of wooded habitat in the study area is considered unlikely to fragment an existing important population into two or more populations.

Adversely affect habitat critical to the survival of a species

No critical habitat is listed for this species under the EPBC Act. Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment Water Heritage and the Arts, 2009).

The proposed works will remove a small area (0.48ha) of wooded habitats, which may represent potential foraging habitat for this species. As this species is highly mobile, it is likely that suitable foraging resources could be accessed widely throughout the locality and beyond. Therefore, wooded habitat within the study area would not meet the above criteria.

Disrupt the breeding cycle of an important population

Not applicable. The Swift Parrot does not breed locally.

Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The loss of 0.48ha of wooded habitat in the study area is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

It is not likely that invasive species (such as introduced predators) that are harmful to the Swift Parrot would become further established as a result of the proposal.

Introduce disease that may cause the species to decline

No. There are no known diseases that are likely to increase in the area as a result of the proposed works.

Interfere substantially with the recovery of the species

Due to the limited foraging habitat likely to be affect by the proposed works (0.48 ha of wooded habitats) and as no breeding habitats are located in the vicinity of the study area, the proposed works are not likely to interfere with the recovery of this species.

Conclusion
The extent of native vegetation clearing and habitat removal associated with the proposed works is small (0.48ha) in terms of the available habitat for these species within the surrounding landscape. Although the loss of foraging habitat for Swift Parrot is considered to be an incremental loss of suitable habitat locally, the proposal is not likely to have a significant impact upon available resources for Swift Parrots in the vicinity of the site or its wider locality and the habitat to be impacted is not considered important to the long-term survival of the Swift Parrot.

Square-tailed Kite

Status

The Square-tailed Kite (*Lophoictinia isura*) is listed as Vulnerable under the BC Act. The Square-tailed Kite has been assessed due to its use of wooded habitats, which occur widely along the boundaries of the study area.

Specific Impacts

Fauna habitat assessments undertaken within the study area assessed that wooded vegetation communities with potential to represent habitat for the Square-tailed Kite occur along the boundaries of the study area. The proposal will result in the disturbance 0.48ha of wooded habitats, which may provide potential foraging habitats for this species.

Section 7.3 Test of Significance

In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

A total of 0.48 ha of wooded habitats, representing potential habitat for the Square-tailed Kite, may be adversely affected by the proposed works. Although the proposed works may represent the loss of potential foraging and marginal breeding habitat, such resources within the study area are only a very small marginal component of locally occurring resources that are accessible to this species. Therefore, the proposed works are considered unlikely to impact this species such that a viable local or intermittent seasonal population would be placed at a significant risk of extinction.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

Not applicable.

- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

In relation to the habitat of a threatened species, population or ecological community: the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The proposal will remove or alter approximately 0.48ha of wooded habitats that provide potential foraging habitat for this species.

- **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**

The extent of potential habitat to be removed represents a very small proportion (0.48ha) of potential habitat available within the surrounding landscape. Owing to the relatively small extent of potential habitat impacts, the proposal is assessed as unlikely to significantly affect the long-term survival of the Square-tailed Kite in habitats adjacent to the study area.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The extent of potential habitat that may be impacted represents a small proportion of habitat available to the Square-tailed Kite within the surrounding landscape. Owing to the relatively small extent of habitat impact, the proposal is unlikely to affect the long-term survival of the Square-tailed Kite.

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 study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to the Square-tailed Kite, the proposal is consistent with one key threatening process under the BC Act, being clearing of native vegetation. The extent of native vegetation clearing (0.48ha), and habitat removal associated with the proposed works, is considered very small in terms of the available habitat for this species within the surrounding landscape.

Conclusion

The extent of native vegetation clearing, and habitat removal associated with the proposal, is very small (0.48ha) in terms of the available habitat for this species within the surrounding landscape. The potential loss of habitat for the Square-tailed Kite is not considered to be significant in regard to the maintenance of this species locally, and therefore the proposed works are unlikely to have a significant impact upon this species, which might lead to its extinction locally.

Powerful Owl

Status

The Powerful Owl (*Ninox strenua*) is listed as Vulnerable under the BC Act. The Powerful Owl has been assessed due to its use of wooded habitats, which occur widely along the boundaries of the study area.

Specific Impacts

Fauna habitat assessments undertaken within the study area assessed that wooded habitats with potential to represent habitat for the Powerful Owl occur along the boundaries of the study area. The proposal will result in the disturbance 0.48ha of wooded habitats, which may provide potential foraging habitats for this species.

Section 7.3 Test of Significance

In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

A total of 0.48 ha of wooded habitats, representing potential habitat for the Powerful Owl, may be adversely affected by the proposed works. Although the proposed works may represent the loss of potential foraging habitat, such resources within the study area are only a very small marginal component of locally occurring resources that are accessible to this species. Therefore, the proposed works are considered unlikely to impact these species such that a viable local population would be placed at a significant risk of extinction.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

Not applicable.

- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

In relation to the habitat of a threatened species, population or ecological community: the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The proposal will remove or alter approximately 0.48ha of wooded habitats that provide potential foraging habitat for this species.

- **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**

The extent of potential habitat to be removed represents a very small proportion (0.48ha) of potential habitat available within the surrounding landscape. Owing to the relatively small extent of potential habitat impacts, the proposal is assessed as unlikely to significantly affect the long-term survival of the Powerful Owl in habitats adjacent to the study area.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The extent of potential habitat that may be impacted represents a small proportion (0.48ha) of habitat available to the Powerful Owl within the surrounding landscape. Owing to the relatively small extent of habitat impact, the proposal is unlikely to affect the long-term survival of the Powerful Owl.

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 study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to the Powerful Owl, the proposal is consistent with one key threatening process under the BC Act, being clearing of native vegetation. The extent of native vegetation clearing, and habitat removal associated with the proposed works, is considered very small (0.48ha) in terms of the available habitat for this species within the surrounding landscape.

Conclusion
The extent of native vegetation clearing, and habitat removal associated with the proposal, is very small (0.48ha) in terms of the available habitat for this species within the surrounding landscape. The potential loss of habitat for the Powerful Owl is not considered to be significant in regard to the maintenance of this species locally, and therefore the proposed works are unlikely to have a significant impact upon this species, which might lead to its extinction locally.

Squirrel Glider

Status

The Squirrel Glider (*Petaurus norfolcensis*) is listed as Vulnerable under the BC Act. The Squirrel Glider has been assessed due to its use of wooded habitats, which occur widely along the boundaries of the study area.

Specific Impacts

Fauna habitat assessments undertaken within the study area assessed that wooded vegetation communities with potential to represent habitat the Squirrel Glider occur along the boundaries of the study area. The proposal will result in the disturbance 0.48ha of wooded habitats, which may provide potential foraging and roosting habitats for this species.

Section 7.3 Test of Significance

In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

A total of 0.48 ha of wooded habitats, representing potential habitat for the Squirrel Glider, may be adversely affected by the proposed works. Although the proposed works may represent the loss of potential foraging and breeding habitat, such resources within the study area are only a very small and marginal component of locally occurring resources that are accessible to this species. Therefore, the proposed works are considered unlikely to impact these species such that a viable local population would be placed at a significant risk of extinction.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

Not applicable.

- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

In relation to the habitat of a threatened species, population or ecological community:

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

The proposal will remove or alter approximately 0.48ha of wooded habitats that provide potential foraging and marginal breeding habitat for this species.

- **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**

The extent of potential habitat to be removed represents a very small proportion (0.48ha) of potential habitat available within the surrounding landscape. Owing to the relatively small extent of potential habitat impacts, the proposal is assessed as unlikely to significantly affect the long-term survival of the Squirrel Glider in habitats adjacent to or within the study area.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The extent of potential habitat that may be impacted represents a small proportion (0.48ha) of habitat available to the Squirrel Glider within the surrounding landscape. Owing to the relatively small extent of habitat impact, the proposal is unlikely to affect the long-term survival of the Squirrel Glider.

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 study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to the Squirrel Glider, the proposal is consistent with one key threatening process under the BC Act, being clearing of native vegetation. The extent of native vegetation clearing, and habitat removal associated with the proposed works, is considered very small (0.48ha) in terms of the available habitat for this species within the surrounding landscape.

Conclusion

The extent of native vegetation clearing, and habitat removal associated with the proposal, is very small (0.48ha) in terms of the available habitat for this species within the surrounding landscape. The potential loss of habitat for the Squirrel Glider is not considered to be significant in regard to the maintenance of this species locally, and therefore the proposed works are unlikely to have a significant impact upon this species, which might lead to its extinction locally.

Cave-dwelling Microchiropteran bats

Status

Little Bent-wing Bat (*Miniopterus australis*), listed as Vulnerable on the BC Act

Large Bent-winged Bat (*Miniopterus orianae oceanensis*), listed as Vulnerable on the BC Act

Specific Impacts

Two species of threatened cave-dwelling microchiropteran bats are assessed as having a moderate or greater chance of occurrence within the proposal study area. Those species of cave-dwelling microchiropteran bat considered most likely to occur, include, the Little Bent-wing Bat

and Large Bent-winged Bat. These two *Miniopterus* sp. are dependent on cave habitats for roosting purposes, which are not present in the study area or its vicinity, so local occurrences are dependent only upon aerial foraging resources associated with onsite vegetation. The Little Bent-winged Bat was recorded during the survey.

Section 7.3 Test of Significance

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.

Due to the very small amount (0.48ha) of forested foraging habitats to be impacted, the proposed works are unlikely to have a significant adverse effect on the life cycle of cave-dwelling microchiropteran bats to the point that these species are likely to be placed at risk of extinction.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

Not applicable.

- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

In relation to the habitat of a threatened species, population or ecological community: the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

Approximately 0.48 ha of wooded foraging habitats.

- **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**

The removal of 0.48 ha of wooded vegetation within the study area will not add substantially to existing fragmentation or prevent movements to and from the abundance of similar and higher quality habitat within the wider locality.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

Although the proposed action will add incrementally to foraging habitat loss within the locality it is unlikely to exacerbate fragmentation at local or regional scales that would prevent these species from foraging or breeding within the locality. Given the small area to be impacted (0.48ha), the mobile nature of these species, and the availability of suitable habitat in the wider locality, the loss of a very small amount of potential foraging habitat is unlikely to affect the long-term survival of these species.

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 study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to cave-dwelling microchiropteran bats, the proposed action is consistent with one key threatening process under the BC Act, being clearing of native vegetation consisting of the removal of 0.48ha of wooded vegetation. Therefore, the removal of potential foraging habitat associated with the proposed action is considered relatively small. Although the proposed action will represent a small loss of potential foraging habitat, such habitat represents a very small component of locally occurring resources accessible to these species.

Conclusion

The proposal may remove of 0.48 ha of wooded habitats representing a very small amount of potential foraging habitat for these species. Whilst potential habitat exists within the study area, the extent of habitat removal associated with the proposal is considered relatively small in terms of available local habitat for these species. Although the loss of habitat will represent a small incremental loss of cave-dwelling microchiropteran bat habitat, the proposed works are unlikely to have a significant impact upon these species.

Hollow-dwelling Microchiropteran bats

Status

Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), listed as Vulnerable on the BC Act

Eastern Freetail-bat (*Micronomus norfolkensis*), listed as Vulnerable on the BC Act

Specific Impacts

Two species of threatened hollow-dwelling microchiropteran bats are assessed as having a moderate or greater chance of occurrence within the proposal study area. The proposed works will represent the removal of wooded vegetation with a very low density of hollows suited to the roosting habits of small hollow-dwelling microchiropteran bats. Impact to these species will be largely limited to the removal of foraging habitat only for these species.

Section 7.3 Test of Significance

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.

Due to the very small amount (0.48ha) of forested habitats to be impacted, the proposed works are unlikely to have a significant adverse effect on the life cycle of hollow-dwelling microchiropteran bats to the point that these species are likely to be placed at risk of extinction.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

Not applicable.

- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

In relation to the habitat of a threatened species, population or ecological community: the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

Approximately 0.48 ha of wooded habitats during the proposed works.

- **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**

The removal of 0.48 ha of wooded habitats within the study area will not add substantially to existing fragmentation or prevent movements to and from an abundance of similar and higher quality habitat within the wider locality.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

Although the proposed action will add incrementally to habitat loss within the locality it is unlikely to exacerbate fragmentation at local or regional scales that would prevent these species from foraging or breeding within the locality. Given the small area to be impacted (0.48ha), the mobile nature of these species, and the availability of suitable habitat in the wider locality, the loss of a very small amount of potential habitat is unlikely to affect the long-term survival of these species.

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 study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to hollow-dwelling microchiropteran bats, the proposed action is consistent with one key threatening process under the BC Act, being clearing of native vegetation. The removal of potential habitat associated with the proposed action is considered relatively small (0.48 ha). Although the proposed action will represent a small loss of potential foraging habitat, such habitat only represents a very small component of locally occurring resources accessible to these species.

Conclusion

The proposal may remove of 0.48 ha of wooded vegetation habitats representing a very small amount (0.48ha) of potential foraging habitat for these species. The study area contains a very low density of hollow-bearing trees, which contain a small number of hollows of dimensions, suitable for small microchiropteran bats. Whilst potential foraging habitat exists within the study area, the extent of habitat removal associated with the proposal is considered relatively small in terms of available local habitat for these species. Although the loss of some wooded habitat will represent a small (0.48ha) incremental loss of hollow-dwelling microchiropteran bat habitat, the proposed works are unlikely to have a significant impact upon these species.

Grey-headed flying-fox

Status

The Grey-headed Flying-fox (*Pteropus poliocephalus*) listed as Vulnerable under both the BC Act and EPBC Act. This species was recorded during the survey. The Grey-headed Flying-fox has been assessed due to the species widespread occurrence locally, its high mobility and the occurrence of native tree species that are known to be used by this species for the purpose of foraging.

Specific Impacts

Fauna habitat assessments undertaken assessed that the Grey-Headed Flying-fox was likely to occur intermittently within the study area due to the existence of potential foraging habitat. The proposal will result in the removal of 0.48 ha of wooded vegetation, which is known to provide potential foraging habitat for this species.

Section 7.3 Test of Significance

In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

A total of 0.48 ha of wooded foraging habitat for the Grey-headed Flying-fox, may be affected by the proposed works. Although the proposed works may represent the loss of potential foraging habitat, such resources within the study area is only a very small component of locally occurring resources that are accessible to this species. Therefore, the proposed works are considered unlikely to impact this species such that a viable local or intermittent seasonal population would be placed at a significant risk of extinction.

