C Aboriginal Heritage 2016 (Extent)

EXTENT
HERITAGE ADVISORS
TO AUSTRALIA AND
THE ASIA PACIFIC
Incorporating AHMS and Futurepast

18 February 2016

ADW Johnson
5 Pioneer Avenue
Tuggerah, NSW 2259

Attn: **Stephanie Van Dissel (Senior Town Planner)**

Re: Precinct 7A, Warnervale – Proposed Re-zoning – Aboriginal Heritage

Dear Stephanie,

Background

Extent Heritage Pty Ltd (Extent) has been commissioned by ADW Johnson, on behalf of AVJennings, to advise on the Aboriginal heritage associated with a potential re-zoning of Precinct 7A, Warnervale, NSW (Lot 2, DP 1101086). This precinct was encompassed within an earlier re-zoning undertaken by Wyong Shire Council in 2008, but due to the presence of Aboriginal objects/sites, and the potential complexity in obtaining an Aboriginal Heritage Impact Permit (AHIP), it was left as RE1- Public Recreation. AVJennings is now exploring the potential to re-visit this re-zoning. Information sought from Extent included a review of the existing Aboriginal heritage study, liaison with the relevant Aboriginal stakeholders, and identification of any future requirements.

Extent has reviewed the 2008 investigation of the site entitled, "The archaeological investigation for sites of Indigenous cultural significance in Precinct 7A, Warnervale, Central Coast, NSW" by Archaeological Surveys and Reports Pty Ltd. This report identified 18 Aboriginal objects/sites within the precinct, primarily in association with a broad ridgeline in the centre of the study area. These sites were characterised as containing isolated or very low densities of Aboriginal objects (stone artefacts) situated on tracks or exposures, and were generally considered of low archaeological significance. Only one site, 'Bitova OS 4', contained a higher density of artefacts (~40), near a water tower on the highest point of the ridge, but this similarly retained little research potential being on a disturbed and truncated soil profile. The report recommended that further investigation was required and appropriate permits from the NSW State government obtained should development in these areas be proposed. Comments from the Aboriginal stakeholders were broadly in agreement, although Guringai Tribal Link Aboriginal Corporation (GTLAC) and Darkinjung Local Aboriginal Land Council (LALC) considered Bitova OS 4 of greater cultural significance, and GTLAC also disagreed with the investigative methods proposed.

We consider that the report provides a good baseline assessment for the Aboriginal objects/sites and deposits within the precinct. Based on a brief site visit and regional archaeological models, the findings appear consistent with a fairly ephemeral use of the region in the past – a lack of significant water course being a major hindrance to more extensive occupation. The report does, however, have some deficiencies, most notably that it no longer fulfils current Aboriginal heritage guidelines or requirements (which were modified in 2010), and that no further investigation and characterisation of the sites was undertaken, most notably Bitova OS 4. This latter issue was a recommendation of the report, but was never implemented.

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Aboriginal Consultation

As part of the rezoning discussions, Extent (Alan Williams), AVJennings (Andrew Gallagher) and ADW Johnson (Stephanie Van Dissel, Chris Smith) met with the relevant Aboriginal stakeholders. The intent of these meetings was to engage the stakeholders early in the proposed re-zoning, and obtain their thoughts and feedback on the site. Meetings were held with representatives of Darkinjung LALC (Lynne Hamilton and Lee Davidson) on 15 January 2016 at Warnies Café, Warnervale Road, NSW; and GTLAC (Tracey Howie) on the 2 February 2016 at the same venue. Following a presentation of AVJennings development and design concepts, a site visit was undertaken to visit the precinct on both occasions.

Feedback from the meetings was similar to that provided in 2008. Specifically, that Bitova OS 4 required further investigation, and that any development should appropriately manage Aboriginal heritage within the site. However, there were no issues raised over re-zoning the entire precinct to residential, since *in situ* conservation of the deposits was not considered critical. Rather, there was a preference that appropriate assessment and consideration of any cultural deposits be undertaken through the development process; and areas of cultural value (if present) were managed respectfully. An approach AVJennings, ADW Johnson and Extent supported. In addition, there was significant interest from the Aboriginal stakeholders to ensure appropriate interpretation of Aboriginal heritage was undertaken as part of any development.

Conclusions and Recommendations

Based on a review of the existing study, and feedback from the Aboriginal stakeholders, there appears to be no cultural heritage constraints on re-zoning the site from RE1 to residential. However, the presence of Aboriginal objects/sites within the precinct does require further assessment, and approvals from the Office of Environment and Heritage (OEH) would need to be sought prior to any development being undertaken. Should significant cultural materials be identified during such works, they could be managed and, if necessary, protected through the subsequent planning and approval requirements following re-zoning.

Further investigation would need to take the form of an Aboriginal Cultural Heritage Assessment Report, which is required for sub-surface investigations, and as supporting documentation for an Aboriginal Heritage Impact Permit (AHIP) application. This document must be prepared in accordance with OEH's (2010) *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW* and (2010) *Aboriginal Consultation Requirements for Proponents*, and should focus on further characterisation of the previously identified cultural deposits, most notably Bitova OS 4. Please note that due to mandatory timeframes dictated in OEH guidelines, this report would require 3-6 months to complete, with a further two months added for OEH processing times should an AHIP be required.

For further information, please contact Alan Williams on 02 9555 4000.

Yours sincerely

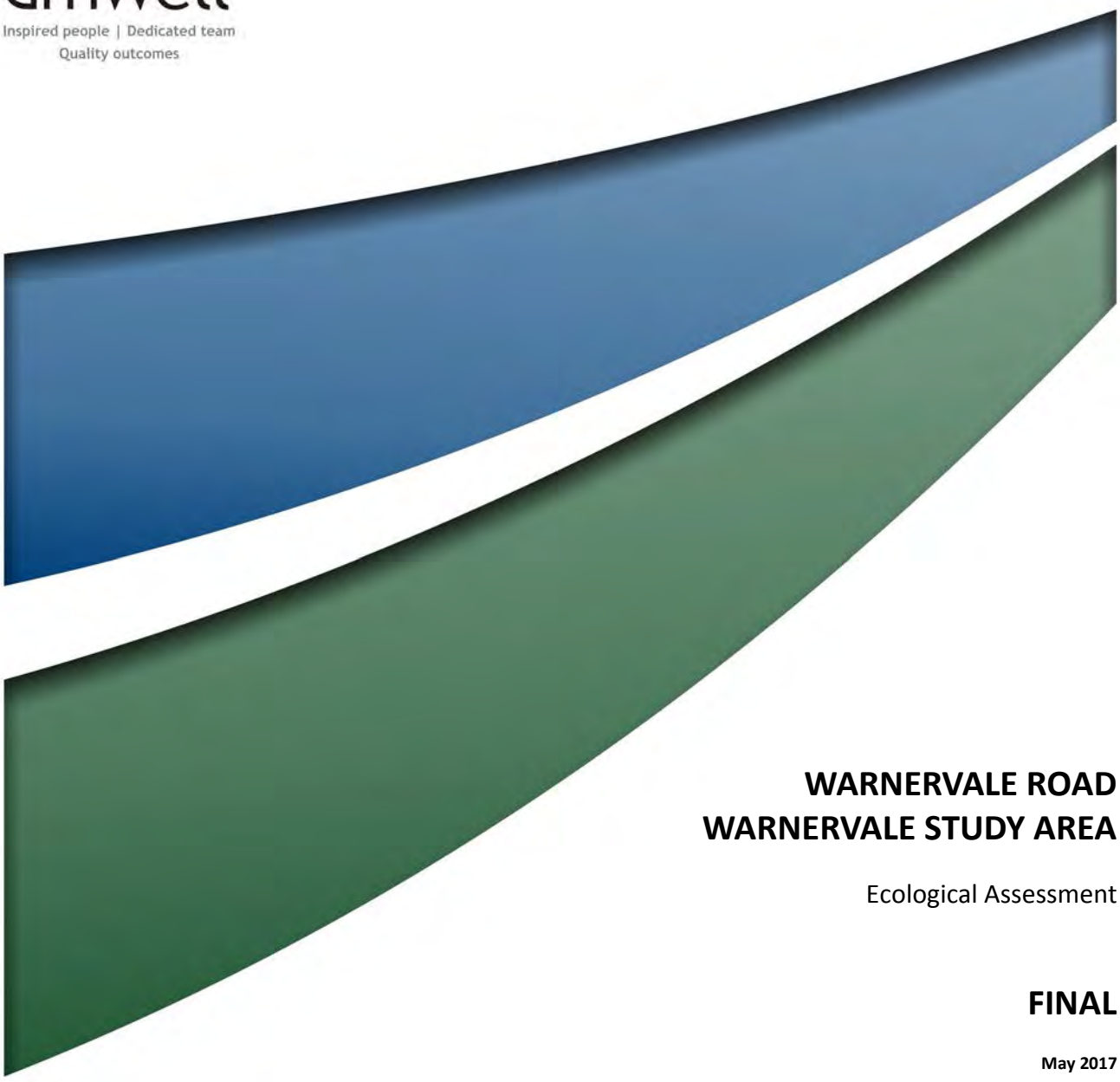
Dr. Alan Williams MAACAI

Aboriginal Heritage Team Leader

D Ecological Assessment 2017 (Umwelt)

umwelt

Inspired people | Dedicated team
Quality outcomes



WARNERVALE ROAD
WARNERVALE STUDY AREA

Ecological Assessment

FINAL

May 2017

WARNERVALE ROAD WARNERVALE STUDY AREA

Ecological Assessment

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
AV Jennings

Project Director:	Rebecca Vere
Project Manager:	Chloe Parkins
Report No.	3616/R02/V7/FINAL
Date:	May 2017

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This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

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1.0 Introduction

Umwelt (Australia) Pty Limited (Umwelt) was commissioned by ADW Johnson to prepare an Ecological Assessment (EA) for 53.2 hectares of land, located along Warnervale Road in Warnervale NSW. This parcel is proposed for urban development by AV Jennings. This area (herein referred to as the Study Area), occurs within the Wyong Shire Local Government Area (LGA). The Study Area is part of a larger area also owned by AV Jennings, however is the only part proposed for urban development as part of this EA. The Study Area (**Figure 1.1**) comprises an Impact Area (proposed for urban development including required access roads) and a Park Area.

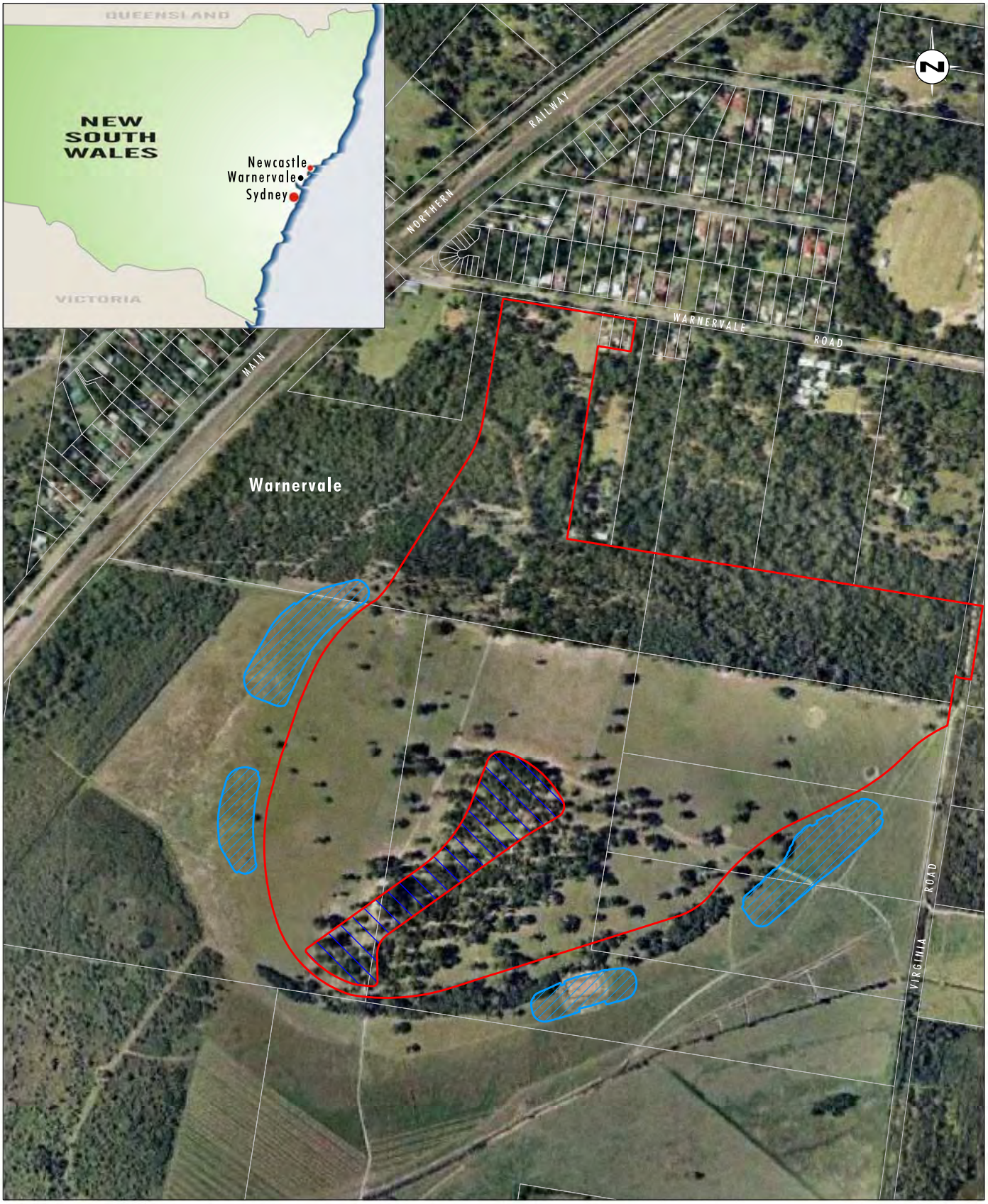
This EA will accompany the development application in order to address section 5A/79C of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The purpose of this EA is to assess the impacts of the urban development of the Study Area (being the Project) on flora and fauna in accordance with Wyong Shire Council's (WSC) *Flora and Fauna Survey Guidelines* as well as Chapter 6.5 - Warnervale South Section 2.14 - Ecological Issues from WSC's 2013 Development Control Plan (DCP).

1.1 Previous Ecological Surveys

The Study Area lies within the boundary of the Warnervale Precinct 7a Study Area that was subject to the *Ecological Assessment – Precinct 7a, Warnervale NSW* (Umwelt 2013) as part of previous land-use planning works undertaken by WSC. In total, Precinct 7a is 558 hectares in size. This work was undertaken to inform a broader land-use strategy to support continued growth for the Wyong LGA. Works undertaken as part of that project included:

- extensive literature reviews
- detailed flora surveys including rapid assessment, plot based surveys and targeted searches for threatened species
- detailed fauna surveys targeting fauna composition and habitats as well as targeted threatened species searches
- impact assessment for threatened and migratory species, endangered populations and threatened ecological communities (TECs) identified or considered to have potential to occur and
- preparation of management strategies including development of a detailed Conservation Management Plan (Umwelt 2014) for the Precinct.

Due to the extensive and recent surveys undertaken as part of the *Ecological Assessment – Precinct 7a, Warnervale NSW* (Umwelt 2013), WSC determined that full survey of the Study Area was not required to inform the current Project. Rather, advice was given on targeted survey required to address key issues within the Study Area to inform the impact assessment for the current Project.