In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**

Not applicable.

- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

In relation to the habitat of a threatened species, population or ecological community:

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

The proposal will remove approximately 0.48 ha foraging habitat for this species.

- **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**

The extent of potential habitat to be removed represents a very small proportion (0.48ha) of foraging habitat available within the surrounding landscape. Owing to the relatively small extent of potential habitat removal and the mobility of these species, the proposal is unlikely to significantly affect their long-term survival.

- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The extent of potential habitat to be removed represents a very small (0.48ha) proportion of habitat available within the surrounding landscape. Owing to the relatively small extent of habitat removal and the mobility of the species, the proposal is unlikely to affect the long-term survival of the Grey-headed Flying-fox.

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 study area did not represent a declared area of outstanding biodiversity value and is not in the immediate vicinity of such areas.

Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to the Grey-headed Flying-fox, the proposal is consistent with one key threatening process under the BC Act, being clearing of native vegetation. The extent of native vegetation clearing, and habitat removal, associated with the proposed works is considered very small (0.48ha) in terms of available habitat for this species within the surrounding landscape.

Conclusion

The extent of native vegetation clearing and habitat removal associated with the proposal is very small (0.48ha) in terms of the available habitat for this species within the surrounding landscape. The potential loss of foraging habitat for the Grey-headed Flying-fox is not considered to be important in regard to the maintenance of this species locally, and therefore the proposed works are unlikely to have a significant impact upon this species, which might lead to its extinction locally.

EPBC Significance Assessment – Grey-headed Flying-fox

The Grey-headed Flying-fox is listed as Vulnerable under the EPBC Act. The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, 2013). Under the Act, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

Is this part of an important population?

Grey-headed Flying-foxes occur across a range of wooded habitats where their favoured food, eucalypt blossom occurs. They set up roosting camps in association with blossom availability, which are usually situated in dense vegetation and associated with water. Grey-headed Flying-foxes can migrate up to 75 km north during the winter and during this time young flying-foxes establish camps.

The study area does not contain suitable habitat for roosting camps and no significant roosting camps occur within its close vicinity. Therefore, a population of Grey-headed Flying-fox in the study area is not considered to be important, as no roost sites would be affected by the proposal.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in one or more of the following:

Lead to a long-term decrease in the size of an important population of a species

Not applicable. Grey-headed Flying-fox occurring in the in the study area is not part of an important population.

Reduce the area of occupancy of an important population

Not applicable. Grey-headed Flying-fox occurring in the in the study area is not part of an important population.

Fragment an existing important population into two or more populations

Not applicable. Grey-headed Flying-fox occurring in the in the study area is not part of an important population.

Adversely affect habitat critical to the survival of a species

No critical habitat is listed for this species under the EPBC Act. Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment Water Heritage and the Arts, 2009).

The proposed works will remove a small area 0.48 ha of wooded habitats, which represent potential foraging habitat for this species. As this species is highly mobile, with individuals foraging up to 50 km from roost sites, it is likely that suitable foraging resources could be accessed widely throughout the locality and beyond. Therefore, this would not meet the above criteria.

Disrupt the breeding cycle of an important population

Not applicable. Grey-headed Flying-fox occurring in the additional assessment areas is not part 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

Not applicable. Grey-headed Flying-fox occurring in the additional assessment areas is not part of an important population.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

It is not likely that invasive species (such as introduced predators) that are harmful to the Grey-headed Flying-fox would become further established as a result of the proposal.

Introduce disease that may cause the species to decline

No. There are no known diseases that are likely to increase in the area as a result of the proposed works.

Interfere substantially with the recovery of the species

Due to the limited foraging habitat likely to be affect by the proposed works (0.48 ha) and as no roost camps are located in the vicinity of the study area, the proposed works are not likely to interfere with the recovery of this species.

Conclusion

The extent of native vegetation clearing and habitat removal associated with the proposed works is small (0.48ha) in terms of the available habitat for these species within the surrounding landscape. Although the loss of foraging habitat for Grey-headed Flying-fox is considered to be an incremental loss of suitable habitat locally, the proposal is not likely to have a significant impact upon available resources for flying-foxes in the vicinity of the site or its wider locality and the habitat to be impacted is not considered important to the long-term survival of the Grey-headed Flying-fox.

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Appendix E

Targeted Orchid Survey (Sclerophyll, 2020)

Sclerophyll
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29 September 2020

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RE: Targeted Orchid Survey, Tumbi Rd Upgrade, Wamberal NSW - Draft

Introduction

Sclerophyll Flora Surveys and Research Pty Ltd (Sclerophyll) was commissioned by AECOM to undertake a targeted orchid survey for 2 Threatened species, these being *Diuris praecox* and *Caladenia tessellata*, as part of a proposal to upgrade the Tumbi Rd/Central Coast Highway intersection situated at Wamberal on the NSW Central Coast. It is understood that the proposal would involve the conversion of the existing intersection roundabout to a traffic light in addition to widening a section of the Central Coast Highway to the north and south of the existing Tumbi Rd roundabout.

For the purposes of this assessment, the study area is shown in **Figure 1** and was determined to be approximately 20 metres wide from the edge of the existing road pavement on both sides of the road corridor, to the north and south of the existing Tumbi Rd roundabout.

Subject Orchid Descriptions

A summary description of the 2 orchids that were targeted as part of the commission are provided below.

Diuris preacox is a terrestrial orchid restricted to coastal areas from Nelson Bay south to Ourimbah, preferring open heathy forest on conglomerate clays, wallum shrubland on coastal headland sandsheets and in slashed powerline easements typically on well drained aeolian dunal sandsheets (Bell 1998; Jones 2006; Wyong Shire Council 2000). There are 3 main populations of the species, these being within Wyrrabalong National Park at Wamberal/Bateau Bay, Awabakal Nature Reserve at Newcastle and Tomago/ Tomaree at Port Stephens. Other populations are known from Norah Head and Munmorah State Conservation Area on Patonga Claystone and conglomerates (author's pers. obs.). *Diuris praecox* is characterised by a light yellow colour on

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its flower segments, a flat and ovate-shaped labellum midlobe and narrow, weakly-toothed labellum sidelobes (Jones 2006; Bishop 2000). The species has been shown to have a 3 week peak flowering period between 7-25 August (Bell 2020) although the author has recorded late flowering individuals up until early September. A population of the species is known locally in Wyrrabalong National Park situated approximately 3km to the north-east of the study area (author's pers. obs.; Bionet 2020). *Diuris praecox* is listed as Vulnerable under both the NSW *Biodiversity Conservation Act* 2016 (BC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act).

Caladenia tessellata is a terrestrial orchid previously recorded in scattered coastal localities south from Swansea on the Central Coast, preferring low, open to dense heathy forest on well drained sands and on wetland fringes (Jones 2006; Bishop 2000; Wyong Shire Council 2000). Flowering of the species is reportedly greatly enhanced by (and easier to detect as a result of) summer fires during the following spring flowering period (Jones 2006). The species is characterised by a heart shaped labellum, a thickened labellum apex as well as sepals and petals with short stiff points. The species has been previously recorded in Frazer Park within Munmorah State Conservation Area to the north of the study area (>10km) in the 1990s, although the author is not aware of any records of the species for over 20 years and thus may be locally extinct. *Caladenia tessellata* is listed as Endangered under the NSW *Biodiversity Conservation Act* 2016 (BC Act) and Vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act).

Environmental Setting

The study area is situated at the Tumbi Rd/Central Coast Highway intersection at Wamberal, NSW, on the NSW Central Coast, within the Central Coast Council LGA. A prominent feature in the vicinity of the study area is the Wamberal Lagoon Nature Reserve on the eastern side of the Central Coast Highway (to the east of the road reserve boundary).

The study area is mapped as being underlain by the following 2 soil landscape groups:

1. Woodburys Bridge, characterised by undulating rises and low hills on Patonga Claystone. Characteristic vegetation of this group observed during the orchid searches included a Spotted Gum (*Corymbia maculata*)-Ironbark (*Eucalyptus paniculata*)-Mahogany (*E.umbra*) community as well as a Sydney Peppermint (*E.piperita*)-Red Bloodwood (*Corymbia gummifera*) community on moist loams (the latter is considered to be a sub-community of the Spotted Gum-Ironbark-Mahogany assemblage); and
2. Wyong, characterised by level floodplains on Quaternary alluvium. Characteristic vegetation of this group observed during the orchid searches comprised a Prickly leaved Paperbark (*Melaleuca nodosa*)-Red Mahogany (*Eucalyptus resinifera* subsp. *resinifera*)

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Swamp Woodland/Low Woodland community on poorly drained loams. This swamp community graded upslope into the Woodburys Bridge vegetation communities that fringed the road corridor in areas of improved drainage.

Methodology

The following methodology was undertaken as part of the commission:

1. Desktop review of Wamberal Lagoon Plan of Management, relevant scientific publications as well as relevant GIS spatial datasets (eg. Hunter/Central Coast vegetation mapping; soil landscape mapping; Bionet atlas);
2. Targeted orchid search comprising parallel line transects in suitable dry sclerophyll habitats within and adjoining the study area, generally in accordance with the NSW Threatened Plant Survey Guidelines (OEH 2016). The search was undertaken by Sclerophyll Flora's Principal Botanist, Isaac Mamott, accompanied by AECOM's Associate Director, Jamie McMahon, on 7 September 2020 in fine conditions over a 3 hour period. A search for the local reference population of *D.praecox* was undertaken immediately prior to the Tumbi Rd site survey in the nearby Wyrrabalong National Park in an attempt to determine if the species/population was still flowering; and
3. Preparation of a letter report detailing the methods and results of the targeted searches.

Results

Diuris praecox

A Bionet search yielded a total of 113 records of *Diuris praecox* at 3 locations within Wyrrabalong National Park to the north of the study area, with the majority of the records (>80%) at 1 'location' in coastal wallum shrubland/woodland habitat on a coastal headland sandsheet. *Diuris praecox* also occurs in a Spotted Gum-Ironbark-Red Bloodwood-Sydney Peppermint community on clay-derived conglomerates in Glenrock State Conservation Area/Awabakal Nature Reserve in Newcastle (Bell 1998; author's pers. obs.) which is floristically similar to the dry sclerophyll forest habitats recorded in the study area. As a result, the dry sclerophyll forest habitats recorded in the study area should be considered potential habitat for *Diuris praecox*.

No population of *Diuris praecox* was recorded in the study area during the targeted searches nor was a flowering reference population detected in Wyrrabalong National Park. Whilst the searches took place outside the known peak flowering period for the species (approx. 2 weeks following the peak period), it is likely that fruiting individuals would have been identified should the species be present (but have finished flowering). Whilst some orchid populations do not

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flower every year, particularly during drought years, it is thought that if present in the study area, the species would likely have flowered this year given the reasonable rainfall experienced in 2020 on the NSW Central Coast.

One species of native orchid was recorded in the study area during the targeted searches, this being *Pterostylis baptistii*, a relatively ubiquitous orchid in coastal moist sclerophyll forests.

Caladenia tessellata

The Bionet search did not yield any records for this species. There is a 1992/1993 record of the species at Frazer Park in Munmorah State Conservation Area as well as a 1996/1997 record at Norah Head on indurated sands, Munmorah conglomerates and Patonga Claystone (Wyong Shire Council 2000). Both sets of records did not identify habitat details for the species.

The species may be locally extinct on the NSW Central Coast based on the absence of records over the past 2 decades.

No population of *Caladenia tessellata* was recorded in the study area during the targeted searches.

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Yours faithfully

Isaac Mamott
Director, Principal Botanist
BAM Assessor (BAAS18008)