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Legend

- Impact Area
- Park Area
- Constructed Wetland

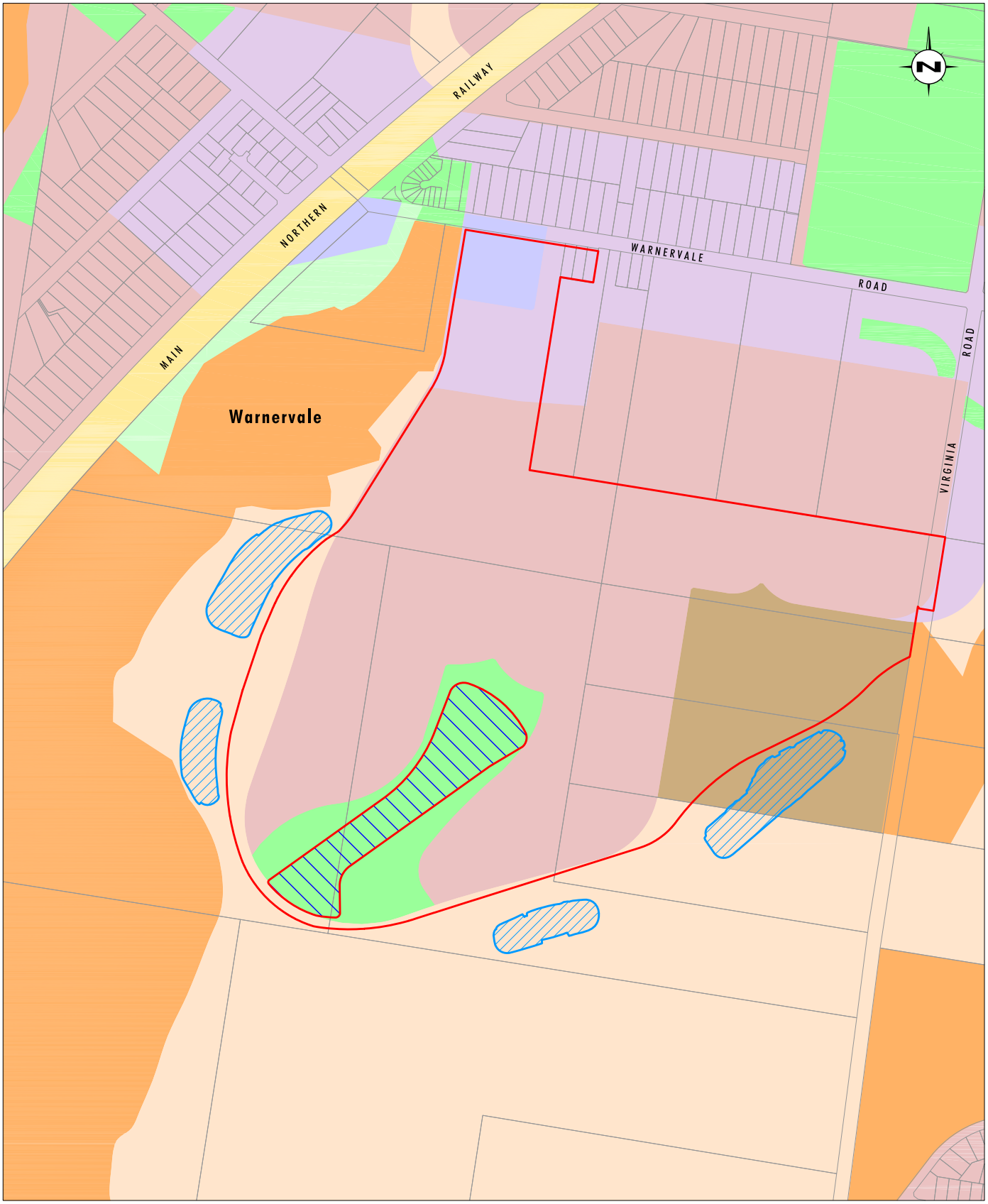
FIGURE 1.1

Study Area

1.2 Zoning

The Study Area is located in land largely zoned as R2 Low Density Residential, with an area in the south zoned as RE1 – Public Recreation and the north-west corner zoned as a combination of B1 – Neighbourhood Centre and R1- General Residential. A small area along the central east is zoned as RU6 – Transition. The western areas outside of the Study Area are zoned for a combination of E2 – Environmental Conservation and E3 – Environmental Management. Zoning of the Study Area is provided in **Figure 1.2**.

It is understood that an application to rezone a portion of the RE1 and RU6 land to residential has been discussed with Council and a Planning Proposal application was lodged on 1 July 2016. This same application also proposed to rezone small amounts of the E3 lands within the Study Area to residential.



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Legend

- Impact Area
- Park Area
- Constructed Wetland
- B1 - Neighbourhood Centre
- B4 - Mixed Use
- B7 - Business Park
- E2 - Environmental Conservation
- E3 - Environmental Management
- IN1 - General Industry
- R1 - General Residential
- R2 - Low Density Residential
- RE1 - Public Recreation
- RE2 - Private Recreation
- RU6 - Transition
- SP2 - Infrastructure

FIGURE 1.2

Zoning Map

1.3 Requirements for the Current Project

Two meetings were held early in the Project design phase to discuss the specific ecological requirements for this Project:

- meeting held on Wednesday 27 May 2015 between Kellie Hassab and Michael Neate (Trehy, Ingold and Neate (TIN)) (being the original managers for the Project, prior to ADW Johnson), John Vagulans (AV Jennings) and Nathan Burr and Sharyn Styman from WSC and
- meeting held Monday 10 August 2015 between Kellie Hassab (TIN), Andrew Gallagher (AV Jennings), Alison Riley (Umwelt) and Sharyn Styman (WSC).

As a consequence of these meetings, the following reporting components were requested by WSC:

- compliance table to demonstrate how the previous and current surveys satisfy WSC's Flora and Fauna Survey Guidelines
- updated database searches and habitat assessments to determine if any recently listed/recorded threatened and migratory species, endangered populations or TECs (listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) or Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)) are likely to occur in the Study Area and for which further targeted surveys must be undertaken
- updated vegetation mapping (including TECs) to reflect any changes that have occurred since previous surveys
- targeted surveys for the following threatened flora species:
    - *Eucalyptus parramattensis* subsp. *parramattensis*
    - Wyong sun orchid (*Thelymitra* sp. *adorata*)
    - Heath wrinklewort (*Rutidosis heterogam*a)
    - *Corunastylis* sp. Charmhaven
- identification of all hollow-bearing trees and potential raptor nests within the Study Area
- stag watching and/or remote camera surveys in potential den trees for squirrel gliders (*Petaurus norfolcensis*)
- targeted powerful owl (*Ninox strenua*), masked owl (*Tyto novaehollandiae*) and barking owl (*Ninox connivens*) surveys, with particular focus on potential nest trees
- habitat assessment for squirrel gliders (*Petaurus norfolcensis*) in accordance with Appendix 1 of WSC's *Squirrel Glider Conservation Management Plan: Wyong Shire* (Smith 2002)
- consideration of impacts to connectivity
- plan of all hollow bearing trees (including species, number and size of hollows) proposed to be retained/removed

- consideration of the likelihood of a maternity colony of threatened micro-bats, including consideration of times and locations of calls

- consideration of watercourse and wetland vegetation as waterfront land as required by the NSW Office of Water (NOW)

- SEPP 44 koala (*Phascolarctos cinereus*) habitat assessment

- consideration of wetland management in accordance with DCP Chapter 3.10 (WSC 2013)

- consideration of application of DCP Part 4 for subdivisions as detailed in Section 3.9.3 of the DCP Part 4 and

- consultation with the Greater Sydney Local Land Service regarding requirements for vegetation clearing under the *Native Vegetation Act 2003* (NV Act).

Each of these issues has been addressed within this Ecological Assessment. It is noted that the proposed rezoning of the E3 lands within the Study Area will remove the necessity to consider the NV Act in this Project.

1.4 The Project

The Project will involve the development of the Study Area to increase the availability of residential dwellings to the rapidly-growing Wyong Shire population. This will involve the construction of approximately 595 residential lots between 225 m^2 and 600 m^2 in size undertaken in a staged manner averaging 100 lots per year. The Project will also involve the construction of access roads for proposed residences and associated infrastructure for the purposes of stormwater management, water and sewer etc. It is assumed in this EA that all land identified as the Impact Area (refer to **Figure 1.1**), will be subject to impact. The impact assessment for this Project also considers the Constructed Wetland areas (**Figure 1.1**), required for stormwater detention purposes.

The land identified as Park Area (refer to **Figure 1.1**) will be retained within the post-development landscape as a recreational area with formal park facilities in the north (picnic pavilions, playground, amenities) grading to a more natural treed area in the south with formal shared pathways, seating and both natural and planted landscaping.

ADW Johnson also proposes to include the following initiatives into the Project design, in order to minimise ecological impact where possible and feasible. These activities are proposed to be undertaken prior to the commencement of construction to minimise time lag in their benefit:

- installation of glider poles (or structures with similar effect, such as fauna overpasses/rope bridges) in select locations to the south of the Study Area to compensate for connectivity losses that will occur in the northern areas of (currently connected) vegetation

- revegetation works in the south of the Study Area to address future habitat and connectivity loss (in the north). These revegetation works will aim to restore floristic structure and diversity (where possible) to those vegetation communities previously present in that part of the Study Area. Where suitable, this composition will also target inclusion of key feed species for target threatened species (such as threatened gliders) and

- retention of 2.9 ha of land in the south of the Study Area as the Park Area, which will include retention of hollow-bearing trees and existing vegetation where possible.

It is noted that these commitments are in addition to those required within the Conservation Management Plan for Precinct 7A, (Umwelt 2014) which is relevant to the Study Area. These commitments are documented in detail in **Section 6** of this report and include (as necessary and relevant to the Study Area):

- weed and feral fauna management
- management of key threatening processes
- management of vegetation clearing, including salvage and reuse of key habitat features (such as hollows)
- community stewardship, education and reporting
- public access, fencing and signage
- aboriginal cultural values
- rubbish dumping and other prohibited uses
- bushfire and stormwater management
- habitat retention and enhancement
- floodplain revegetation and
- ecological monitoring.

2.0 Methods

2.1 Literature Review and Database Searches

In order to identify threatened and migratory species, endangered populations, and TECs with the potential to occur in the Study Area (and broader local area), a detailed assessment of relevant ecological databases was completed. These database sources comprised:

- a 10 kilometre radius search from the centre of the Study Area of the OEH Atlas of NSW Wildlife (January 2016) (OEH 2016a)
- a 10 kilometre radius search from the centre of the Study Area of the DoE Protected Matters Database (January 2016) (DoE 2016)
- a 10 kilometre radius search from the centre of the Study Area of the NSW Flora Online – Spatial Search database (January 2016a)(Botanic Gardens Trust 2016)
- a search of the Atlas of Living Australia (January 2016) and
- a search of the DPI Fisheries and Aquaculture *Threatened and Protected species - records viewer* (January 2016) (DPI 2016).

A list of those species, populations and TECs identified in these searches are provided in **Appendix 1**, along with a rank of the likelihood of the Study Area to provide habitat (high, medium, low or no habitat) for that particular species, population or TEC.

The literature review that was undertaken as part of the *Ecological Assessment – Precinct 7a, Warnervale NSW* (Umwelt 2013) was reconsidered in the context of the current Study Area. This literature included the following and where relevant significant records identified as part of previous studies have been incorporated into this report:

- Bell, S. Branwhite, B and Driscoll, C. (2005) *Thelymitra adorata* Jeanes ms (Orchidaceae): population size and habitat of a highly restricted terrestrial orchid from the Central Coast of New South Wales. The Orchadian, Volume 15, Number 1, pp.6-10. September 2005.
- Bell, S. (2001) Distribution Conservation and Management of the Threatened *Angophora inopina* – Technical Report and Conservation Management Plan. Prepared for Wyong Shire Council.
- Bell, S. (2002) The Natural Vegetation of the Wyong Local Government Area, Central Coast, New South Wales. Report to Wyong Council.
- Bell, S. and Murray, M. (2004). *Flora and Fauna Investigations, Proposed Warnervale Town Centre, Wyong Shire*. Draft Report prepared for Wyong Shire Council.
- Bell, S. and Murray, M. (2007). *Ecological Investigations (Version 2) Wyong Employment Zone. Warnervale Business Park, Warnervale Airport Lands, Precincts 11 & 13 and Precincts 14*. Report prepared for Wyong Shire Council.
- Bell, S. (2010) Lower Hunter Spotted Gum – Ironbark Forest EEC in the Warnervale Area, Wyong Shire. Draft report. Prepared for Wyong Shire Council.

- Conacher Environmental Group (2009) Flora and Fauna Assessment Report – Proposed Development Lot 7 DP 1071685, Minnesota Rd, Hamlyn Terrace.

- Conacher Travers (2006) Wadalba Wildlife Corridor Management Plan. Prepared for Wyong Shire Council.

- Connell Wagner (2007) Warnervale Link Road and Water Main Review of Environmental Factors – Northern Section. A report to Wyong Shire Council.

- Connell Wagner (2008) Draft Conservation Offset Strategy and Habitat Restoration Plan – Warnervale Link Road and Watermain. Prepared for Wyong Shire Council.

- DECC (2008) Identification Guidelines for Freshwater Wetlands on Coastal Floodplains (Freshwater Wetlands). www.environment.nsw.gov.au.

- Eastcoast Flora Survey (2002) Population size and habitat of the endangered *Acacia bynoeana* Benth. (Fabaceae: Mimosoideae) in Wyong Shire. Prepared for Wyong Shire Council.

- Eastcoast Flora Survey (2003a) Supplementary Survey for Thelymitra 'adorata' ms (Orchidaceae) at the Proposed North Wyong Sporting Facility, Pollock Avenue, North Wyong. Prepared for Wyong Shire Council.

- Eastcoast Flora Survey (2003b) The Natural Vegetation of the Wyong Local Government Area, Central Coast, New South Wales: Technical Report. Prepared for Wyong Shire Council.

- Eastcoast Flora Survey (2005) *Grevillea parviflora* subsp. *parviflora* in Wyong Local Government area: Progress Report. Prepared for Wyong Shire Council.

- Eastcoast Flora Survey (2008a) Revised Vegetation Mapping of Wyong LGA: Stage 1 – West of F3 Freeway. Prepared for Wyong Shire Council.

- Eastcoast Flora Survey (2008b) Summary of the Vegetation Map Revision for Wyong LGA 2008. Prepared for Wyong Shire Council.

- EcoLogical Australia (2008) Biodiversity Certification Application: Warnervale Town Centre. Prepared for the Department of Planning and NSW Department of Environment and Climate Change and Water.

- EcoLogical Australia (2009) Plan of Management – Draft: Warnervale Heath Wrinklewort Reserve. Prepared for Rail Corp.

- Ecological Surveys and Management and Forest Fauna Surveys Pty Ltd (2001) Reconnaissance Flora, Fauna and Habitat Assessment Warnervale District. Report to Wyong Shire Council.

- Ecotone Ecological Consultants (2001) Lower Hunter and Central Coast Regional Biodiversity Conservation Project – Fauna Survey and Mapping Project: Module 1. Fauna Survey. A report for the Steering Committee for the Lower Hunter and Central Coast Regional Environmental Strategy.

- EDAW AECOM (2009) Porters Creek Wetland and Wyong River Risk Assessment: Part A – Porters Creek Wetland Inundation Pattern and Vegetation Communities (Final Draft). A report for Wyong Shire Council.

- Forest Fauna Surveys & Eastcoast Flora Survey (2004). Flora and Fauna Investigations – Proposed Warnervale Town Centre, Wyong Shire. Prepared for Wyong Shire Council.

- Forest Fauna Surveys and Eastcoast Flora Survey (2007) Ecological Investigations (Version 2) Wyong Employment Zone – Warnervale Business Park, Warnervale Airport Lands, Precincts 11 & 13 and Precinct 14. Prepared for Wyong Shire Council.

- GHD Pty Limited (2008) Ecological Impact Assessment. A report to Pacific Beverages Pty Limited.

- Gunninah Environmental Consultants (2003) Wyong Ground Orchid Survey – Wyong Shire. Prepared for Wyong Shire Council.

- Keystone Ecological (2008) Habitat Tree Assessment for Warnervale Industrial Estate. Prepared for Warnervale Industrial Estate.

- LesryK Environmental Consultants (2000) Flora and Fauna Assessment within and adjacent to Portions 32 and 33, Part Portion 30, Part Lot 764, DP 7091, Part Lot 75, DP 7091 and Part Lot 76, DP 7091 In Relation to the Reorganisation of Warnervale Farm and Creation of Environmental Corridors, A report to the Urban Partnership.

- Patterson Britton and Partners (2006) Morisset to Warnervale Water Trunk Main and Morisset Water Pumping Station – Review of Environmental Factors. Prepared for Wyong Shire Council

- Robert Payne – Ecological Surveys and Management (undated) The Link Road and the Lakes Grammar School Flora, Fauna and Aquatic Survey. Prepared for Wyong Shire Council.

- Robert Payne Ecological Surveys and Management (1997) Addendum to Integrated Flora and Fauna Assessment. A report to Wyong Shire Council.

- Robert Payne – Ecological Surveys and Management (2001) Threatened Species Management Strategy – Educational Development Site at Warnervale. Prepared for Wyong Shire Council.

- Robert Payne Ecological Survey and Management (2002) Wildlife Corridor Strategy – Field Evaluation of Linkages. Prepared for Wyong Shire Council.

- Robert Payne – Ecological Surveys and Management (2006) Ecological Reconnaissance Survey Report – Sporting Facilities – Hamlyn Terrace. Prepared for Wyong Shire Council.

- Robert Payne – Ecological Surveys and Management (2009) Interim Monitoring Report – Stage 3 Lakes Grammar – an Anglican School, Warnervale. Prepared for Wyong Shire Council.

- Sainty and Associates (2003) Porters Creek Wetland Environmental Management Plan. Prepared for Wyong Shire Council.

- Smith, A & Murray, M (undated) Habitat requirements of the squirrel glider (Petaurus norfolcensis) and associated possums on the NSW Central Coast. Austeco Environmental Consultants, Armidale.

- Smith A.P., Watson G. & Murray M. (2002) Fauna habitat modelling and wildlife linkages in Wyong Shire. Austeco, Armidale.

- Smith, A. (2002a) Squirrel Glider (Petaurus norfolcensis) Conservation Management Plan: Wyong Shire. Prepared for Wyong Shire Council.

- Smith, A. (2002b) Effects of Clearing and Fragmentation on the Squirrel Glider (Petaurus norfolcensis: Petauridae). Prepared for Wyong Shire Council.

- Travers Bushfire and Ecology (2009) Flora and Fauna Assessment – Bulk Transport Terminal Lot 412, DP 1058215, Warren Rd, Warnervale. Prepared for Wyong Shire Council.

- Umwelt Pty Ltd (2013) Ecological Assessment - Precinct 7A, Warnervale NSW. Report prepared for Wyong Council, February 2011.

- Umwelt Pty Ltd (2014) Conservation Management Plan – Precinct 7A, Warnervale NSW. Report prepared for Wyong Shire Council, March 2012.

- W.S Rooney and Associates Pty Limited (1990) Kemcon Project: Kemcon Wetlands Ecology, Water, Sediment and Soils Assessment. Prepared for Kemcon.

- Wyong Shire Council Strategic Planning Department (2003) Draft Wyong Conservation Strategy. Prepared for Wyong Shire Council.

- Wyong Shire Council (2007) BioCertification Report: Wyong Employment Zone (WEZ) Rezoning. Prepared for Wyong Shire Council.

- Wyong Shire Council (2008) Summary of the Vegetation Map Revision for Wyong LGA 2008. Internal report.

Ongoing subscription to service Eremaea Birdline (Interesting and unusual bird observations) (maintained by BirdLife Australia and Birding NSW) has identified recent records of powerful owl (*Ninox strenua*) on nearby Virginia Road, Warnervale during January 2016.

Correspondence with WSC has also identified the presence of leafless tongue-orchid (*Cryptostylis hunteriana*), to the north-east of the Study Area less than 400 metres away.

2.1.1 Outcomes of Consultation with Greater Sydney Local Land Services

Umwelt consulted Greater Sydney Local Land Service in January and February of 2016 to determine the assessment requirements for clearing of vegetation in lands zoned as *RU6 - Transition*, *E2 – Environmental Conservation* and *E3 – Environmental Management* as required under the NV Act. Since that time, and as discussed previously, a rezoning has been lodged which will remove the necessity to consider the NV Act in this Project.

2.2 Floristic Surveys

Floristic surveys undertaken as part of the current study included rapid assessments, targeted threatened species searches and ground-truthing surveys. Each is described in greater detail below. The locations of relevant surveys completed as part of the current and previous projects (Umwelt 2013 and literature review) are provided in **Figure 2.1**.

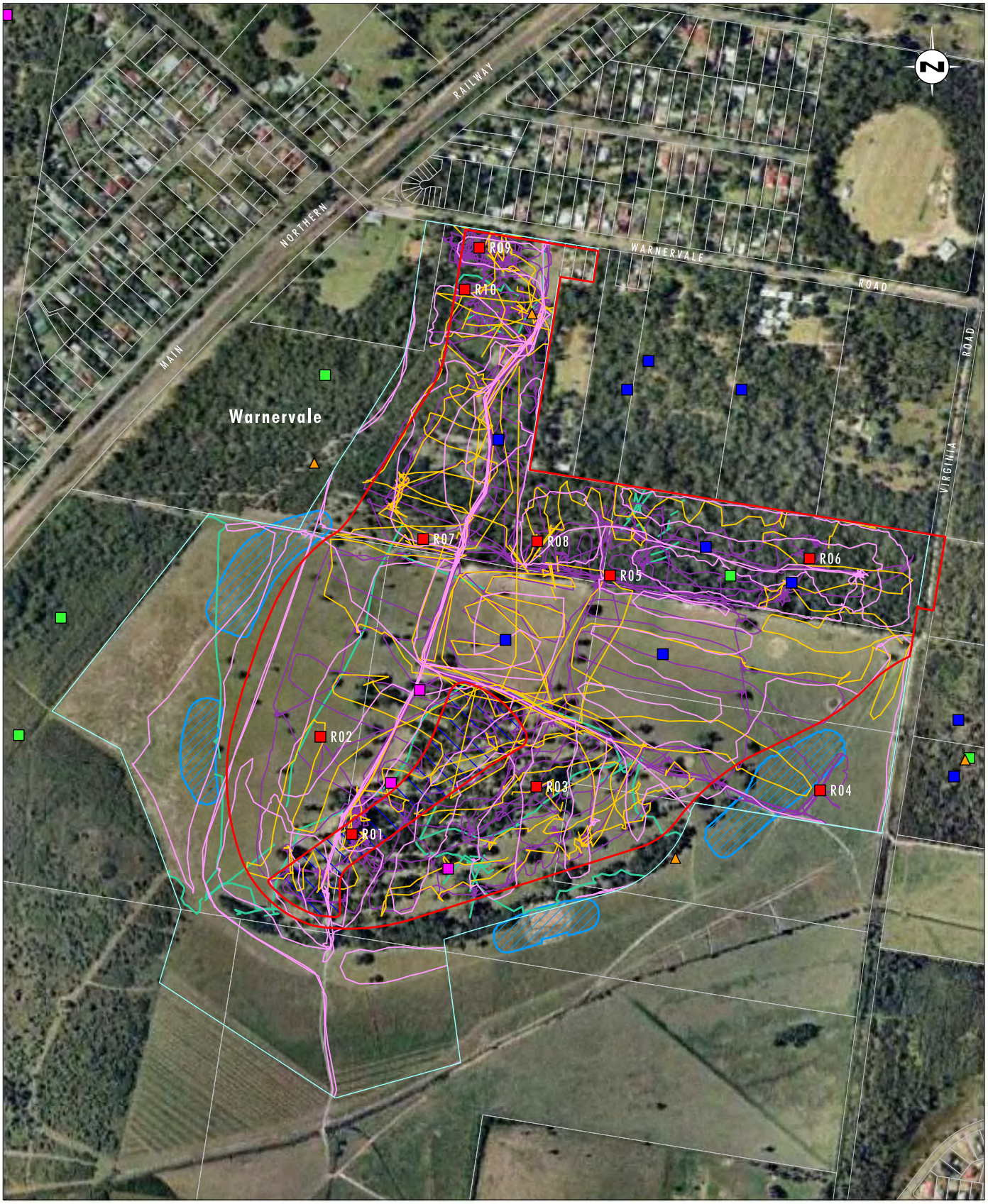

Image Source: Google Earth (2010)
Data Source: Wyong Shire Council (2010)

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Legend

- Impact Area
- Park Area
- Constructed Wetland
- Previous Meander Surveys
- September 2015 Walking Meanders
- October 2015 Walking Meanders
- February 2016 Walking Meanders
- Rapid Assessment Points (Current Study)

Previous Survey Results:

- Non-Umwelt Site
- Non-Umwelt Plot used in the Biodiversity Certification Assessment
- Umwelt Vegetation Plot
- Umwelt Vegetation Rapid Assessment Plot

FIGURE 2.1

Flora Survey Locations

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2.2.1 Previous Floristic Surveys

Previous surveys undertaken within the Study Area as part of previous studies included meander transects, nine plots and one rapid assessment.

2.2.2 Rapid Assessments

Due to the extent of floristic surveys that were undertaken as part of the *Ecological Assessment – Precinct 7a, Warnervale NSW* (Umwelt 2013), detailed floristic surveys for the purposes of vegetation mapping were not undertaken for this Project. Instead, rapid assessments were undertaken at targeted locations throughout the Study Area to document changes to vegetation that had occurred since the Umwelt (2013) surveys. A key focus of these rapid assessments was to record and compare vegetation condition.

Rapid assessment plots of 10 x 10 metres were carried out to maximise information about the vegetation in the Study Area. Approximately 15 to 20 minutes was spent searching for vascular plants occurring within the 100m^2 rapid plot. A total of ten rapid assessments were made in the Study Area, the locations of each of these are shown on **Figure 2.1**.

All vascular plants recorded in a plot were assigned a cover-abundance score using the modified Braun-Blanquet 6-point scale (Braun-Blanquet 1927, with selected modifications sourced from Poore 1955 and Austin *et al*. 2000) shown in **Table 2.1**. The score indicates the percentage cover of each species within the plot. Notable and important plants occurring outside of the plot were also recorded without a cover-abundance score.

Table 2.1 Modified Braun-Blanquet Crown Cover-Abundance Scale

Class	Cover-abundance*	Notes
1	Few individuals (less than 5% cover)	Herbs, sedges and grasses: <5 individuals Shrubs and small trees: <5 individuals
2	Many individuals (less than 5% cover)	Herbs, sedges and grasses: 5 or more individuals Shrubs and small trees: 5 or more individuals Medium-large overhanging tree
3	5 – less than 20% cover	-
4	20 – less than 50% cover	-
5	50 – less than 75% cover	-
6	75 – 100% cover	-

Note: * Modified Braun-Blanquet scale (Poore 1955; Austin *et al*. 2000).

2.2.3 Targeted Threatened Flora Surveys

Based on advice provided by WSC, by habitats present and by known occurrences in surrounding habitats identified in the *Ecological Assessment – Precinct 7a, Warnervale NSW* (Umwelt 2013), targeted threatened flora species searches were completed for the following species:

- *Thelymitra* sp. *adorata*
- Charmhaven orchid (*Corunastylis* sp. Charmhaven)
- heath wrinklewort (*Rutidosis heterogama*) and
- Parramatta red gum (Eucalyptus *parramattensis* subsp. *parramattensis*).

Subsequent correspondence with WSC identified that threatened species leafless tongue orchid (*Cryptostylis hunteriana*) also has potential to occur (Pers comm. Styman 2016).

Targeted threatened species searches were undertaken for each of the above species. These searches were carried out by way of walking transects through relevant habitat during appropriate survey seasons (i.e. undertaken to coincide with flowering – as required). Flowering was confirmed (with WSC and via known local reference populations) for the key orchid species prior to surveys.

The locations of walking meander transects undertaken are provided in **Figure 2.1** and the timing of targeted threatened species searches undertaken compared to known flowering periods provided in **Table 2.2** below.

Table 2.2 Survey Timing Requirements of Threatened Flora Species and Times Surveyed

Threatened Flora Species	Survey Month												Total kms of Walking Searches
	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	
Thelymitra sp. adorata									30th	1st, 6th, 15th			66km
Cryptostylis hunteriana		15th, 16th											23km
Corunastylis sp. Charmhaven		15th, 16th											23km
Rutidosis heterogama		15th, 16th							30th	1st, 6th, 15th			89km
Eucalyptus parramattensis subsp. *parramattensis*		15th, 16th							30th	1st, 6th, 15th			89km

Legend	
Optimal survey timing	
Sub-optimal* survey timing	

* Surveys can be undertaken during this time, however not at peak flowering.

Targeted threatened flora surveys were carried out by two ecologists during September and October 2015 and by a single ecologist during February 2016. Walking transects were undertaken at an approximate spacing of 10 to 30 metres of each other depending on the quality of the habitat available.

Where potential threatened species were encountered details on the following were recorded:

- coordinates of specimen
- physical characteristics of location
- size of population
- relevant vegetation community
- relevant landscape and soil features
- flowering status (i.e. budding, fully opened etc) and
- any other relevant ecological factors.

2.2.4 Ground-truthing of Vegetation Mapping

Ground-truthing of existing vegetation mapping was also undertaken during the targeted threatened flora surveys. Field reconnaissance (or ground truthing) assists identification of vegetation community boundaries for mapping purposes and observation of vegetation variance across an environmental gradient. Field reconnaissance typically crosses several habitat factors, such as landform elements, soil types, slopes and aspects to observe changes in vegetation associated with these. It was carried out on foot, such as during walking transects, and by vehicle to cover larger parts and degraded habitats of the Study Area. Locations of meander transects undertaken are provided in **Figure 2.1**.

2.2.5 Plant Nomenclature

All vascular plants recorded or collected within plots and along transects were identified using keys and nomenclature in Harden (1992, 1993, 2000 & 2002) and Wheeler *et al*. (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from *PlantNET* (Botanic Gardens Trust 2016b), the on-line plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 & 2002) where available, and draw on other sources such as local names where these references do not provide a common name. Where the identity of a specimen was unknown or uncertain, it was lodged with the National Herbarium of New South Wales at the Royal Botanic Gardens Sydney. Where necessary, specimens of threatened species (or potential threatened species) were sent to the National Herbarium of New South Wales for confirmation of their identity.

2.3 Fauna Surveys

Fauna surveys comprised area based searches as well as recording/call broadcast based searches. Each of these is described in greater detail below.

2.3.1 Previous Fauna Surveys

Fauna surveys undertaken in the Study Area as part of previous studies included:

- spotlighting
- hair-tube surveys
- cage and Elliot trapping
- call playback
- diurnal bird surveys
- nocturnal herpetological surveys
- anabats and
- harp trapping.

Fauna surveys completed as part of the current Project are documented below.

2.3.2 Remote Camera Surveys

Remote camera surveys were undertaken at nine locations (**Figure 2.2**), for the purposes of general fauna records. Remote cameras were directed at tree trunks with scratch-marks or other areas of potential habitat for key threatened species and baited with peanut butter and honey. In total, remote camera surveys were undertaken over 27 nights, giving a total of 243 trap nights.

Image Source: Google Earth (2010)
Data Source: Wyong Shire Council (2010)

0 100 200 400m
1:7 500

Legend

- Impact Area
- Park Area
- Constructed Wetland
- Aerial Remote Cameras
- Anabat Express
- Diurnal Bird Survey
- Diurnal Herpetofauna Surveys
- Nocturnal Bird and Mammal Call Playback
- Nocturnal Crinia signifera Call Playback and Spotlight
- Terrestrial Remote Cameras

FIGURE 2.2

Fauna Survey Locations

File Name (A4): R02/3616_005.dgn
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2.3.3 Hollow-bearing Tree Surveys

One of the key potential impacts of the Project is the loss of hollow-bearing trees, as such recording of all hollow-bearing trees present in the Study Area was a focus of the fauna survey. This included an initial survey during which locations of each known and potential hollow-bearing tree was documented, followed by follow-up surveys to physically inspect hollows (where possible), or use of remote cameras at suitable vantage points whereby hollow usage could be monitored.

Hollow-bearing tree surveys were undertaken with the focus of identifying appropriate habitat for the powerful owl (*Ninox strenua*), masked owl (*Tyto novaehollandiae*), barking owl (*Ninox connivens*) and squirrel glider (*Petaurus norfolcensis*). Hollow-bearing trees were identified during targeted threatened flora species surveys of the site. For each hollow-bearing tree encountered, the following information was documented:

- tree species
- number of hollows
- approximate height of hollow
- hollow position
- hollow aspect
- approximate size of the hollow-opening and
- coordinates of location.

Searches were also completed at the base of each hollow-bearing tree for owl pellets, predatory debris (bones, fur etc.) or scratch marks on the trunk.

2.3.3.1 Physical Hollow Inspections

Where trees were considered to have potential owl or glider hollows, physical inspection was undertaken by climbing and/or use of pole-mounted inspection cameras. The purpose of this was to determine approximate hollow dimensions and their suitability (or otherwise) for owl or glider usage.

Physical hollow inspections were undertaken on 23, 24 and 25 February 2016 and involved inspection of a total of 80 out of a total of 104 hollows identified in the Study Area (as well a further 45 hollows from areas outside of the Study Area). Hollow inspection was undertaken using a pole camera and wireless video screen that allowed viewing of the content of the hollows as well as approximate dimensions from the ground. This camera-screen combination captured photos and videos, as well as real-time footage to identify any fauna encountered within the hollows. Climbing gear, ladders and harnesses were used to access higher hollows where possible, however a number of hollows were unable to be inspected. These were generally located higher than the ladders reach (generally 10 metres) and/or in unsafe positions such as at the end of long branches.

2.3.3.2 Targeted Remote Camera Surveys

In addition to general remote camera surveys, targeted camera surveys were conducted for augment the physical hollow inspections. This involved attaching remote cameras to trees with hollows that were unable to be physically inspected or had high potential for owl or glider usage. These surveys specifically targeted owl and glider species, however all fauna observed using tree hollows was recorded. Cameras were deployed using a ladder to climb the tree or on nearby trees that faced the target hollow. Where possible, cameras were mounted on platforms attached to the tree and facing the target hollow. In cases where the hollow was inaccessible, cameras were attached to trees nearby and orientated to face the hollow of the adjacent tree. In some instances where a tree had multiple hollows, additional cameras were set for the same tree.

Targeted remote camera surveys were used as a substitute for stag-watching surveys as they can be utilised over a longer period of time to determine whether a hollow is in use or not. Many hollow-dwelling fauna species utilise several hollows within their territories and there is potential that stag-watching surveys would not identify species utilising certain hollows on an irregular basis.

A total of 15 cameras were installed to monitor hollows of 13 different trees (**Figure 2.2**). Cameras were deployed on 15 February 2016 and retrieved on the 25 March 2016 (a total of 19 camera survey nights), giving a total of 285 additional survey nights.

2.3.4 Call Playback

Nocturnal call playback sessions consisted of calls being broadcast using a 10 watt directional loud hailer, undertaken within the first four hours after dusk. Call playback sessions commenced with a quiet listening period of approximately five minutes. Each species call was played for a minimum of four minutes followed by a listening period of two minutes before the beginning of the next species call. Mammal calls were played before bird calls to prevent the calls of predators (such as owls) decreasing the likelihood of prey species (such as gliders) responding to call playback. Nocturnal call playback sessions included the calls of:

- squirrel glider (*Petaurus norfolcensis*)
- koala (*Phascolarctos cinereus*)
- masked owl (*Tyto novaehollandiae*)
- barking owl (*Ninox connivens*) and
- powerful owl (*Ninox strenua*).

Call playback was undertaken at four locations across the Study Area. One of these locations was subject to one session and the remaining three sites subject to three separate sessions over three non-consecutive nights, giving a total of ten call playback sessions. Locations of each of these are shown on **Figure 2.2**.

2.3.5 Spotlighting

Spotlighting searches were undertaken both on foot and from a slow moving vehicle. Walking spotlighting searches were undertaken by two observers for a period of at least 30 minutes (total of one person hour) on each occasion. Vehicle spotlighting searches were undertaken by the passenger from a slowly moving (first gear, low range) four wheel drive vehicle. Spotlighting was undertaken whenever driving through the Study Area at night. Walking and vehicle spotlighting searches were undertaken using 30 watt spotlights.

Spotlighting was undertaken at four locations across the Study Area. One of these locations subject to one night of survey and the remaining three sites were subject to three separate nights of surveys; giving a total of ten on-foot spotlighting surveys. Locations of each of these are shown on **Figure 2.2**.

The primary purpose of spotlighting surveys was to target the squirrel glider (*Petaurus norfolcensis*), koala (*Phascolarctos cinereus*), masked owl (*Tyto novaehollandiae*), powerful owl (*Ninox strenua*) and barking owl (*Ninox connivens*). However all fauna species opportunistically identified during these surveys were documented.