Figure 1 Orchid Transect Map and Study Area

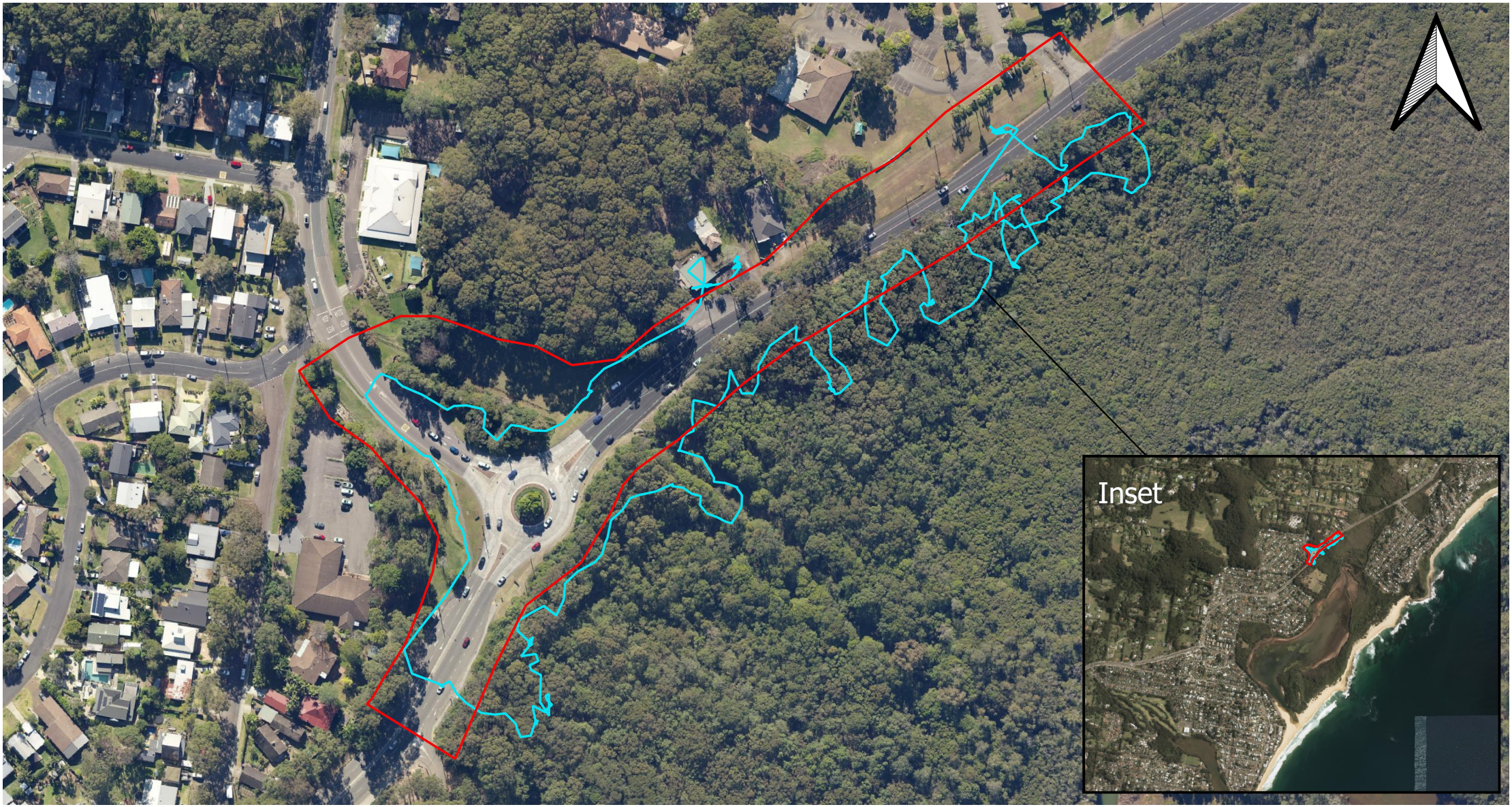

Figure 1
Tumbi Rd Upgrade Orchid Survey Transect Map

Legend

- Tumbi Rd Upgrade study area
- Wamberal orchid survey transect_TumbiRdUpgrade_AECOM_7.9.20

Project - Tumbi Rd Upgrade
Map Projection - GDA94 MGA56
Map Author - IM
Map Date and Version - 25.9.20; v1
Imagery Source - NSW LPI

Sclerophyll
FLORA SURVEYS AND RESEARCH

Appendix F

Targeted Orchid Survey (Sclerophyll, 2021)

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13 January 2021

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RE: Targeted Orchid Survey, Tumbi Road/Central Coast Highway Intersection Upgrade, Wamberal NSW - Final

Introduction

Sclerophyll Flora Surveys and Research Pty Ltd (Sclerophyll) was commissioned by AECOM to undertake a targeted orchid survey for the Threatened orchid species, Leafless Tongue Orchid (*Cryptostylis hunteriana)*, as part of a proposal to upgrade the Tumbi Road/Central Coast Highway intersection situated at Wamberal on the NSW Central Coast. *Cryptostylis hunteriana* is a rare terrestrial orchid listed as Vulnerable under both the NSW *Biodiversity Conservation Act* 2016 (BC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

It is understood that the proposal would involve the conversion of the existing intersection roundabout to a traffic light in addition to widening a section of the Central Coast Highway to the north and south of the existing Tumbi Road roundabout.

For the purposes of this assessment, the study area is shown in **Figure 1** and was determined to be approximately 20 metres wide from the edge of the existing road pavement on both sides of the road corridor, to the north and south of the existing Tumbi Road roundabout.

Environmental Setting

The study area is situated at the Tumbi Road/Central Coast Highway intersection at Wamberal, NSW, on the NSW Central Coast, within the Central Coast Council LGA. A prominent feature in the vicinity of the study area is the Wamberal Lagoon Nature Reserve on the eastern side of the Central Coast Highway (to the east of the road reserve boundary).

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The study area is mapped as being underlain by the following 2 soil landscape groups:

1. Woodburys Bridge, characterised by undulating rises and low hills on Patonga Claystone. Characteristic vegetation of this group observed during the orchid searches included a Spotted Gum (*Corymbia maculata*)-Ironbark (*Eucalyptus paniculata*)-Mahogany (*E. umbra*) community as well as a Sydney Peppermint (*E. piperita*)-Red Bloodwood (*Corymbia gummifera*) community on moist loams (the latter is considered to be a sub-community of the Spotted Gum-Ironbark-Mahogany assemblage); and
2. Wyong, characterised by level floodplains on Quaternary alluvium. Characteristic vegetation of this group observed during the orchid searches comprised a Prickly leaved Paperbark (*Melaleuca nodosa*)-Red Mahogany (*Eucalyptus resinifera* subsp. *resinifera*) Swamp Woodland/Low Woodland community on poorly drained loams. This swamp community graded upslope into the Woodburys Bridge vegetation communities that fringed the road corridor in areas of improved drainage.

Subject Orchid Description

A summary description of the morphology, known habitat and distribution (on the Central Coast) of *Cryptostylis hunteriana* is provided below.

Morphology

per Jones 2006

> *Plants leafless. Flower stem 80-450mm tall, stiff, usually yellowish, 1-10 flowered. Flowers 20-30 x 6-8mm. Perianth segments yellow. Dorsal sepal 15-22 x 1-1.5mm, decurved. Lateral sepals 15-22 x 1-1.5mm, divergent, spreading or reflexed. Petals 7-10 x 0.5mm, spreading or reflexed. Labellum stiffly erect close to the stem, 20-33 x 6-8mm when flattened, dark red, covered with short stiff glandular hairs; margins recurved. Callus a black ridge.*

per Bishop 2000

> *Leafless saprophytic herb. Flowering stem pale yellow, to 45cm, bearing up to 10 flowers. Flower 25mm long. Sepals and petals linear, spreading. Labellum pointing upwaRoads, oblong with strongly curved margins, deep maroon, with 5 dark lines; most of upper surface densely and conspicuously hairy.*

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Cryptostylis hunteriana is superficially similar to *C. subulata* and *C. leptochila*, however *C. subulata* has a downward pointing labellum with a prominent fleshy maroon callus near its tip whilst *C. leptochila* has leaves, a strongly curved labellum at its base with several shiny, black, dome-shaped calli along the length of the labellum (author's pers. obs.).

A reference photo of *Cryptostylis hunteriana* is shown below.

Photo 1 – Flowering *Cryptostylis hunteriana* (reference photo only)

Habitat

A total of 2 main habitat types have been recorded for *Cryptostylis hunteriana* populations on the Central Coast (Bell 2001), these being:

1. Coastal Plains Smooth barked Apple Woodland (per NPWS 2000), having a canopy dominated by *Angophora costata*, *Corymbia gummifera*, *Eucalyptus capitellata* and *Eucalyptus umbra* on the Doyalson soil landscapes on ridges, hillcrests and upper slopes;
2. Coastal Plain Scribbly Gum Woodland (per NPWS 2000), having a canopy dominated by *Eucalyptus haemastoma*, *Corymbia gummifera*, *Eucalyptus capitellata* and *Angophora inopina*, on the Doyalson and Gorokan soil landscapes on upper slopes and crests.

None of these habitats nor soil landscape groups known for *Cryptostylis hunteriana* on the Central Coast are present within the study area. It is noted, however, that one of the key habitat types for the species in the Shoalhaven LGA on the NSW South Coast is *Corymbia gummifera*-

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Eucalyptus piperita dry sclerophyll forest (Clark *et al* 2004). This habitat type is present within the south-eastern portion of the study area and thus a targeted search for the species was considered warranted.

Distribution

The following Central Coast populations are known for *Cryptostylis hunteriana* based on a review of Bell (2001) and a current Bionet record search (post 1980 records):

1. Munmorah State Conservation Area at Freemans Waterhole;
2. Vales Point Power Station, southern Lake Macquarie;
3. Crown Lands at Doyalson;
4. Gwandalan, south-east Lake Macquarie;
5. Lake Haven/Charmhaven, western side of Budgewoi Lake;
6. Warnervale; and
7. North-west Gosford.