2.3.6 Micro-bat Echolocation Recording

2.3.6.1 Anabat II Bat Detectors

Micro-bat echolocation calls were detected using an Anabat II Bat Detector and recorded digitally onto memory cards using Anabat CF storage ZCAIM. The combination of detector and recording device is collectively referred to as the 'Anabat detector'.

Anabat detectors were positioned in areas likely to be utilised by micro-bats, typically over dams or along flight pathways. Anabat detectors were positioned a clear view of potential micro-bat flyways. The recorders were automated and programmed to start recording one hour before dusk and to stop recording one hour after sunrise the following morning.

All Anabat detector recordings were analysed by Anna McConville (a recognised expert in the field) of Echo Ecology. The echolocation calls of species were identified to one of three levels of confidence:

- definite
- probable and
- possible.

For the purposes of this assessment, all three levels of confidence were treated as positive identifications.

The number of individual passes and time of night for each species was also documented.

Micro-bat echolocation recording was undertaken at two separate locations (as provided in **Figure 2.2**) for two full nights each, giving a total of four survey nights.

2.3.6.2 Anabat Express Units

Anabat surveys were also undertaken with Anabat Express units at two separate locations. The Anabat Express unit has a longer life battery that allows for devices to be left out for an extensive period of time. These units are for all other purposes functionally the same as the Anabat II Bat Detector.

Anabat Express units were deployed on appropriate flight paths on 24 February 2016 and collected on 14 March 2016. A total of 19 nights of Anabat Express units were undertaken at each location, giving a total of 36 Anabat Express survey nights.

Locations of Anabat Express units are provided on **Figure 2.2**.

Anabat data was also analysed by expert Anna McConville for the potential presence of roost sites in the Study Area. This involved the tally of bat calls recorded around sunset to identify what species (or species groups) were recorded very early in the night. If roosts were present close to the locations of Anabats, then it would be expected that some early calls of that species would be made. Attention was also paid to identifying clustered calls within the analysis suggesting possible groups of micro-bats exiting roost sites.

2.3.7 Diurnal Bird Survey

Bird surveys were undertaken in a range of different habitat types. Bird searches were undertaken by two observers for a minimum of 30 minutes. Opportunistic observations were recorded during all other aspects of the field survey, particularly when travelling throughout the Study Area. Bird species were identified from characteristic calls (where confident) and by observation using a 15 - 45 × 50 spotting scope or 10 × 60 binoculars. Focal habitat areas such as large dams and patches of heavily-flowering eucalypts were targeted for opportunistic bird surveys, whenever encountered.

Diurnal bird searches were undertaken at three locations, none of these sites were surveyed on multiple occasions. Locations of diurnal bird searches are presented on **Figure 2.2**.

2.3.8 Diurnal Herpetofauna Survey

Diurnal searches specifically targeting reptiles and opportunistically targeting amphibians were undertaken during the warmest parts of the day. Nocturnal searches targeted amphibians and nocturnal reptile species. All reptile and amphibian searches were undertaken by two ecologists for a period of at least 30 minutes.

Habitat features investigated during reptile and amphibian searches included water bodies, emergent vegetation, wet soak areas, logs, rocks, loose bark on tree trunks, exposed bedrock, leaf litter and open grassland areas. Amphibians not readily identifiable from their calls were captured for identification. All amphibians were handled according to the OEH hygiene protocol for the control of disease in frogs (NPWS 2001). Non-venomous snake species and small lizards were captured for identification, wherever possible.

A total of three diurnal herpetofauna surveys were undertaken in the Study Area, these locations are presented on **Figure 2.2**.

2.3.9 Habitat Assessment

Habitat assessment was undertaken at each of the ten rapid assessment points, each of these included assessment of the following:

- general vegetation health
- evidence of natural seedling recruitment
- occurrence and abundance of weed species
- structure and floristics of vegetation cover
- signs of disturbance (by stock, people or feral animals)
- nature and extent of erosion
- evidence of fire

- characteristic of ground cover (e.g. leaf litter, rocks, logs and soil)
- nectar or fruit resources and perch sites
- water resources
- secondary evidence of fauna use such as scats, tree scratches or diggings and
- SEPP 44 Assessment.

The location of the habitat assessment points are provided on **Figure 2.3**.

2.3.9.1 SEPP 44 Assessment

Any development application in a SEPP 44 specified local government area, affecting an area of one (1) hectare or greater, must be assessed under SEPP 44. Assessment under SEPP 44 is based on an initial determination of whether the land constitutes potential koala (*Phascolarctos cinereus*) habitat. This is determined by assessing whether the eucalypt species present in Schedule 2 of the policy constitute 15 per cent or more of the total number of trees in the upper or lower strata of the tree component. If potential koala habitat is present, the area must be further assessed to determine if the land is core koala habitat. SEPP 44 assessments were completed at each of the habitat assessment points completed (**Figure 2.3**).

The species listed in Schedule 2 of the policy are listed in **Table 2.3**.

Table 2.3 Species of Eucalyptus Listed under Schedule 2 of SEPP 44

Scientific Name	Common Name
Eucalyptus tereticornis	forest red gum
Eucalyptus microcorys	Tallowwood
Eucalyptus punctata	grey gum
Eucalyptus viminalis	ribbon or manna gum
Eucalyptus camaldulensis	river red gum
Eucalyptus haemastoma	broad-leaved scribbly gum
Eucalyptus signata	scribbly gum
Eucalyptus albens	white box
Eucalyptus populnea	bimble box or poplar box
Eucalyptus robusta	swamp mahogany

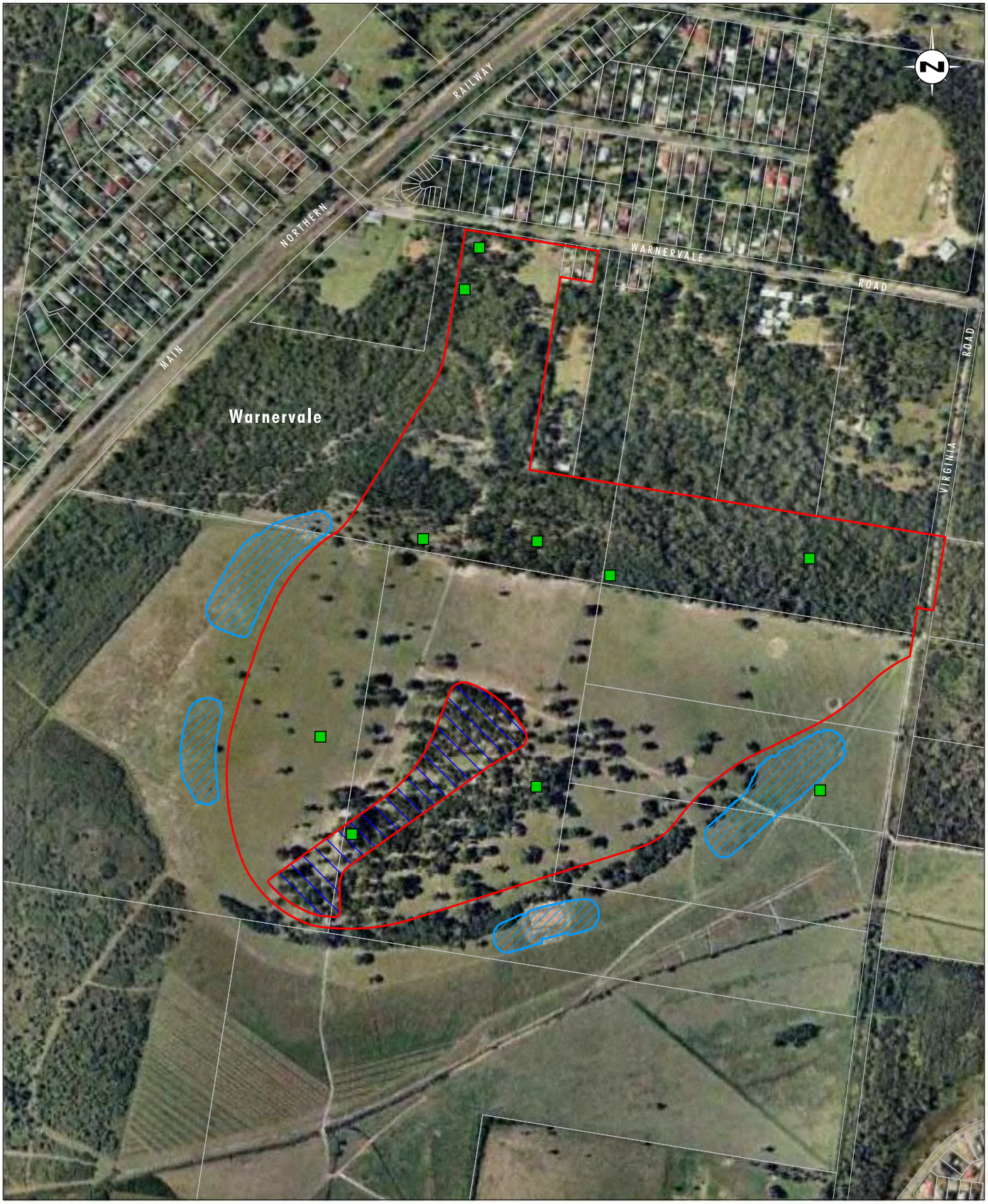

Image Source: Google Earth (2010)
Data Source: Wyong Shire Council (2010)

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Legend

- Impact Area
- Park Area
- Constructed Wetland
- Habitat Assessment Points

FIGURE 2.3

Habitat Assessment Locations

2.4 Wetland and Riparian Corridor Mapping

Riparian corridors were mapped by way of walking meanders completed during all aspects of surveys. They comprised any waterways, drainage lines or channels identified, any associated riparian vegetation, as well as SEPP 14 wetlands.

2.5 Survey Effort Compliance

Table 2.4 below contains a comparison of the survey effort undertaken for the Study Area compared to relevant guidelines and advice from WSC.

Table 2.4 Compliance of Survey Effort Undertaken

WSC Recommended Level of Survey	WSC Recommended and Guideline References	Previous Survey	Surveys Completed	Adequacy
Call playback - One point census/km^2 repeated minimum of 3 visits non-consecutive nights	Not specified	Narrabeen Buttonderry Footslopes Regeneration forest (1 site over 2 nights) Disturbed Grassland (1 site – unknown number of nights)	Melaleuca sedge (1 site over . non-consecutive nights) Narrabeen Buttonderry Regeneration (2 sites over 3 non-consecutive nights) Red Gum (1 site over 1 night) Narrabeen Buttonderry Forest (1 site over 2 non-consecutive nights)	More than adequate given site less than 1km²
Nocturnal spotlighting - 2 x 30 min searches on 2 separate nights at walking rate of 1 km/hr per site	Not specified	Narrabeen Buttonderry Footslopes Forest Regenerating (2 sites on two separate nights)	Melaleuca sedge (1 site over 3 non-consecutive nights) Narrabeen Buttonderry Regeneration (2 sites over 3 non-consecutive nights) Red Gum (1 site over 1 night) Narrabeen Buttonderry Forest (1 site over 2 non-consecutive nights	Adequate Supplemented with targeted hollow surveys (physical inspections and remote cameras)

WSC Recommended Level of Survey	WSC Recommended and Guideline References	Previous Survey	Surveys Completed	Adequacy
Anabats- 4 separate nights continuous recording from dusk per site (minimum 4 hrs) unattended detectors or 3 separate nights for 1-2 hours after dusk if detectors are attended in target habitat (i.e. high quality roosting habitat is present or for a threatened species that is known to be present (identified by echolocation call)	Time and location micro-bat calls are recorded and number of calls should be presented and considered with regard to likelihood of maternity colony of threatened species	Narrabeen Buttonderry Forest (1 site over 2 nights) Grassland (2 sites over 2 nights) Narrabeen Buttonderry Regeneration (2 sites over 2 nights)	Narrabeen Buttonderry Forest (1 site for 2 nights) Narrabeen Buttonderry (1 site for 2 nights) Alluvial Melaleuca Sedge Forest (2 sites for 19 nights)	Adequate. Supplemented with targeted hollow-bearing surveys.
Harp-trapping 2 harp trap nights per site over 2consecutive nights	Not specified	Narrabeen Buttonderry forest (2) Narrabeen Buttonderry Regeneration (1)	None undertaken	Adequate Anabat surveys sufficient to address this in recent surveys Supplemented by targeted hollow-bearing tree surveys

WSC Recommended Level of Survey	WSC Recommended and Guideline References	Previous Survey	Surveys Completed	Adequacy
SEPP 44 Assessment - Follow Spot Assessment guidelines – sample a minimum of 20 trees within a circle radiating from a central point for koala scats at the base of each tree for a maximum of 2-3 person minutes per tree.	The site is larger than 1 ha and so SEPP 44 applies and an assessment is required with the development application.	1 site in Narrabeen Buttonderry Footslopes	Disturbed Grassland (3 feed tree assessments) Alluvial Red Gum Footslopes Forest (1 feed tree assessment) Alluvial Melaleuca Sedge Forest (1 feed tree assessment) Narrabeen Buttonderry Footslopes Forest (1 feed tree assessment) Narrabeen Buttonderry Regeneration (2 feed tree assessments) Narrabeen Buttonderry Variant C (0 feed tree assessments) Alluvial Red Gum Footslopes (2 feed tree assessments)	Adequate
Diurnal Herpetofauna – 1 ha search for 30 mins on 2 separate days per veg comm or habitat type	Not specified	-	Alluvial Red Gum Footslopes Forest (0.5 with sedge forest) Alluvial Melaleuca Sedge Forest (0.5 with red gum) Narrabeen Buttonderry Footslopes Forest (1) Narrabeen Buttonderry Regeneration (1)	Adequate considering minimal habitats present

WSC Recommended Level of Survey	WSC Recommended and Guideline References	Previous Survey	Surveys Completed	Adequacy
Nocturnal herpetofauna - 2 x 30 min searches on 2 separate nights at walking rate of 1 km/hr per site (may be done in conjunction with spotlighting for mammals)	-	Narrabeen Buttonderry Regeneration (1 site , 1 night)	Melaleuca sedge (1 site over 3 non-consecutive nights) Narrabeen Buttonderry Regeneration (2 sites over 3 non-consecutive nights) Red Gum (1 site over 1 night) Narrabeen Buttonderry Forest (1 site over 2 non-consecutive nights	Adequate considering minimal habitats present
Remote camera surveys - 2 per vegetation community or habitat type for 14 consecutive nights	-	-	Grassland- 2 for 27 nights Forest – 2 for 27 nights Sedge – 2 for 27 nights Regeneration- 2 for 27 nights	Adequate

WSC Recommended Level of Survey	WSC Recommended and Guideline References	Previous Survey	Surveys Completed	Adequacy
-	Inspection of any large hollow bearing tree to determine internal dimensions and identify any evidence of use Any potential den trees for squirrel gliders must be stagwatched	-	Searches completed at the base of all hollow bearing trees for pellets/scats Physical hollow-inspections for 80 hollows where access was safe/possible for internal dimensions and potential target species in the Study Area Targeted remote camera surveys were undertaken for 13 different hollow-bearing trees (with 35 hollows between them) using 15 remote sensing cameras, each camera was deployed for 19 survey nights giving a total of 285 survey nights	Physical hollow inspections completed for those 80 hollows where access was possible/safe Targeted remote camera work considered adequate replacement for stag watching
-	Raptor nest searches and demarcation	-	Meander surveys undertaken throughout Study Area	Adequate

WSC Recommended Level of Survey	WSC Recommended and Guideline References	Previous Survey	Surveys Completed	Adequacy
Diurnal Birds - 1 ha sample plot per vegetation community for 20 mins	None required	Opportunistic observations were recorded during all other aspects of the field survey, with birds positively identified by their characteristic calls and observation No specific surveys undertaken	Disturbed Grassland (0) Alluvial Red Gum Footslopes Forest (0.5 with sedge forest) Alluvial Melaleuca Sedge Forest (0.5 with red gum) Narrabeen Buttonderry Footslopes Forest (0) Narrabeen Buttonderry Regeneration (1) Narrabeen Buttonderry Variant C (0)	Not considered necessary given extent of works previously undertaken Assessment of threatened woodland bird habitat based on habitat requirements as opposed to surveys

WSC Recommended Level of Survey	WSC Recommended and Guideline References	Previous Survey	Surveys Completed	Adequacy
Small mammals (Elliott A) - 100 trap nights over 4 consecutive nights per vegetation community Cage/Elliott B- 12 trap nights over 4 consecutive nights per vegetation community	Not specified	None completed by Umwelt. Lesryk 1999 last to complete 19 Elliot traps Narrabeen Buttonderry regeneration (6 nights total) Narrabeen Buttonderry Forest (6 nights total) Hair Funnel Lines 15 tubes total for ten nights Narrabeen Buttonderry forest (2 lines) Narrabeen Buttonderry Regeneration (1 line)	Not undertaken. Supplemented instead with remote cameras	Not defined as necessary by WSC Remote cameras highly effective alternative

WSC Recommended Level of Survey	WSC Recommended and Guideline References	Previous Survey	Surveys Completed	Adequacy
Vegetation				
>50ha site simplistic* floristic structure 4–6 walking transects (100m)+ 1 quadrat per community + 1 replicate quadrat per community ☐5 ha		Disturbed Grassland (2 plots, 0 rapids) Alluvial Red Gum Footslopes Forest (0 plots, 1 rapid) Alluvial Melaleuca Sedge Forest (0 plots, 0 rapids) Narrabeen Buttonderry Footslopes Forest (3 plots, 0 rapids) Narrabeen Buttonderry Footslopes Forest - Cleared Understorey (3 plots, 0 rapids) Narrabeen Buttonderry Footslopes Forest - Variant C (1 plot, 0 rapids)	Disturbed Grassland (3 rapids, 41.4 km) Alluvial Red Gum Footslopes Forest (1 rapid, 5.7km) Alluvial Melaleuca Sedge Forest (1 rapid, 2.8km) Narrabeen Buttonderry Footslopes Forest (3 rapids, 18.9km) Narrabeen Buttonderry Footslopes Forest – Cleared Understorey (2 rapids, 25.1km) Narrabeen Buttonderry Footslopes Forest - Variant C (0 rapids, 2.8km)	Adequate
Targeted *Eucalyptus parramattensis* subsp. *parramattensis* surveys	Meanders of entire site during appropriate survey times	-	Completed meanders of Study Area A total of 89 km of meander surveys completed during September and October 2015 and February 2016	Adequate

WSC Recommended Level of Survey	WSC Recommended and Guideline References	Previous Survey	Surveys Completed	Adequacy
Targeted *Thelymitra* sp. *adorata* surveys	Meanders of entire site during appropriate survey times	-	Completed meanders of Study Area during appropriate survey time A total of 66 km of meander surveys completed during September and October 2015	Not undertaken in proposed road or addition surveys areas however habitats not considered appropriate and highly disturbed Adequate
Targeted heath wrinklewort (*Rutidosis heterogama*) surveys	Meanders of entire site during appropriate survey times	-	Completed meanders of Study Area A total of 89 km of meander surveys completed during September and October of 2015 and February 2016	Adequate
Targeted *Corunastylis* sp. Charmhaven surveys	Meanders of entire site during appropriate survey times	-	Completed meanders of Study Area A total of 23 km of meander surveys completed during February 2016	Adequate
Targeted leafless tongue-orchid (*Cryptostylis hunteriana*)	Meanders of entire site during appropriate survey times		Completed meanders of Study Area A total of 23 km of meander surveys completed February 2016	Adequate

* Simplistic is defined as three distinct structural layers.

3.0 Results

The following sections document the outcomes of the surveys completed for this Project.

3.1 Floristics

A complete list of vascular flora species identified in the Study Area is provided in **Appendix 2**. This includes species identified as part of current surveys as well as previous surveys (Umwelt 2013). Groundcover vegetation has substantially altered since the original surveys were undertaken, with grazing practices leading to suppression of native species and an increase in coverage of introduced species kikuyu (*Pennisetum clandestinum*), buffalo grass (*Stenotaphrum secundatum*), white clover (*Trifolium repens*) and fireweed (*Senecio madagascariensis*).

A total of 159 flora species have been recorded in the Study Area, this includes seven from the class Filicopsida (ferns), 66 from the class Magnoliopsida (Liliidae (monocots)) and 86 from Magnoliopsida (Magnoliidae (Dicots)).

Thirty-seven (23 per cent) of the flora species identified are introduced species. Of these, two noxious weeds were identified, both of these were in the north-east of the Study Area and comprised blackberry (*Rubus fruticosus*) and lantana (*Lantana camara*).

3.1.1 Threatened Flora Species and Endangered Flora Populations

Although two records of threatened species heath wrinklewort (*Rutidosis heterogama*) (listed as vulnerable under the TSC Act and EPBC Act) were identified during previous surveys of the Study Area, these could not be relocated during surveys in 2015 or 2016. It is assumed that they are no longer present as a result of cattle grazing and trampling of habitat. No other threatened flora species were identified during surveys undertaken during 2015 or 2016 or during previous surveys. Their previous location is provided on **Figure 3.1**.

In addition to the threatened heath wrinklewort (*Rutidosis heterogama*) specified above, the threatened species presented in **Table 3.1** were each considered to have potential to occur.

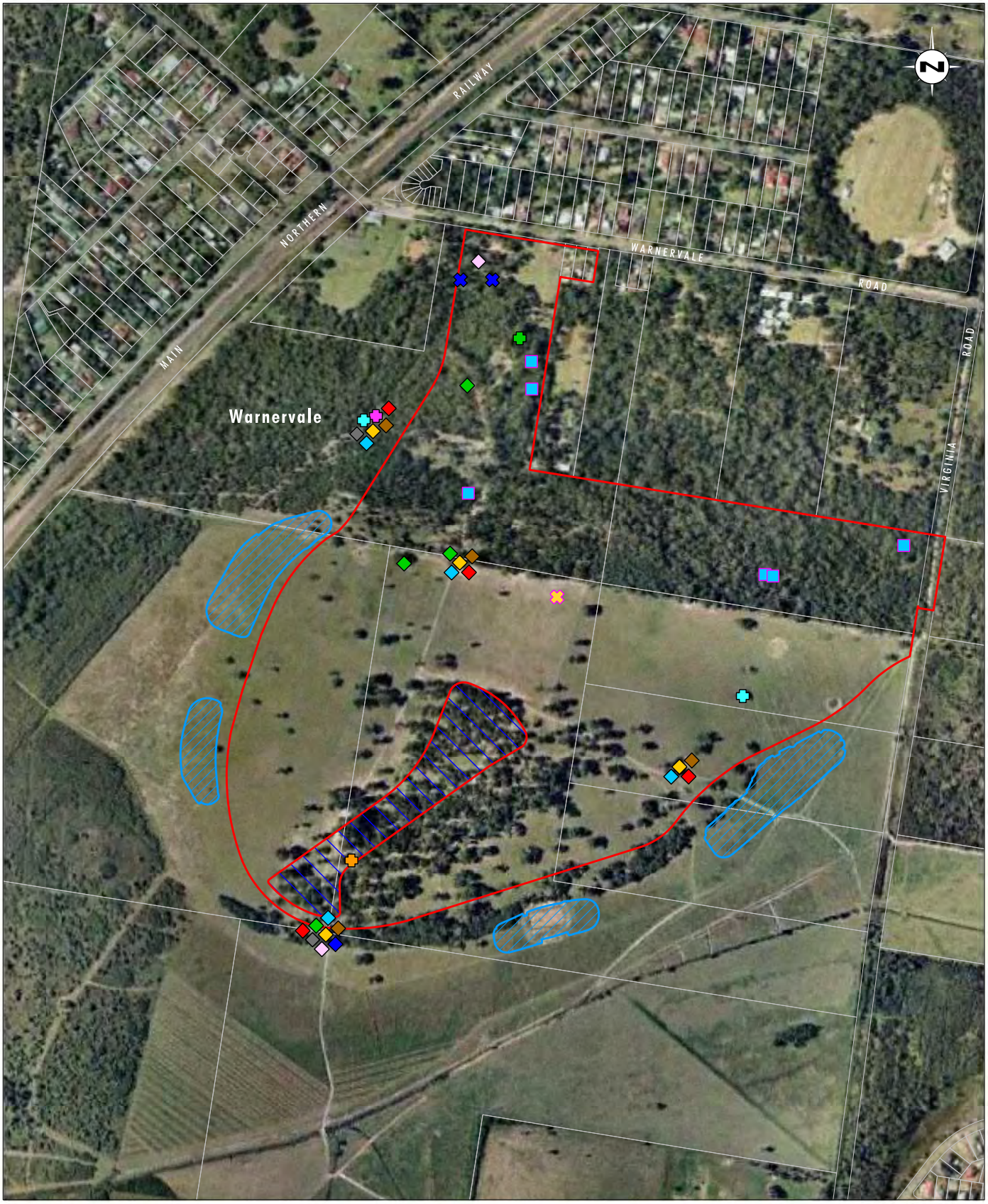

Image Source: Google Earth (2010)
Data Source: Wyong Shire Council (2010)

0 100 200 400m
1:7 500

Legend

- Impact Area
- Park Area
- Constructed Wetland
- Barking Owl
- Black Falcon
- East-coast Freetail-bat
- Eastern Bentwing-bat
- Eastern Cave Bat
- Eastern False Pipistrell
- Greater Broad-nosed Bat
- Little Bentwing-bat
- Southern Myotis
- Unidentified Glider
- Unidentified Micro-bat
- Yellow-bellied Sheathtail-bat
- *Rutidosis heterogama*

Previously Identified Records:
- Squirrel Glider
- Wallum Froglet

FIGURE 3.1

Threatened Species Locations

File Name (A4): R02/3616_007.dgn
20170501 16.13

Table 3.1 Potentially Occurring Threatened Flora Species and Endangered Flora Populations

Common Name	Scientific Name	TSC Act Status	EPBC Act Status
small-flower grevillea	*Grevillea parviflora* susbp. *parviflora*	V	V
variable midge orchid	*Genoplesium insignis*	CE	CE
thick-lipped spider orchid	*Caladenia tessellata*	E	V
netted bottle brush	*Callistemon linearifolius*	V	-
	Corunastylis sp. Charmhaven	CE	CE
leafless tongue orchid	*Cryptostylis hunteriana*	V	V
	Maundia triglochinoides	V	-
Wyong sun orchid	*Thelymitra* sp. *adorata*	CE	CE
	Eucalyptus parramattensis subsp. *parramattensis*	EP	-

C Critically endangered
E Endangered
EP Endangered population
EPBC Act *Environment Protection and Biodiversity Conservation Act 1999*
TSC Act *Threatened Species Conservation Act 1995*
V Vulnerable

3.2 Vegetation Communities

Six vegetation communities were identified within the Study Area, the extent of each of these is provided in **Table 3.2** below and vegetation community mapping is presented in **Figure 3.2.**

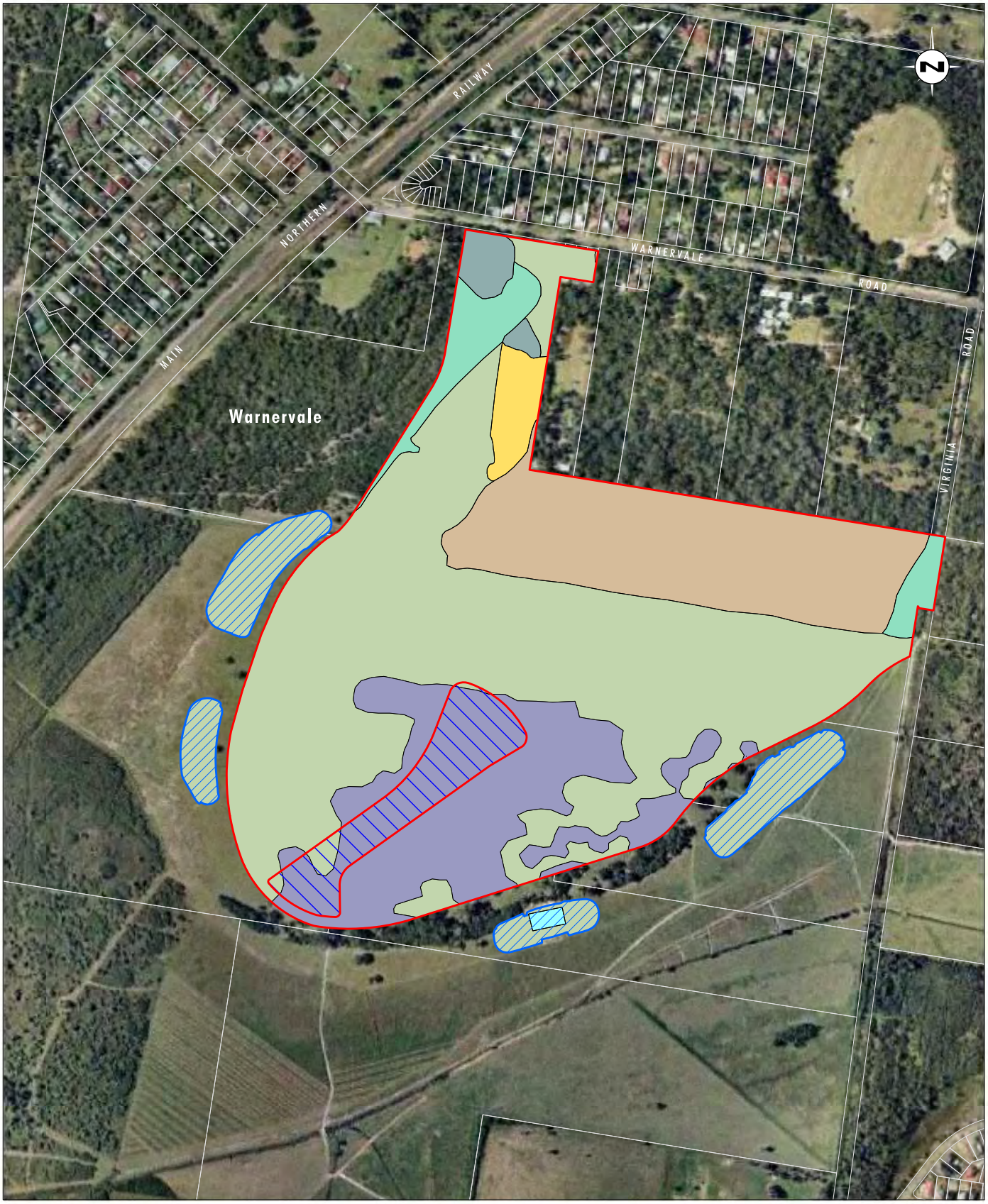

Image Source: Google Earth (2010)
Data Source: Wyong Shire Council (2010)

0 100 200 400m
1:7 500

Legend

- Impact Area
- Park Area
- Constructed Wetland
- Alluvial Red Gum Footslopes Forest - Cleared Understorey
- Alluvial Melaleuca Sedge Forest
- Narrabeen Buttonderry Footslopes Forest
- Narrabeen Buttonderry Footslopes Forest - Cleared Understorey
- Narrabeen Buttonderry Footslopes Forest - Variant C
- Dam
- Disturbed Grassland

FIGURE 3.2

Vegetation Communities

File Name (A4): R02/3616_003.dgn
20170501 15.59

Table 3.2 Vegetation Communities Present

Vegetation Community	Corresponding Vegetation Community (Bell 2002)	Conservation Status		Extent in Study Area (ha) *	Extent in Constructed Wetlands (ha)
		TSC Act	EPBC Act		
Narrabeen Buttonderry Footslopes Forest	Narrabeen Buttonderry Footslopes Forest (Unit 28)	-	-	9.3	0
Narrabeen Buttonderry Footslopes Forest – Cleared Understorey	Narrabeen Buttonderry Footslopes Forest (Unit 28)	-	-	10.3	0
Narrabeen Buttonderry Footslopes Forest – Variant C	Narrabeen Buttonderry Footslopes Forest (Unit 28)	-	-	1.0	0
Alluvial Red Gum Footslopes Forest Cleared Understorey	Alluvial Red Gum Footslopes Forest (Unit 15)	EEC - River Flat Eucalypt Forest on Coastal Floodplains	-	0.7	0
Alluvial Melaleuca Sedge Forest	Alluvial Woollybutt -Melaleuca Sedge Forest (Unit 19)	EEC - Swamp Sclerophyll Forest on Coastal Floodplains	-	2.0	0
Disturbed Grassland	NA	-	-	25.9	3.8
Dam	NA	-	-	-	0.1
Total Vegetation Communities				49.2	3.9

Vegetation Community	Corresponding Vegetation Community (Bell 2002)	Conservation Status		Extent in Study Area (ha) *	Extent in Constructed Wetlands (ha)
		TSC Act	EPBC Act		
Total EEC				2.7	0
Total					**53.2**

* Please note that this includes 2.7 ha of Narrabeen Buttonderry Footslopes Forest-Cleared Understorey and 0.2 ha of Disturbed Grassland that are proposed to be (for the most part) retained within the Park Area.

Descriptions of each of the vegetation communities present are provided below.

3.2.1 Narrabeen Buttonderry Footslopes Forest

This vegetation corresponds to Bell (2002) community: Narrabeen Buttonderry Footslopes Forest (Unit 28). A representative photo of this vegetation is provided in **Plate 3.1**. The shrubby and groundcover vegetation across this vegetation community within the Study Area has been substantially modified by cattle grazing and trampling which are suppressing the presence and growth of native species. This vegetation is in a moderate condition as the groundcover is dominated by introduced species; however some recruitment of canopy species was observed. Ring-barking of trees in this area was observed from cattle rubbing.

Plate 3.1

Representative Photo of Narrabeen Buttonderry Footslopes Forest

A representative photo of this vegetation from earlier surveys is provided in **Plate 3.2**. Note that the vegetation has a substantially less modified midstorey and that tree trunks are not ring-barked from cattle. Also note the abundance of woody debris.

Plate 3.2

Representative Photo of Narrabeen Buttonderry Footslopes Forest During Previous Surveys undertaken

In the Study Area Narrabeen Buttonderry Footslopes Forest occurs on lower hillslopes of the Gorokan soil landscape. It is characterised by an open forest layer dominated by smooth-barked apple (*Angophora costata*), and to a lesser extent blue-leaved stringybark (*Eucalyptus agglomerata*) and red ironbark (*Eucalyptus fibrosa*).

A mid-dense to dense subcanopy occurs with *Melaleuca* trees (typically *Melaleuca nodosa*) and black sheoak (*Allocasuarina littoralis*) common. Where the *Melaleuca* stratum becomes dominant and eucalypts sparse, the unit more closely represents the Variant C. The understorey diversity is moderate and open, including a range of shrubs forming a mid-stratum over a mid-dense ground cover of sedges, grasses and forbs. Some common shrubs recorded were *Pimelea linifolia*, bracken fern (*Pteridium esculentum*), *Melaleuca thymifolia* and wallum heath (*Epacris pulchella*).