Most of the Central Coast records appear to be on private lands and support very low numbers of the species. The north-west Gosford population is a 2008 record denoting a single plant and is situated approximately 13km to the west of the study area.

Methodology

The following methodology was undertaken as part of the commission:

1. Desktop review of Wamberal Lagoon Plan of Management, relevant scientific publications as well as relevant GIS spatial datasets (eg. Hunter/Central Coast vegetation mapping; soil landscape mapping; Bionet atlas);
2. Targeted orchid search comprising parallel line transects in suitable Bloodwood-Peppermint dry sclerophyll habitats within the study area, generally in accordance with the NSW Threatened Plant Survey Guidelines (OEH 2016). The search was undertaken by Sclerophyll Flora's Principal Botanist, Isaac Mamott, on 21 December 2020 in overcast conditions over a 3 hour period.

   All of the southern Central Coast populations of *Cryptostylis hunteriana* (closest to the study area) are situated on private lands (or Crown lands requiring access approval) which prevented a search of flowering reference populations. Nevertheless, the author has previously recorded observed all the known Port Stephens and mid north coast populations of this species and thus has a good working knowledge of its typical flowering period for the species north from Sydney (late November – late December is optimal with some early and late flowering individuals beyond this optimal period). This is consistent with the fact that the majority of the *Cryptostylis hunteriana* Central Coast

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population records are from late November through to late December with a small number into late January.

3. Preparation of a letter report detailing the methods and results of the targeted search (this report).

Results

No individuals of *Cryptostylis hunteriana* was recorded in the study area during the targeted survey. Whilst some orchid populations do not flower every year, particularly during drought years with poor winter and spring rainfall, it is thought that if present in the study area, the species would likely have flowered this year given the reasonable rainfall experienced in 2020 on the NSW Central Coast.

Two other species of *Cryptostylis* were, however, recorded flowering during the survey, these being *C. erecta* and *C. subulata* within the Bloodwood-Peppermint vegetation community (refer Photos 2 and 3 shown below). DPIE (2019) note that the Central Coast populations of *Cryptostylis hunteriana* have been 'associated'/recorded with these 2 *Cryptostylis* taxa, although the author has often not found this to be the case with the North Coast populations of the species.

Survey transects and the study area are shown in **Figure 1**.

Photo 2 - *Cryptostylis subulata* (site photo)

Photo 3 - *Cryptostylis erecta* (site photo)

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W : www.sclerophyll.com.au

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Yours faithfully

Isaac Mamott
Director, Principal Botanist
BAM Assessor (BAAS18008)

Figure 1 Orchid Transect Map and Study Area

Central Coast Highway/Tumbi Road Intersection Upgrade - Orchid Survey (Figure 1)

0 75 150 m

Legend

- Study Area
- Cryptostylis hunteriana Survey Transect (21 December 2020)
- Diuris praecox Survey Transect (7 September 2020)

Client - AECOM/RMS
Map Illustrator - IM
Map Date and Version - 13.1.21; v2
Projection - GDA94 MGA56
Imagery - NSW LPI

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Appendix G

Targeted Frog Survey (EcoPlanning, 2020)

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AECOM
Level 21, 420 George Street, Sydney, NSW 2000
PO Box Q410, QVB PO,
Sydney, NSW, 1230
Supplied by email Jamie.McMahon@aecom.com

21 July 2021

Dear Jamie,

Re: Targeted Frog Survey and Habitat Assessment, The Entrance Road upgrade, Forresters Beach, NSW

I am writing to provide a brief description of works and results of survey related to an upgrade of The Entrance Rd, Foresters Beach, NSW, during November 2020 (the 'subject site', see **Figure 1**). As requested by AECOM, targeted surveys and habitat evaluation were undertaken for a number of threatened frog species that were considered as having some potential to occur within and/or adjacent to the subject site.

BACKGROUND

It is understood that the proposed upgrade of the Central Coast Highway and Tumbi Road intersection (the Proposal) was determined as having the potential to affect several threatened frog species and/or their habitat. Based on this preliminary evaluation surveys were commissioned by AECOM for the extent of the Proposal (the Proposal) and relevant surrounding areas, these surveys were undertaken on 9-12 November 2020 by Ross Wellington (Principal Ecologist/Director, Australian Environmental Surveys), a qualified amphibian expert and who applied suitable protocols and survey effort for the implicated target species and the scale of the subject site concerned.

The surveys were carried out to evaluate habitat and potential impacts on four threatened frog species including, *Litoria aurea* (Green and Golden Bell Frog) (GGBF), *Litoria brevipalmata* (Green-thighed Frog) (GTF), *Crinia tinnula* (Wallum Frog) (WF) and the recently described and listed *Uperoleia mahonyi* (Mahony's Froglet) (MF).

METHODS

Literature and database review

A search of the Bionet Atlas and Atlas of Living Australia Databases were undertaken. An evaluation of detailed local knowledge of amphibian distribution across the Central Coast accumulated over 30 years was also applied.

Field survey

The survey effort occurred primarily over four afternoon-evenings, but also included diurnal search efforts that further incorporated additional searches being undertaken at two reference sites in the wider locality and where two of the specific target species are known to occur. Ross Wellington (Principal Ecologist, AES), an expert herpetologist with extensive experience with frogs and their distribution across the locality, was accompanied by Sidnee Harris and James Hughes (Environmental Scientists, AECOM) for the surveys. The surveys included survey of a reference site located at Avoca Lagoon for the GGBF, as well as a known reference site for the GTF at Chittaway.

Survey effort included manual searching of ground covers and scanning of vegetation diurnally. Auditory call detection including call playback and call imitation response techniques. Nocturnal survey consisted of using spotlight and head torches to undertake searches of suitable vegetation, drainage features, tracking calls and scanning for active frogs.

Commonwealth and NSW Frog Survey Guidelines were referred to and their intents were applied as far as possible and necessary. Frogs detected were, where possible, identified to species in the hand but only where necessary and possible.

RESULTS

Literature and database review

Frogs determined as having the potential to occur, on the basis of occurrence within a 10 km radius, were tabulated and reviewed as being likely or potential target species or not (see **Table 1**).

Field survey

Surveys of the reference site at Avoca Lagoon for the GGBF determined that the species was active contemporaneously with the surveys at the study area. Conversely, surveys at the GTF reference site at Chittaway revealed no GTF activity, however the prevailing timing and conditions were less than ideal for this species and hence the overall surveys for this species were limited to the evaluation of presence, extent, and condition of its habitat. Wallum Froglet and MF have no nearby known reference sites but were still surveyed for visually and using auditory cues in areas consistent with the known habitat values for this species, and to the extent that these habitat values are known, particularly for MF.