Typically encountered groundcover species were introduced species white clover (*Trifolium repens*) and perennial ryegrass (*Lolium perenne*). A few of the most common sedges and rushes are natives *Lepidosperma laterale* and *Cyperus polystachyos*. A moderate diversity of native grasses is also present at low densities including wiry panic (*Entolasia stricta*) and weeping grass (*Microlaena stipoides*).

This vegetation is not consistent with any TECs listed under the TSC Act or EPBC Act.

Based upon 1990 aerial photography of the Study Area, this vegetation does not comprise the definition of *regrowth* as described under the NV Act. All of this vegetation community was treed when the aerial photographs were taken.

3.2.2 Narrabeen Buttonderry Footslopes Forest – Cleared Understorey

This vegetation also corresponds to Bell (2002) community: Narrabeen Buttonderry Footslopes Forest (Unit 28) and a representative photo of this vegetation is provided in **Plate 3.3**. However this form of the community has been cleared of lower trees/shrubs (primarily *Melaleucas*), and is now dominated by an open canopy layer, with an open layer of regenerating shrubs and an open grassy layer. Although this vegetation is subject to grazing, the pasture has not been improved. This vegetation is in moderate condition and minor natural regeneration was observed. The leaf litter layer present in this area is also moderate.

Plate 3.3

Representative Photo of Narrabeen Buttonderry Footslopes Forest –Cleared Understorey

The cleared variant of this vegetation community also occurs on lower hillslopes of the Gorokan soil landscape. It is characterised by an open forest layer dominated by smooth-barked apple (*Angophora costata*), and to a lesser extent red ironbark (*Eucalyptus fibrosa*) and forest red gum (*Eucalyptus tereticornis*).

The characteristic sub-canopy of Narrabeen Buttonderry Footslopes Forest is absent, however an open low shrub layer is present. Where present, shrubs almost exclusively comprise gorse bitter pea (*Daviesia ulicifolia*).

Groundcover vegetation is open and characterised by native kangaroo grass (*Themeda triandra*), wiry grass (*Entolasia stricta*), tufted hedgehog grass (*Echinopogon caespitosus*), forest hedgehog grass (*Echinopogon ovatus*), shorthair plumegrass (*Dichelachne micrantha*), small-flower finger grass (*Digitaria parviflora*), native sedge (*Juncus usitatsus*) and forb whiteroot (*Pratia purpurascens*). Commonly encountered introduced species includes flatweed (*Hypochaeris radicata*), fireweed (*Senecio madagascariensis*), narrow-leaved carpe grass (*Axonopus fissifolius*), quaking grass (*Briza maxima*) and perennial ryegrass (*Lolium perenne*).

This vegetation is not consistent with any TECs listed under the TSC Act or EPBC Act.

Based upon 1990 aerial photography of the Study Area, this vegetation does not comprise the definition of *regrowth* as described under the NV Act. All of this vegetation community was treed when the 1990 aerial photographs were taken.

3.2.3 Narrabeen Buttonderry Footslopes Forest – Variant C

This vegetation corresponds to Bell (2002) community: Narrabeen Buttonderry Footslopes Forest (Unit 28). A representative photo of this vegetation is provided in **Plate 3.4** and indicates the level of disturbance of groundcover vegetation (particularly in presence of fireweed (*Senecio madagascariensis*)). The shrubby and groundcover vegetation of this site has been modified by cattle grazing and trampling which are suppressing and restricting native species regrowth. This vegetation community is in the form of an emergent eucalypt layer, dense *Melaleuca* mid storey with a dense grass and forb groundcover.

Plate 3.4

Representative Photo of Narrabeen Buttonderry Footslopes Forest Variant C

In the Study Area Narrabeen Buttonderry Footslopes Forest – Variant C occurs on lower hillslopes of the Gorokan soil landscape. It is characterised by an open emergent layer to heights of approximately 15 metres dominated by smooth-barked apple (*Angophora costata*), and to a lesser extent blue-leaved stringybark (*Eucalyptus agglomerata*) and red ironbark (*Eucalyptus fibrosa*). It is similar to the Narrabeen Buttonderry Footslopes forest; however with fewer Eucalypt trees. This vegetation comprised a moderate to dense layer almost exclusively comprised of *Melaleuca nodosa*.

Small shrubs were largely absent due to suppression from grazing, however where occasionally identified. Typically encountered species were slender tea-tree (*Leptospermum trinervum*) and *Goodenia heterophylla.*

The dense ground cover (approximately 80 per cent) occurred to heights of approximately 50 cm and was dominated by introduced fireweed (*Senecio madagascarensis*) and native species spiny-headed mat-rush (*Lomandra longifolia*), wiry panic (*Entolasia stricta*) and *Imperata cylindrica* var. *major*.

This vegetation is not consistent with any TECs listed under the TSC Act or EPBC Act.

Based upon 1990 aerial photography of the Study Area, this vegetation does not comprise the definition of *regrowth* as described under the NV Act. All of this vegetation community was treed when the 1990 aerial photographs were taken.

3.2.4 Alluvial Red Gum Footslopes Forest - Cleared Understorey

This vegetation corresponds with Bell (2002) mapping of Alluvial Red Gum Footslopes Forest (Unit 15). A representative photo of this vegetation is provided in **Plate 3.5**, this photo shows the level of clearing and slashing currently occurring in this vegetation type. This vegetation community is subject to ongoing clearing, slashing and grazing practices, which have left the vegetation present as a canopy layer with a heavily modified groundcover. This vegetation is considered to be in low to moderate condition and no natural regeneration of canopy species was observed.

Plate 3.5

Representative Photo of Alluvial Red Gum Footslopes Forest –Cleared Understorey

Alluvial Red Gum Footslopes Forest -Cleared Understorey occurs on the alluvial floodplain and its margins on the footslopes of adjacent hills. It tends to develop in minor depressions and soaks on deep, moist soils. In the Study Area it is distinguished by a clear dominance of forest red gum (*Eucalyptus tereticornis*) in the canopy. An erratic sub canopy is present which comprises *Melaleuca nodosa* and flax-leaved paperbark (*Melaleuca linariifolia*). Rare occurrences of small-leaved privet (*Ligustrum sinense*) are also present.

The ground cover is typically dense and in non-disturbed areas is diverse; however in the Study Area is dominated by introduced grasses buffalo grass (*Stenotaphrum secundatum*) and kikuyu (*Pennisetum clandestinum*). Native species that currently occur in low densities that would have previously been more prevalent include sedges and rushes such as tall sedge (*Carex appressa*) and *Juncus usitatus*, and grasses including wiry panic (*Entolasia stricta*), bordered panic (*E. marginata*), *Oplismenus aemulus* var. *aemulus*, *Microlaena stipoides* var. *stipoides* and *Paspalidium distans*. Occasional occurrences of wandering Jew (*Commelina cyanea*), whiteroot (*Pratia purpurascens*), slender knotweed (*Persicaria decipiens*), water pepper (*Persicaria hydropiper*) and buttercups (*Ranunculus inundatus*) are also present.

Although it is highly modified, this vegetation is considered to be consistent with River Flat Eucalypt Forest on Coastal Floodplains EEC (listed under the TSC Act). It is not consistent with any TECs listed under the EPBC Act.

Based upon 1990 aerial photography of the Study Area, this vegetation does not comprise the definition of *regrowth* as described under the NV Act. All of this vegetation community was treed when the 1990 aerial photographs were taken.

3.2.5 Alluvial Melaleuca Sedge Forest

This vegetation corresponds with the Bell (2002) mapping of Alluvial Melaleuca Sedge Forest (Unit 19D). A representative photo of this vegetation is provided in **Plate 3.6**. Grazing in these areas does not appear to be as dense as in surrounding vegetation and this vegetation is much less modified than the Narrabeen Buttonderry Footslopes Forest and its variants to the Alluvial Red Gum Footslopes Forest. This vegetation comprises a tall melaleuca and eucalypt emergent layer, a dense melaleuca understorey and a groundcover dominated by sedges and sphagnum moss. This vegetation retains water during periods of heavy rainfall and is subject to periodic inundation and soil water logging.

Plate 3.6

Representative Photo of Alluvial Melaleuca Sedge Forest

Alluvial Melaleuca Sedge Forest is a disturbed variant of Bell's Unit 19: Alluvial Woollybutt-Melaleuca Sedge Forest. The alluvial flats in the Study Area have a history of disturbance that has modified the vegetation so that it does not fully correspond to any one of Bell's units. However, the vegetation best matches the Alluvial Woollybutt-Melaleuca Sedge Forest (Unit 19), as a variant form that has fewer *Eucalyptus* trees and a typically dense, low canopy of several *Melaleuca* trees over a dense ground cover of sedges.

Emergent trees are scattered and include, but are not limited to, woollybutt (*Eucalyptus longifolia*), smooth-barked apple (*Angophora costata*), forest red gum (*Eucalyptus tereticornis*) and spotted gum (*Corymbia maculata*). However, this vegetation is characterised by a low to mid-high, closed (dense) forest

of *Melaleuca* trees, particularly M*elaleuca nodosa* and *Melaleuca linariifolia*, although *Melaleuca ericifolia* and M*elaleuca sieberi* are also common. Common silkpod (*Parsonsia straminea*) is also widespread.

A sparse to mid-dense shrub stratum occurs with *Coopernookia barbata* and *Gonocarpus humilis* recorded. Tall sedges are also present in this mid stratum.

The ground cover is typically dense and comprises a mix of sedges, including tall sedge (*Carex appressa*), tall saw sedge (*Gahnia clarkei*), *Chorizandra cymbaria*, *Lepidosperma laterale* and *Juncus usitatus*; and grasses, including bordered panic (*Entolasia marginata*), wiry panic (*Entolasia stricta*) and *Oplismenus aemulus*. *Persicaria* species are also common, including water pepper (*Persicaria hydropiper*).

Alluvial Melaleuca Sedge Forest is consistent with the EEC Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast Sydney Basin and South East Corner Bioregions (listed under the TSC Act). It is not consistent with any TECs listed under the EPBC Act.

Based upon 1990 aerial photography of the Study Area, this vegetation does not comprise the definition of *regrowth* as described under the NV Act. All of this vegetation community was treed when the 1990 aerial photographs were taken.

3.2.6 Disturbed Grassland

This vegetation is not consistent with any naturally occurring vegetation community and has been subject to historical and recent clearing practices, pasture improvement and ongoing grazing. A representative photo of this vegetation is provided in **Plate 3.7**. No natural recruitment of canopy species were observed in these areas; however occasional remnant paddock trees were present. Much of the vegetation mapped as Disturbed Grassland for this current survey in the north was previously mapped as Alluvial Melaleuca Sedge Forest or regenerating native vegetation; however subsequent under scrubbing and grazing in this area have degraded large quantities of this vegetation to a Disturbed Grassland state.

Plate 3.7

Representative Photo of Disturbed Grassland

Plate 3.7 shows an area of this vegetation that was previously mapped as Alluvial Melaleuca Sedge Forest that is now consistent with Disturbed Grassland. **Plate 3.8** shows piles of shrubs that have been removed during under scrubbing activities from areas previously mapped as Alluvial Melaleuca Sedge Forest.

Plate 3.8

Photo of Underscrubbing Stockpiled vegetation

Plate 3.9 shows a close-up of the vegetation in this community; note the prevalence of white clover (*Trifolium repens*) and fireweed (*Senecio madagascariensis*).

Plate 3.9

Close-up of Disturbed Grassland Vegetation

This vegetation occurred in the far west, centre and east of the Study Area on lower slopes and was typically less than 30 cm in height and at a cover of at least 90 per cent. These areas are dominated by introduced pasture grasses such as buffalo grass (*Stenotaphrum secundatum*), perennial ryegrass (*Lolium perenne*), kikuyu (*Pennisetum clandestinum*), shivery grass (*Briza minor*) and introduced forbs such as lambs tongues (*Plantago lanceolata*), white clover (*Trifolium repens*), flatweed (*Hypochaeris radicata*), *Centaurium tenuifolium*, mouse-eared chickweed (*Cerastium glomeratum*) and fireweed (*Senecio madagascariensis*). Native species short-hair plumegrass (*Dichelachne micrantha*) also occurs occasionally throughout this vegetation community.

The lowest lying areas in the far east and far west are subject to periodic inundation following heavy rainfall to the extent that the following native partially water dependent species were also recorded with moderate frequency *Drosera spatulata*, river buttercup (*Ranunculus inanduatus*), *Cyperus polystachos*, *Schoenus apogon* and *Juncus usitatus*. However native species did not dominate any area of this vegetation community. Aerial photography displayed in the figures used in this report were from images made prior to 2013 and are not representative of the vegetation currently present.

This vegetation is not consistent with any TECs listed under the TSC Act or EPBC Act.

Based upon 1990 aerial photography of the Study Area, this vegetation does not comprise the definition of *regrowth* as described under the NV Act.

3.2.7 Threatened Ecological Communities

Two vegetation communities within the Study Area conform with TECs, these are the:

- Alluvial Melaleuca Sedge Forest - which conforms with *Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions EEC* (TSC Act)

- Alluvial Red Gum Footslopes Forest - Cleared Understorey – which conforms with *River-flat Eucalypt Forest on Coastal Floodplains EEC* (TSC Act)

Each of these is described in detail below.

3.2.7.1 Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-East Corner Bioregions

This vegetation occurs on the majority of the coastal floodplain in the Warnervale area, forming part of the *complex of forested and treeless wetland communities found throughout the coastal floodplains of NSW* (NSW Scientific Committee 2008b) and conform to the EEC Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (Swamp Sclerophyll Forest EEC) (NSW Scientific Committee 2008b).

This vegetation comprises diversity consistent with floristic species characteristic of this EEC. The complex pattern of regeneration in this vegetation results from the long disturbance history of the floodplain. The relative number and abundance of species is recognised by the NSW Scientific Committee (2008b) as being determined by the degree of and time since disturbance, which includes *fire, grazing, flooding and land clearing*.

The vegetation conforms to the description of the Swamp Sclerophyll Forest EEC as an *open to dense tree layer of eucalypts and paperbarks, which may exceed 25 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. For example, stands dominated by Melaleuca ericifolia typically do not exceed 8 m in height* (NSW Scientific Committee 2008b).

This vegetation also occurs on *small alluvial flats and peripheral parts of floodplains where they adjoin lithic substrates or coastal sandplains* (NSW Scientific Committee 2008b), which is characteristic of Swamp Sclerophyll Forest EEC. Additionally, the soils in these communities are *usually waterlogged, stained black or dark grey with humus, and show little influence of saline ground water*, which is also characteristic of the EEC (NSW Scientific Committee 2008b).

The NSW Scientific Committee (2008b) states that *large areas of habitat formerly occupied by Swamp Sclerophyll Forest...have been directly drained by construction of artificial channels* and this is clearly evident in the Warnervale area (including the Study Area) where artificial channels and pipes cross the floodplain in various locations.

3.2.7.2 River Flat Eucalypt Forest on Coastal Floodplains

The characteristics of Alluvial Red Gum Footslopes Forest (Unit 15) in the Study Area conform to this EEC (NSW Scientific Committee, 2008c) in location, position in the landscape, floristic structure and flora.

The characteristic species list provided by the NSW Scientific Committee (2008c) for this EEC represents its range from Port Stephens in the NSW North Coast, Sydney Basin and South East Corner bioregions and includes species typically encountered within this vegetation in the Study Area.

The NSW Scientific Committee (2008c) states:

> *River-Flat Eucalypt Forest on Coastal Floodplains may adjoin or intergrade with several other endangered ecological communities, which collectively cover all remaining native vegetation on the coastal floodplains of New South Wales. These include...Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions...Swamp Oak Floodplain Forest...and Freshwater Wetlands on Coastal Floodplains.*

This pattern is clear in the Study Area, where Alluvial Red Gum Footslopes Forests occurs on the floodplain and on associated low rises with Alluvial Melaleuca Sedge Forest.

Alluvial Red Gum Footslopes Forest also conforms well to the descriptions of the EEC as:

> *a tall mixed open forest to woodland occurring on river flats and terraces in the central to upper parts of coastal floodplains...distinguished from other floodplain EECs by its dominance of either a mixed or single species eucalypt tree layer...and a prominent groundcover of soft leaved herbs and grasses (NSW Scientific Committee 2008c).*

Alluvial Red Gum Footslopes Forest comprises an open forest or woodland with a mixture of *Eucalyptus* trees, particularly forest red gum (*Eucalyptus tereticornis*). Although shrub presence is low due to current grazing practices, where identified, native groundcover and shrub vegetation comprised characteristic species list for the EEC. This vegetation also occurs on river flats and adjoining low rises in the upper part of the coastal floodplain, on a loamy soil with little saline influence.

Additionally, the Alluvial Red Gum Footslopes Forest occurs within the distribution of the EEC, being the Sydney Basin, and in the typical elevation, which is below 50 metres above sea level. The characteristics of Alluvial Red Gum Footslopes Forest in the Study Area conform to the EEC, in location, position in the landscape, floristic structure and flora.

3.3 Fauna Species

A list of all fauna species recorded within the Study Area during the 2015 and 2016 surveys is recorded in **Appendix 3** (with previously identified threatened species records also included), with a summary provided below. A total of 65 fauna species were identified as part of the current surveys, as well as a further 11 micro-bat species groups that could not be distinguished from each other (see **Section 2.3.6.1**).

3.3.1 Amphibians

Three amphibian species were identified during the current surveys these were the Peron's tree frog (*Litoria peronii*), dwarf tree frog (*Litoria fallax*) and common froglet (*Crinia signifera*). Each of these is a locally common species.