Ten (10) species of frogs were detected during the survey, of which one was a targeted species, the GGBF. Species identified to occur were as follows:

- Within the proposal area:
  - Dwarf Green Tree Frog (*Litoria fallax*)
  - Emerald Spotted Tree Frog (*Litoria peronii*)
  - Tyler's Tree Frog (*Litoria tyleri*)
  - Leaf Green Tree Frog (*Litoria phyllochroa*)
  - Green and Golden Bell Frog (*Litoria aurea*)
  - Brown Striped Marsh Frog (*Limnodynastes peronii*)
  - Spotted Marsh Frog (*Limnodynastes tasmaniensis*)
  - Tusked Frog (*Adelotus brevis*)
  - Smooth Toadlet (*Uperoleia laevigata*)

  - Common Toadlet (*Crinia signifera*).
- At Reference Site 1, Avoca Lagoon (Barina Wetland):
  - Green and Golden Bell Frog (*Litoria aurea*)
  - Whirring Tree Frog (*Litoria dentata*).
- At Reference Site 2, Enterprise Drive Berkeley Vale/Chittaway (Apprentice Drive):
  - Common Toadlet (*Crinia signifera*)
  - Tyler's Tree Frog (*Litoria tyleri*)
  - Emerald Spotted Tree Frog (*Litoria peronii*)
  - Brown Striped Marsh Frog (*Limnodynastes peronii*).

Habitat for the GGBF and potential habitat for the GTF were identified within the vicinity of the proposed direct impact zone. Impacts associated with the proposal could extend to the areas immediately adjacent to the development footprint. The GTF has not been recorded previously from the Wamberal Lagoon catchment but has been recorded at Ourimbah Creek drainage at Lisarow and Chittaway (being its southern most known limit of distribution), and hence of sufficient proximity to test the understood southern limit of its assumed extent. Given only one atlas record of this species exists within 5 km of the site from 2011, located outside the Wamberal Lagoon catchment, the likelihood of this species being present is unlikely and only potential habitat for the GTF is identified and assessed on a precautionary basis.

Of the other target species, the WF has some potential for impact to what could be regarded as potential habitat only as the species has similarly not previously been detected in the catchment of Wamberal lagoon. Coupled with the fact that some components of its habitat are less easily demarcated, it is equivocal as to whether WF are actually present and hence have any potential for impact. What is herein perceived or identified as potential foraging and shelter habitat for WF, is hence also equivocal. The recently listed MF is a species that is only included in the investigation on a precautionary basis. It has not been previously detected this far south and the nearest known location is to the north near Norah Head (25 km north on other side of Tuggerah Lake). Habitat associations for this recently described species are not well understood and it is therefore difficult to be categoric in outlining any delimitations to its distribution.

Discussion and Recommendations

Within the proposal area habitat values for any of the target species is of quite poor quality. Where the proposal interfaces with the existing main road, established urbanised areas and with drainage features traversing the proposal area receive flows from upstream areas influenced by development. These interface areas were identified as being somewhat degraded by weedy exotic flora and rubbish accumulation from motorists, dumping and urban storm water flows, as well as other disturbance factors.

The detection of a GGBF individual by call north of the proposal area suggests that further investigation into the presence of this species is warranted for future development in this area. Should this species be confirmed in this location it is recommended that suitable habitat enhancement strategies be prepared and implemented to the advantage of the species and using the Best Practice Habitat Guide formulated for this purpose (DECC 2007), but tailored to suit the site and project specifics. This may include facilitated passage beneath the existing and perhaps later modified culverts, which might be considered as an offset package of other

'conservation measures' for the species consistent with the national Recovery Plan for the species (DEC 2005).

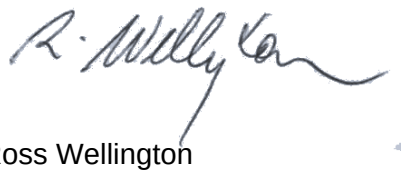
Despite most of the interface of the proposal being within an already degraded and cleared road reserve, a careful approach to the execution of the project should be encouraged. This might reasonably include targeted preclearance surveys and contingency strategies being developed prior to construction in the event of unexpected detections during construction and staff induction along these lines. This should be coordinated or facilitated by a suitably experienced frog expert/ecologist working with the road construction team.

A bush regeneration/rehabilitation strategy may be developed and implemented to reduce existing and future weed migration into bushland along the interface margins of the proposal. This should then be monitored for a suitable period. Consultation with the NSW NPWS should be undertaken to obtain guidance inputs and perspective from local staff charged with the day-to-day management of the reserve. This requirement is covered by an existing protocol NPWS (2020).

The proposal is thus considered as likely having minimal direct impact to habitat and/or assumed habitat for the target threatened species. Actual habitat for the GGBF that has been identified is outside the proposal area and is hence avoided and an assessment of significance for GTF (see below) has concluded that any risk to the species is insignificant.

Please do not hesitate to contact the writer to discuss further the findings outlined here and the implications of them for the proposal and other possible options.

Yours sincerely



Ross Wellington

Principal Ecologist | AES (as sub-contractor to Ecoplanning).
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Figure 1: Frog records, potential habitat and survey traces within and around the subject site.

ASSESSMENT OF SIGNIFICANCE

This assessment of significance (AoS) has been prepared under Section 7.3 of the *Biodiversity Conservation Act 2016* (BC Act) and has been undertaken with due consideration of the Threatened Species Test of Significance Guidelines (OEH 2018).

The proposal is an activity under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Green-thighed Frog (*Litoria brevipalmata*) (GTF)

The GTF has never been recorded from drainages south of the Tuggerah Lakes system and in particular the Ourimbah Creek sub-catchment. The southernmost sites known are within the Cut Rock Creek and Ourimbah Creek peripheral drainage at localities near Lisarow, Berkeley Vale/Chittaway and at Palm Grove (Type Locality).

Consequently, an evaluation of habitat that appears to be consistent with GTF habitat within the project area interface at Wamberal was assessed and evaluated only on a precautionary basis due to its air distance proximity with known locations to the subject site.

The GTF has a reputation for crypsis and is most regularly detected during a very short breeding period window of opportunity during which time they aggregate near breeding sites, making their detection somewhat easier. Accounts of the species distribution and habitat preference within the Central Coast and more broadly can be found in Wellington and Wells, (1993); Mahony (1993); Murphy and Turbill, (1999); Lemckert et al. (2006).

Generally, the potential habitat along the interface to the subject site at its southern and eastern edge is merely consistent with the habitat values and vegetation association found at the reference site at Berkeley Vale/Chittaway and adjacent to Lisarow High School.

On the basis of potential habitat alone, and hence only a very marginal chance of occurrence, this AOS is undertaken on a precautionary basis and to demonstrate that were the species to be recorded at this location any impacts would not be significant.

(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

Potential habitat for GTF has been identified immediately adjacent to the subject site but is unlikely to be adversely affected to any significant degree by the proposal. Despite it being equivocal as to whether any GTF actually occupy this habitat, especially given understanding of known limits to geographic distribution that have been formulated over many years, were the species to actually occur (as unlikely as that is), impact to it in that circumstance is considered to be insignificant. The sensitivity in approach with respect to the works bordering the Nature Reserve will highly stringent and hence indirect impacts will be minimal. Given it is unlikely that the potential habitat is actually occupied by GTF and the impacts will be minimal the likelihood that a viable GTF population would be impacted is negligible and certainly not put at risk of extinction even if it were to occur.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to modify the composition of the ecological community substantially and adversely such that its local occurrence is likely to be placed at risk of extinction

The GTF is not an endangered or critically endangered ecological community and hence this assessment component does not apply to this entity.