No threatened amphibian species were identified during the current surveys; however previous records of the threatened wallum froglet (*Crinia tinnula*) have been made in the previous alluvial sedge forest areas in the north. It is unlikely that this represents an extant population due to the occurrence of grazing in these areas; however there is potential that this species may still persist.

3.3.2 Reptiles

Three reptile species were identified in the Study Area as part of the current surveys being the lace monitor (*Varanus varius*), eastern long-necked turtle (*Chelodina longicollis*) and three-toed skink (*Saphois equalis*). Each of these is a locally common species.

No threatened reptile species were identified or considered to have potential to occur.

3.3.3 Birds

Thirty-nine bird species were identified in the Study Area as part of the current surveys, this including both diurnal and nocturnal bird species. Typically encountered nocturnal birds were the Australian owlet nightjar (*Aegotheles cristatus*) and tawny frogmouth (*Podargus strigoides*). Typically encountered diurnal birds included the red-browed finch (*Neochmia temporalis*), Australian magpie (*Cracticus tibicen*), white-winged chough (*Corcorax melanorhamphos*) and Australian wood duck (*Chenonetta jubata*).

Although not listed under the TSC Act or EPBC Act, the eastern barn owl (*Tyto alba*) was identified which have been identified by WSC as regionally significant species.

Threatened bird species (**Figure 3.2**) recorded during the current surveys were the black falcon (*Falco subniger*) and barking owl (*Ninox connivens*). Although not recorded during the current survey the little eagle (*Hieraaetus morphnoides*) has also been recorded in this area in the past. Each of these species is listed as vulnerable under the TSC Act and there are likely extant populations present in the area. There is potential that the barking owl (*Ninox connivens*) and black falcon (*Falco subniger*) are both nesting/roosting within the Study Area (although no evidence of this was recorded despite targeted surveys).

One additional migratory bird species listed under the EPBC Act was also identified in the Study Area being the cattle egret (*Ardea ibis*). This species was typically associated with the cattle grazing occurring in the disturbed grassland areas.

One introduced bird species was identified being the common mynah (*Sturnus tristis*) this species is typical in disturbed and urban coastal areas.

3.3.4 Mammals

A total of 20 mammal species were identified utilising the habitats of the Study Area, with a further 11 micro-bat species groups identified for which presence of specific species could not be confirmed. The most commonly encountered mammals were the common brushtail possum (*Trichosurus vulpecula*) and common ringtail possum (*Pseudocheirus peregrinus*).

Although not listed under the TSC Act or EPBC Act, the sugar glider (*Petaurus breviceps*) and eastern forest bat (*Vespadelus pumilus*) were both identified and are recognised by WSC as regionally significant species.

Threatened mammal species (each listed as vulnerable under the TSC Act) identified during the current study are presented in **Figure 3.2** and comprised:

- unidentified glider (*Petaurus* sp), which could have been the threatened squirrel glider (*Petaurus norfolcensis*) or locally common sugar glider (*Petaurus breviceps*)
- yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*)
- Eastern freetail-bat (*Mormopterus norfolkensis*)
- little bentwing-bat (*Miniopterus australis*) and
- greater broad-nosed bat (*Scoteanax rueppellii*).

The Eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) was identified confidently in surveys previously undertaken of the Study Area, however during current studies was only identified as part of a species group (could not be distinguished from other species). As a precautionary approach, it has been assumed that this species occurs within the Study Area.

The following three threatened species were also identified as part of species groups: eastern cave bat (*Vespadelus troughtoni*); eastern false pipistrelle (*Falsistrellus tasmaniensis*) and southern myotis (*Myotis macropus*). A precautionary approach has been adopted for these species and for the purposes of this report, they have been assumed to be present.

Based on the times of calls recorded, primarily early in the night (around sunset) expert Anna McConville analysed the Anabat data collected and determined that the following species had likely come from close by (i.e. potential roots):

- little bentwing-bat (*Miniopterus australis*)
- Eastern freetail-bat (*Mormopterus norfolkensis*)
- greater broad-nosed bat (*Scoteanax rueppellii*)
- Eastern false pipistrelle (*Falsistrellus tasmaniensis*) and
- Southern myotis (*Myotis macropus*).

This does not necessarily indicate that none of the other micro-bats recorded have potential to roost in the Study Area. With the exception of cave roosting species little bentwing-bat (*Miniopterus australis*) and the eastern cave bat (*Vespadelus troughtoni*) each have potential to be roosting in the Study Area. Analysis by micro-bat expert Anna McConville further determined that the potential for presence of maternity roosts was inconclusive; and would not be possible to confirm without undertaking targeted surveys of potential

roost trees. It is possible however that such additional survey could not rule out the potential for presence of maternity roosts as species are known to swap roost sites on a regular basis.

No roost sites were identified during the targeted hollow surveys undertaken.

Three introduced mammals species were identified during the current study, being cattle (*Bos taurus*), domestic dog (*Canis lupus familiaris*) and fox (*Vulpes vulpes*).

3.3.5 Threatened and Migratory Fauna Species

In addition to the threatened fauna specified in the above sections, the threatened species presented in **Table 3.3** were also considered to have potential to occur.

Table 3.3 Potentially Occurring Threatened and Migratory Fauna Species

Common Name	Scientific Name	TSC Act Status	EPBC Act Status
wallum froglet	*Crinia tinnula*	V	
black bittern	*Ixobrychus flavicollis*	V	
Australasian bittern	*Botaurus poiciloptilus*	E	E
varied sittella	*Daphoenositta chrysoptera*	V	
glossy black cockatoo	*Calyptorhynchus lathami*	V	
swift parrot	*Lathamus discolor*	E	E
little lorikeet	*Glossopsitta pusilla*	V	
powerful owl	*Ninox strenua*	V	
masked owl	*Tyto novaehollandiae*	V	
regent honeyeater	*Anthochaera phrygia*	CE	CE
scarlet robin	*Petroica boodang*	V	
flame robin	*Petroica phoenicea*	V	
koala	*Phascolarctos cinereus*	V	V
eastern pygmy possum	*Cercartetus nanus*	V	
grey-headed flying fox	*Pteropus poliocephalus*	V	V
eastern chestnut mouse	*Pseudomys gracilicaudatus*	V	
fork-tailed swift	*Apus pacificus*		MIG
oriental cuckoo	*Cuculus optatus*		MIG

Common Name	Scientific Name	TSC Act Status	EPBC Act Status
white-throated needletail	*Hirundapus caudatus*		MIG
great egret	*Ardea alba*		MIG
Japanese snipe	*Galliango hardwickii*		MIG
osprey	*Pandion haliaetus*		MIG
black-faced monarch	*Monarcha melanopsis*		MIG
spectacled monarch	*Monarcha trivirgata*		MIG
satin flycatcher	*Myagria cyanoleuca*		MIG
rufous fantail	*Rhipidura albifrons*		MIG

CE Critically endangered
E Endangered
EPBC Act *Environmental Protection and Biodiversity Conservation Act 1999*
MIG Migratory
TSC Act *Threatened Species Conservation Act 1999*
V Vulnerable

3.4 Habitat Assessment

The following section contains general details of the habitat values of the Study Area, as well as specific information on hollow-bearing trees, raptor nests, squirrel glider (*Petaurus norfolcensis*) habitat and SEPP 44 koala (*Phascolarctos cinereus*) habitat.

The Study Area contained three broad habitat types being:

- Grasslands
- Thickets and
- Forests.

3.4.1 Formation Condition Changes since Previous Surveys

At the time of previous surveys (as part of Umwelt 2013), cattle grazing was occurring throughout the Study Area. It appears that subsequent grazing activities have caused substantial degradation to the quality of habitats available. A large component of the vegetation was previously mapped as Alluvial Melaleuca Sedge Forest in the north which has subsequently been cleared and is now dominated by introduced groundcover species. This clearing has changed the habitat that was currently available in this area from Thicket to Grassland formation. Natural recruitment of canopy and midstorey species was previously common in this area.

The remaining areas of Thicket formation had previously been observed as being subject to light grazing, however substantial pugging of the surface had not been observed as is currently present. These areas are

also now dominated by introduced species in the groundcover and midstorey; however canopy and sub-canopy vegetation is largely intact. Very little recruitment of canopy or sub-canopy vegetation is present.

In the areas of Forest formation, cattle grazing is causing substantial impacts to mature canopy vegetation. Cattle appear to be rubbing on trees and numerous trees appear to be recently deceased from ring-barking as a result of these activities (a representative photo of ring-barking is provided in **Plate 3.10**). Recently fallen large trees comprised most of the log cover in this community, with most previous woody debris having been trampled and crushed. The forest formation (particularly the Narrabeen Buttonderry Footslopes Forest) was previously considered to be in moderate to good condition.

Plate 3.10

Cattle-caused ring-barking in Forest Formation

Plate 3.11 represents areas were clusters of trees have died as a result of ring-barking activities.

Plate 3.11

Cluster of deceased trees as a result of cattle ring-barking

3.4.2 Grassland Formation

The cleared grassland habitats of the Study Area have arisen primarily from past clearing for agricultural purposes. The health and integrity of the vegetation largely corresponds with the grazing history, particularly grazing intensity.

The ground cover is generally quite low from grazing or slashing and is subsequently not considered appropriate as either foraging or refuge habitat for terrestrial bird species such as quails. These areas tend to be devoid of treed vegetation (and consequently of fallen timber/hollow logs, and leaf litter) and had a low presence of rocky habitat, making them poor habitat for reptile species.

Water resources in this formation were low and restricted to constructed dams with minimal fringing vegetation.

The cleared formation areas within the Study Area exhibited moderate levels of disturbance, including moderate to severe levels of grazing (domestic stock), areas of pugging (from breaking of the soil surface by stock hooves after rain) and areas of moderate weed infestation. Grazed areas appear to be regularly subject to periods of prolonged inundation following heavy rainfall events.

A summary of the habitats of this grassland formation is provided below.

Grasslands		
Total Area	29.7 ha	
Vegetation Structure and Health		
Canopy Dominants	Generally, a tree canopy is absent from the grassland formation, however scattered remnant trees occur. Where present, these typically comprise smooth-barked apple (*Angophora costata*)	
	Height (m)	Cover (%)
Canopy	Generally absent	Generally absent
Mid	Generally absent	Generally absent
Ground	<0.5	70-100
Age/Maturity	Given the general grassy nature of the vegetation in these cleared formations, the vegetation is quite young. Any trees present were mature, with very few saplings or regenerating trees present due to a history of clearing and grazing.	
Vegetation Health	Despite the derived nature of this community, the vegetation contained within it would be considered to be in good (modified) health.	
Disturbances		
Fire	No evidence of fire was observed in the grassland formation.	
Weeds	There is a relatively high abundance of weed species in this formation, however these are predominantly annual pasture species. The most commonly observed introduced species in these areas was fireweed (*Senecio madagascariensis*).	
Dieback	There was little observable dieback in this formation.	
Erosion	Some small areas of stock-induced erosion were evident around dam fringes in grazing paddocks. This included areas of pugging from the breaking of a moist soil surface by stock hooves.	
Mistletoe	Overall, mistletoe density on remnant paddock trees was low.	
Grazing	All areas of the grassland formation within the Study Area are subject to current grazing by livestock. Grazing is keeping grass levels low (mostly less than 30cm in height) which is impeding use as refuge habitat for small terrestrial fauna such as quails. Castle trampling is also impeding regrowth of native canopy and midstorey species and assisting in the spread and colonisation of introduced species (introduced species dominate this vegetation type). Pasture improvement activities in this area have removed native diversity for native fauna species grazing purposes. This reduces the value of this vegetation for grazing species such as macropods.	
Feral Animals	No evidence of feral animals was observed in this formation.	

Grasslands	
Insect Attack	Little evidence of insect attack in the remnant canopy trees was observed.
Ground Habitats	
Log Cover	No log cover was observed in these grassland areas.
Leaf Litter	Leaf litter is very low due to the lack of canopy vegetation present.
Bare Soil	The extent of bare soil varied depending on the grazing regime. Those areas currently subject to heavy grazing particularly adjacent to dams had higher areas of bare soil, whereas areas with less grazing had lower areas of bare soil.
Specific Habitats and Foraging Resources	
Hollow Density per Hectare	5 hollow-bearing trees were identified within the Study Area. Approximately 0.2 hollow-bearing trees per hectare occur in this vegetation community.
Foraging Resources	The foraging resources in this formation would be limited due to the highly modified structure of the vegetation. However the sporadic flowering *Eucalyptus* and *Melaleuca* canopy trees provide foraging resources for nectarivorous and insectivorous species. Small granivorous birds could forage in the grassland, particularly if grasses were left free of grazing long enough to develop seed heads.
Dominant Winter-flowering Tree Species	Limited by lack of trees present.
Perch Sites	Given the lack of a tree stratum, there is a very low abundance of perch sites in the grassland formation. These are present where there are scattered trees.
Water Resources	A small number of dams occur in this formation.

3.4.3 Thicket Formation

Thickets are areas of dense stands of trees or tall shrubs, and these areas are typically dominated by one or only a small number of species. The thicket formations of the Study Area are restricted to the areas of Alluvial Melaleuca Sedge Forest vegetation community (consistent with the *Swamp Sclerophyll Forest on Coastal Floodplains* EEC).

The habitat in this formation was not observed as containing many fauna species. Due to the highly limited nature and variety of habitat features present within this formation, it is most likely to provide habitat for small woodland bird species capable of finding refuge amongst the dense canopy vegetation. There is unlikely to be significant fauna refuge and foraging habitat for larger fauna species such as macropods, large parrots or arboreal fauna due to a lack of hollows and suitable vegetation. Consequently, there is low chance of this formation sustaining threatened fauna populations.

This formation is likely to provide habitat for amphibian species when waterlogged following heavy rainfall events.

This formation occurs on disturbed waterlogged alluvial flats that have a history of clearance. This clearance is likely to be a contributing factor to the formation of these dense stands of largely *Melaleuca* species.

A summary of the habitats of the Thicket formation is provided below.

Thicket Formation		
Total Area	2.0 ha	
Vegetation Structure and Health		
Canopy Dominants	Swamp paperbark (*Melaleuca ericifolia*), *Melaleuca nodosa* and flax-leaved paperbark (*Melaleuca linariifolia*).	
	Height (m)	Cover (%)
Emergent	16 – 25	< 5%
Canopy	6-10	50 - 70%
Mid	1-5	<5%
Ground	<0.5	40-90%
Age/Maturity	Due to a history of selective logging and clearing for agriculture, the majority of this vegetation is young. Exceptions are in the form of emergent *Eucalypt* species which are likely to fall into the mature age category. Most of the *Melaleuca* trees present are regenerating.	
Vegetation Health	The thicket formation appears to have a significant introduced species influence as well as impacts from edge effects from the urban environment and adjacent agriculture. This vegetation is in a moderate condition, despite the generally young age due to past clearing and grazing on the edges.	
Disturbances		
Fire	No evidence of fire across this formation.	
Weeds	This formation has a large number of introduced species present. This is likely to be a consequence of numerous factors, including fast colonisation by introduced species following clearing, edge effects from adjacent urban areas and grazing. Dominant introduced species included blackberry (*Rubus fruticosus* sp, agg), camphor laurel (*Cinnamomum camphora*), Arum lily (*Zantedeschia aethiopica*), asparagus fern (*Asparagus aethiopicus*), spear thistle (*Cirsium vulgare*) and *Senna pendula* var. *glabrata*.	
Dieback	Dieback observed in the thicket formation tended to be generally absent to mild. Where emergent eucalypt species were present, some ring-barking from cattle rubbing is occurring.	
Erosion	Mild erosion was observed in areas of this formation.	

Thicket Formation	
Mistletoe	No mistletoe was observed occurring in this formation.
Grazing	Cattle grazing is present throughout the Study Area. In some areas impacts from this were severe, with cattle causing ring-barking of trees and trampling of understorey vegetation. Regeneration of native canopy and midstorey vegetation is also being suppressed by cattle trampling. Cattle grazing is assisting in the spread and colonisation of introduced species in the groundcover vegetation of this formation. In some areas of this vegetation the surface in quite muddy and boggy for cattle usage.
Feral Animals	No evidence of feral animals was observed in this formation.
Insect Attack	Mild insect attack within this formation – however the extent was not considered to be significant.
Ground Habitats	
Log Cover	<5%
Leaf Litter	<5%
Bare Soil	<15%
Specific Habitats and Foraging Resources	
Hollow Density per Hectare	Six hollow bearing-trees were observed in this formation in the Study Area, equating to approximately 2.1 hollow-bearing trees per hectare.
Foraging Resources	Dense Melaleucas are appropriate feed trees for squirrel gliders (*Petaurus norfolcensis*).
Dominant Winter-flowering Tree Species	-
Perch Sites	Perch sites are abundant for small birds and moderate for large birds of prey.
Water Resources	This formation is typified by its waterlogged soil and there is a small ephemeral creekline running through this formation.

3.4.4 Forest Formation

The forested formations of the Study Area are highly variable, ranging between open and closed densely wooded habitats. This formation comprised a number of communities that were floristically and structurally diverse to each other. The canopy layer was highly variable and ranged between eucalypt dominated (primarily smooth-barked apple (*Angophora costata*)) and melaleuca dominated communities. The groundcover of the forested formation generally comprises grasses and forbs (of variable densities) and leaf litter. Rock cover in this formation was scarce throughout and presence of logs was low.

In the northern areas, moderate to dense understories provide protection and foraging resources for a diversity of bird groups including thornbills, wrens, robins and honeyeaters. Similarly, the ground stratum is low to moderate and offers habitat for terrestrial species including small mammals and reptiles.

Water resources in this area were limited to a small ephemeral channel occurring within the Alluvial Red Gum Forest – Cleared Understorey that provided minimal habitat value. There are also small constructed farm dams with minimal fringing vegetation.