(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

There is unlikely to be any direct loss of what is herein considered potential habitat for the GTF. The proposal has avoided and minimised all impacts along the Nature Reserve interface both by design and alignment positioning and the methodology proposed. What has been identified as potential GTF habitat, on a precautionary basis, is directly avoided and only likely to be subjected to a risk of some perceived indirect impacts. Consequently, the stringent approach to minimising indirect impacts means that the potential habitat will not be modified and hence not place the GTF at risk of extinction were a population to be present.

(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

The proposal will not fragment or isolate the identified potential habitat from other such areas.

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

The identified potential habitat will be subject to a minor impact, and perceived indirect impacts will be avoided and minimised by the stringent approach taken in the planning and methods proposed. Given that the area is only potential habitat and consideration given on a precautionary basis, the presence of GTF equivocal if at all, it cannot be considered an important area of habitat for the GTF in terms of its long-term survival. The proposal will not modify or fragment what is herein considered potential habitat on a precautionary basis.

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

No declaration of any area in the vicinity of the proposal has been declared an AOBV.

(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

The proposal both generally and specifically could be perceived as constituting or exacerbating a number of KTPs. Of the currently listed KTPs that are generally or specifically considered likely to be affecting threatened frogs listed below.

- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands
- Bushrock removal (as described in the final determination of the Scientific Committee to list the threatening process)
- Clearing of native vegetation
- Infection of frogs by amphibian chytrid causing the disease chytridiomycosis
- Predation by Gambusia holbrooki Girard, 1859 (Plague Minnow or Mosquito Fish) (
- Removal of dead wood and dead trees

None can be considered as being unduly caused or exacerbated as a direct or indirect consequence of the proposal in relation to the GTF or frogs more generally.

CONCLUSION

Considering the above factors, both individually and collectively, it is herein concluded that no significant impact is likely to occur to the identified potential habitat of the GTF and hence to any actual GTF population were such a population to exist in the locality.

Table 1 – Frog Records for the Study Area

Family	*Scientific Name*	Common Name	NSW Status	EPBC Act Status	Previous Locality Records	Project Site Study	Ref Site Avoca	Ref Site Chittaway	Comment
Limnodynastidae	***Adelotus brevis***	**Tusked Frog**	**P**		***(24)**	*	-	-	**At the southern limit of its southern distribution at Narara and Wamberal Lagoon and the Ridgeway at Wambina NR**
	Limnodynastes dumerilii grayi	Eastern Banjo Frog	P		*(1)	-	-	-	Previously recorded from many areas to the west of the study site in forested areas and as far south as Umina in the near coastal strip
	Limnodynastes peronii	**Brown-striped Marsh Frog**	**P**		***(142**	*	-	*	**Common and abundant across the Central Coast**
	Limnodynastes tasmaniensis	**Spotted Marsh Frog**	**P**		***(2)**	*	-	-	**Recorded from various sites across the Central Coast including farm dams but has declined in the more urbanised areas**
Myobatrachidae	***Crinia signifera***	**Common Eastern Froglet**	**P**		***(107)**	*	-	*	**Common and abundant across the Central Coast**
	Crinia tinnula	Wallum Froglet	V		*(1)	-	-	-	Not recorded from the Wamberal Lagoon catchment but is recorded from proximal localities in the Tuggerah drainage. Potential habitat for the species is present elsewhere in the Wamberal Lagoon NR
	Pseudophryne australis	Red-crowned Toadlet	V		*(5)	-	-	-	Occurring primarily in the sandstone outcrop areas to the west of Gosford and along the Bouddi Peninsula and small isolated pockets within suitable ridgetop areas of the COSS.
	Pseudophryne bibronii	Bibron's Toadlet	P		*(1)	-	-	-	A species with most known records north and west of Wyong. A species apparently in decline in many areas.
	Uperoleia fusca	Dusky Toadlet	P		* (6)	-	-	-	Not detected but likely present in surrounding areas of the project site
	Uperoleia laevigata	**Smooth Toadlet**	**P**		***(5)**	*	-	-	**Detected calling from west of the impact zone and beyond any likely direct impacts**

Family	*Scientific Name*	Common Name	NSW Status	EPBC Act Status	Previous Locality Records	Project Site Study	Ref Site Avoca	Ref Site Chittaway	Comment
	Uperoleia mahonyi	Mahony's Toadlet	E		-	-	-	-	Only recently describedand habitat values poorly known. Sightings from Norah Head and purportedly Fountaindale implicate the species but habitat not consistent with currently understood values.
Pelodryadidae	***Litoria aurea***	**Green and Golden Bell Frog**	**E1**	**V**	***(10)**	*	*	**-**	**Historically present throughout the Central Coast from the entire Tuggerah Lakes Catchment and Gosford Coastal Lagoons, Brisbane Water wetland area margins and south to include the Ettymalong Swamp (now North Pearl estate) and other swamp areas surrounding the Ettymalong Creek system and similarly at Pearl Beach; now likely extinct locally from many of these sites; Previously known nearest extant population at Kincumber, Davistown and Nth. Avoca. The latter the reference site for this study where it was also detected.**
	Litoria brevipalmata	Green-thighed Frog	V		*(1)	-	-	-	Not definitely known south of Ourimbah Creek and Chittaway (reference site); nearest habitat known is at Lisarow wetland now being heavily modified by development.
	Litoria caerulea	Green Tree Frog	P		*(6)	-	-	-	Not detected this study but likely present across the area
	Litoria chloris	Red-eyed Tree Frog	P		*(5)	-	-	-	Known from various locations from within the Gosford COSS including Katandra and Wambina NR. Arboreal and cryptic until calling and breeding.
	Litoria dentata	Bleating Tree Frog	P		*(28)	-	*	-	Not detected this study within the subject site but previously recorded from areas across the surrounding locality.
	Litoria fallax	**Eastern Dwarf Tree Frog**	**P**		***(159)**	*	**-**	**-**	**Commonly detected and abundant across the area and found during the study.**

Family	*Scientific Name*	Common Name	NSW Status	EPBC Act Status	Previous Locality Records	Project Site Study	Ref Site Avoca	Ref Site Chittaway	Comment
	Litoria jervisiensis	Jervis Bay Tree Frog	P		*(2)	-	-	-	Sporadically detected on the Central Coast, where it is uncommon.
	Litoria latopalmata	Broad-palmed Frog	P		*(6)	-	-	-	Not detected during the study but likely present during suitable conditions across the area
	Litoria peronii	**Peron's Tree Frog**	**P**		***(205)**	*****	**-**	*****	**Commonly recorded from across the Central Coast detected within the project study site.**
	Litoria phyllochroa	**Leaf-green Tree Frog**	**P**		***(10)**	*****	**-**	**-**	**Detected this study along the drainage line at the southern part of the project site.**
	Litoria tyleri	**Tyler's Tree Frog**	**P**		***(30)**	*****	**-**	*****	**Detected calling across the project site and adjacent areas during the survey**
	Litoria verreauxii	Verreaux's Frog	P		*(46)	-	-	-	Not detected; Winter caller; equivocally present; *L. 'revelata'* replaces this species north at around Wyong.
Bufonidae	*Rhinella marina*	Cane Toad	Exotic		*(2)	-	-	-	Introduced species; no resident breeding population known south of Port Macquarie; regularly detected amongst agricultural and landscape produce transported from Qld.

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