This formation typically comprises mature vegetation refuge habitat for numerous species, with an abundance of hollows, peeling bark and tree fissures present. Foraging resources in the form of shrubby species were generally lacking through this formation.

It is likely that given the extent of forested habitat present in the Study Area and the habitats provided by this formation, this habitat is the most likely to be utilised by threatened species in the area.

A summary of the habitats of the Forest formation is provided below.

Forest Formation		
Total Area	21.3 hectares	
Vegetation Structure and Health		
Canopy Dominants	*Angophora costata, Corymbia maculata, Eucalyptus fibrosa, Eucalyptus tereticornis*	
	Height (m)	Cover (%)
Canopy	12-25	Highly variable – 20 to 70% (although most typically about 25%)
Mid (sub-canopy)	2-12 (depending on whether forest was regenerating)	1 - 70
Mid 2 (Shrub/sedge)	0.5 - 2	<5%
Ground	0 – 0.5	20 - 80 (although typically moderately dense)
Age/Maturity	The maturity of vegetation was highly variable. Areas of forested habitat that had been subject to clearing events and had regrown as dense melaleuca stands were considered to be quite young, whereas vegetation deeper in remnant areas of vegetation more frequently consisted of mature vegetation. A range of age/size classes present, although saplings were few likely as a result of cattle trampling.	
Vegetation Health	Overall the forest formation was in moderate health, from edge effects weed infestation (mostly escaped pasture grasses) and impacts from cattle grazing.	
Disturbances		
Fire	None significant observed.	

Forest Formation	
Weeds	Weed extent across the site was moderate, depending on proximity to areas of disturbance, clearing and grazing. Weed species that showed a wide presence throughout this formation included fireweed (*Senecio madagascariensis*), flatweed (*Hypochaeris radicata*) and lambs tongues *(Plantago lanceolata*). Two weeds of concern were recorded in this formation – lantana (*Lantana camara)* and blackberry (*Rubus fruticosus* subp. Agg), both of which are listed as noxious weeds.
Dieback	Mild to moderate – caused by cattle rubbing on base of trees causing ring-barking.
Erosion	Overall, minor extent of erosion was recorded in this formation. Where present this was typically in association with grazing cattle around dams.
Mistletoe	Absent or mild.
Grazing	Cattle grazing is present throughout the Study Area. In some areas this was severe, with cattle causing ring-barking of trees and trampling understorey vegetation. The cattle grazing of this formation has also caused the destruction of most of the woody debris on the ground. Although abundant during previous survey, these have mostly been crushed. This vegetation is most intact in the Narrabeen Buttonderry Footslopes Forest.
Feral Animals	Slight indication of disturbance by foxes (*Vulpes vulpes*) was recorded. Although cattle are not considered to be feral animals, their presence is highly detrimental to the condition and extent of the Narrabeen Buttonderry Footslopes Forest (and its variants) and the Alluvial Red Gum Forest.
Insect Attack	Very little insect attack was recorded at most sites.
Ground Habitats	
Log Cover	<1%
Leaf Litter	Most sites had approximately 25% cover
Bare Soil	<35%
Specific Habitats and Foraging Resources	
Hollow Density per Hectare	39 hollow-bearing trees were observed in this formation in the Study Area. This equates to approximately 1.9 hollow-bearing trees per ha.
Foraging Resources	Abundant Casuarina trees were present in the north-east of the Study Area which could provide foraging habitat for the threatened glossy-black cockatoo. Eucalypts, melaleucas and small amounts of mistletoe also have the potential to provide a specific foraging resource for honeyeaters. Dense areas of melaleuca also have potential to provide foraging habitat for threatened squirrel gliders (*Petaurus norfolcensis*).

Forest Formation	
Dominant Winter-flowering Tree Species	*Eucalyptus tereticornis*
Perch Sites	Moderate to numerous density of horizontal perch sites.
Water Resources	Limited mostly in the form of dams.

3.4.5 Hollow-bearing Trees and Raptor Nests

A list of hollow-bearing trees identified during surveys is provided in **Appendix 4** and the locations of these trees are provided on **Figure 3.3**. A total of 164 hollows were identified during survey of the Study Area (including area outside of those proposed to be impacted for the purposes of context), these occurred in 67 trees with most trees containing more than one hollow. The total number of hollows within areas proposed for disturbance is over 90 spread across 45 trees. Hollows ranged between tiny (<25 mm) to massive (301+ mm). Hollows typically occurred in either smooth-barked apples (*Angophora costata*) or stag trees (of unknown species). A breakdown of the number of hollows in each size category is provided in **Table 3.4** below.

Table 3.4 Number of Hollows identified in the Study Area

	Tiny<25	Small 26-50	Medium 51-100	Large 100-300	Massive 301+	Total
Total Number of Hollows in Impact Areas	2	17	22	33	16	**90**
Total Number of Hollows in Park Area	0	1	7	2	1	**11**
Total Number of Hollows in Constructed Wetlands	0	0	0	0	0	**0**
Total Number of hollows in broader Study Area*	0	11	10	27	15	**63**

	Tiny<25	Small 26-50	Medium 51-100	Large 100-300	Massive 301+	Total
Total Number of Hollows Identified	**2**	**29**	**39**	**62**	**32**	**164**

* Not proposed to be impacted and assessed for context only.

Field surveys focused on the identification of medium or larger sized hollows as these have greatest potential to provide habitat for threatened gliders and owl species. All hollows encountered were recorded however.

Of the hollows identified, 80 were physically inspected by way of pole-mounted inspection camera and/or climbing and inspecting visually. A further 13 trees were surveyed with remote-sensing cameras positioned to capture usage. A total of 20 hollows from 14 trees could not be surveyed by either method as they were inaccessible for safety reasons or did not have appropriate adjacent vegetation to attach a remote camera to. These may or may not be actual hollows as they could be blind (as can be the case where there is an opening however it does not extend far enough to allow animals to make use of them).

Of the trees proposed to be impacted that could either be inspected or were able to be surveyed using a remote camera, none were observed as being utilised by threatened owl species or squirrel gliders (*Petaurus norfolcensis*). However, 23 trees (bearing a combined total of 32 appropriate hollows) were identified as providing potential roost hollows for threatened owls and 27 trees (bearing a combined total of 37 appropriate hollows) were identified as providing potential den habitat for squirrel gliders (*Petaurus norfolcensis*) as shown in **Figure 3.3**.

Within the Park Area, a further one hollow bearing tree (containing one appropriate hollow) was identified as providing potential roost hollows for threatened owls, and a further four hollow bearing trees (bearing a combined total of 7 appropriate hollows) were identified as providing potential den habitats for squirrel gliders (*Petaurus norfolcensis*), as shown in **Figure 3.3**.

Appropriate hollows for these species were identified firstly based on appropriate entrance dimensions, then whether the depth, height and condition of the hollow were appropriate, or if signs of presence were observed. Measurements used were in accordance with requirements identified in *Nest Boxes for Wildlife – A Practical Guide* (Franks & Franks 2004). Hollows were excluded as having potential if they contained substantial insect nests/usage (such as bees, wasps, ants, spiders or termites), were nearly blind or were full of sap.

Trees with potential to provide roosting habitat for threatened owls and potential den habitat for squirrel gliders (*Petaurus norfolcensis*) are provided in **Table 3.5** and **Table 3.6** respectively.

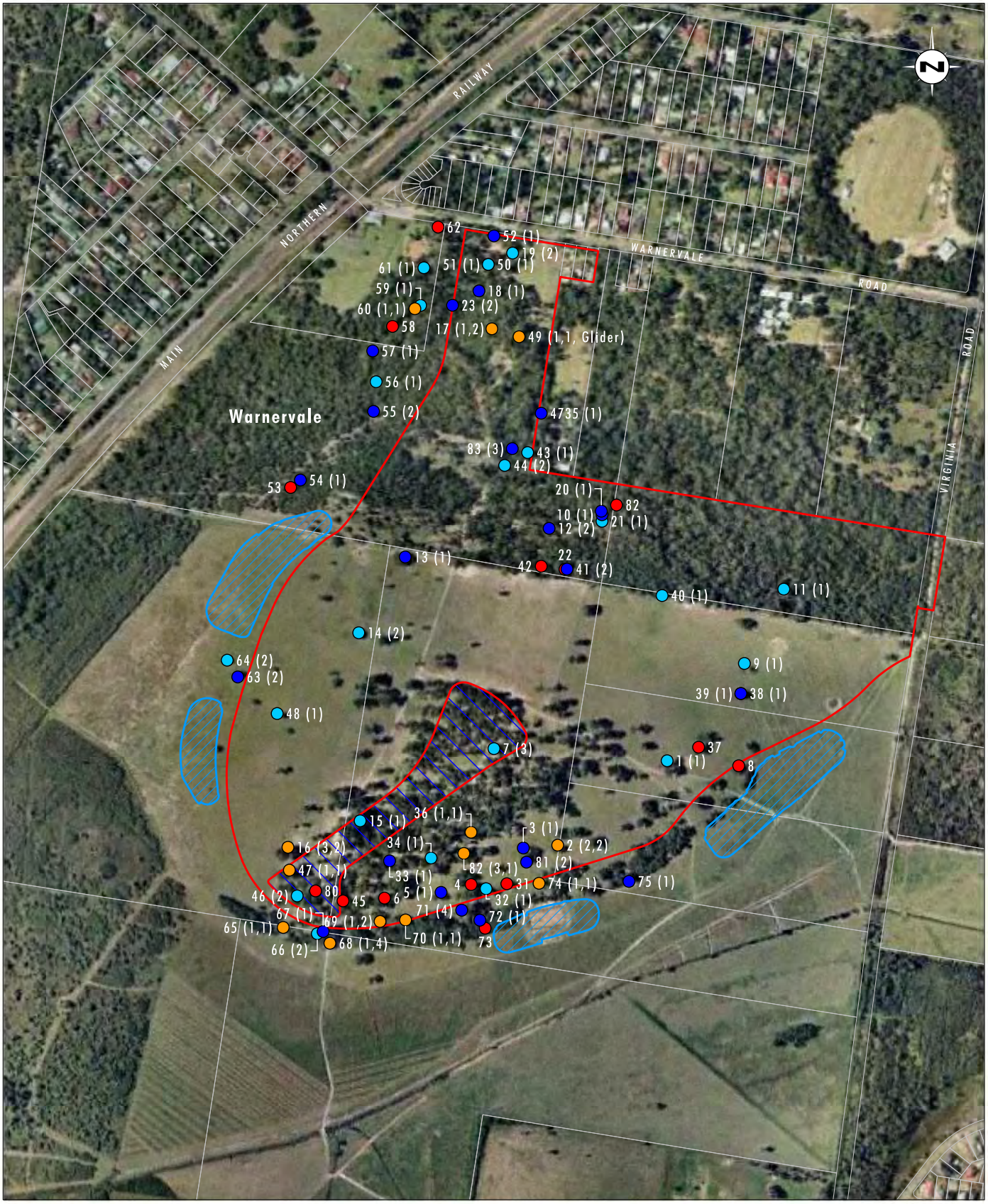

Image Source: Google Earth (2010)
Data Source: Wyong Shire Council (2010)
Note: Numbers in brackets indicate the number of appropriate hollows for Owls and Gliders respectively

0 100 200 400m
1:7 500

Legend

- Impact Area
- Park Area
- Constructed Wetland
- Trees with Potential Owl and Glider Hollows
- Trees with Potential Owl Hollows
- Trees with Potential Glider Hollows
- Trees with Hollows not Appropriate for Owls or Gliders

FIGURE 3.3

Hollow-bearing Trees

Table 3.5 Trees with Potential to Provide Roosts for Threatened Owls

Tree ID	Tree Species	Eastings (MGA 56)	Northings (MGA 56)
Trees that could not be accessed with cameras and could not be excluded as potential owl trees			
63[1]	Stag	355359	6319548
70[1]	*Corymbia maculata*	355593	6319208
81[2]	*Angophora costata*	355762	6319289
82[2]	*Corymbia maculata*	355675	6319301
83[2]	Stag	355743	6319867
Potential hollows containing non-target species			
2[2]	*Eucalyptus capitellata*	355806	6319313
6[2]	*Angophora costata*	355565	6319239
12[2]	Stag	355795	6319756
18[2]	Stag	355697	6320088
20[2]	Stag	355868	6319781
37[2]	*Angophora costata*	356004	6319451
41[2]	*Angophora costata*	355820	6319699
47[3]	*Angophora costata*	355432	6319278
49[2]	Stringybark	355753	6320025
60[1]	*Eucalyptus tereticornis*	355606	6320063
67[1]	*Angophora costata*	355478	6319192
68[1]	*Angophora costata*	355488	6319176
69[2]	*Angophora costata*	355558	6319206
71[2]	*Angophora costata*	355672	6319222
74[2]	Stringybark	355780	6319260
Tree with low potential as hollow was cracked, rotten or not solid			
4[2]	*Angophora costata*	355685	6319259
4735[1]	Stag	355768	6319917
45[2]	*Angophora costata*	355507	6319235

Tree ID	Tree Species	Eastings (MGA 56)	Northings (MGA 56)
70[1]	*Corymbia maculata*	355593	6319208
Potential roost trees with no signs of occupation			
2[2]	*Eucalyptus capitellata*	355806	6319313
3[2]	*Angophora costata*	355758	6319309
5[2]	*Angophora costata*	355643	6319248
10[2]	*Angophora costata*	355868	6319776
12[2]	Stag	355795	6319756
13[2]	*Angophora costata*	355594	6319717
16[2]	*Angophora costata*	355430	6319311
17[2]	*Angophora costata*	355715	6320035
19[2]	Stag	355743	6320142
23[1]	*Melaleuca quinquenervia?*	355660	6320068
33[2]	*Angophora costata*	355571	6319291
36[2]	*Eucalyptus tereticornis*	355686	6319331
38[2]	*Angophora costata*	356062	6319524
41[2]	*Angophora costata*	355820	6319699
47[3]	*Angophora costata*	355432	6319278
49[2]	*Angophora costata*	355753	6320025
52[2]	*Angophora costata*	355718	6320166

[1] Trees found in the Study Area however not within the Impact Area or Park Area

[2] Trees located in the Impact Area

[3] Trees located within the Park Area

Table 3.6 Trees with Potential to Provide Dens for Squirrel Gliders

Tree ID	Tree Species	Eastings (MGA 56)	Northings (MGA 56)
Trees that could not be accessed with cameras and could not be excluded as potential squirrel glider trees			
1[1]	*Angophora costata*	355960	6319431
9[1]	Stag	356068	6319567
11[1]	*Angophora costata*	356123	6319672
15[2]	*Angophora costata*	355530	6319348
21[1]	Stag	355869	6319766
40[1]	*Angophora costata*	355953	6319662
43[1]	*Angophora costata*	355765	6319862
44[1]	*Melaleuca quinquenervia?*	355732	6319844
51[1]	Stag	355710	6320125
Potential hollows containing non-target species			
2[1]	*Eucalyptus capitellata*	355806	6319313
7[2]	*Eucalypts fibrosa*	355718	6319448
14[1]	Stringybark	355528	6319611
16	*Angophora costata*	355430	6319311
46[2]	*Angophora costata*	355443	6319243
48[1]	Stringybark	355415	6319498
50[1]	*Angophora costata*	355710	6320125
70[3]	*Corymbia maculata*	355593	6319208
Tree with low potential as hollow was cracked, rotten or not solid			
7[2]	*Eucalypts fibrosa*	355718	6319448
13[1]	*Angophora costata*	355594	6319717
32[1]	*Angophora costata*	355706	6319253
50[1]	*Angophora costata*	355710	6320125
69[1]	*Angophora costata*	355558	6319206

Tree ID	Tree Species	Eastings (MGA 56)	Northings (MGA 56)
Potential den trees with no signs of occupation			
2[1]	*Eucalyptus capitellata*	355806	6319313
7[2]	*Eucalypts fibrosa*	355718	6319448
14[1]	Stringybark	355528	6319611
16[1]	*Angophora costata*	355430	6319311
17[1]	*Angophora costata*	355715	6320035
19[1]	Stag	355743	6320142
34[1]	*Angophora costata*	355629	6319295
36[1]	*Eucalypts tereticornis*	355686	6319331
39[1]	Stag	356063	6319525
42	Stag	355784	6319703
46[2]	*Angophora costata*	355443	6319243
47[2]	*Angophora costata*	355432	6319278
69[1]	*Angophora costata*	355558	6319206
70[3]	*Corymbia maculata*	355593	6319208
82[1]	*Corymbia maculata*	355675	6319301
Potential tree with signs of presence or potential occupation (*Petaurus* sp. identified inside or characteristic leaf nest)			
19[1]	Stag	355743	6320142
32[1]	*Angophora costata*	355706	6319253
49[1]	*Angophora costata*	355753	6320025

[1] Trees located in the Impact Area

[2] Trees located within the Park Area

[3] Trees found in the Study Area however not within the Impact Area or Park Area.

The trees provided in **Table 3.4** and **3.5** have potential to provide either roosting or denning habitat for threatened owl species or squirrel gliders (*Petaurus norfolcensis*) respectively .

No squirrel glider (*Petaurus norfolcensis*) scats or threatened owl pellets were identified at the base of any of the hollow-bearing trees surveyed. Barn owl (*Tyto alba*) pellets were identified within the Study Area, although not directly beneath any hollow-bearing trees. An unidentifiable glider (which may have been a threatened squirrel glider (*Petaurus norfolcensis*) or non-threatened sugar glider (*Petaurus breviceps*)) was identified within hollow-bearing tree 49.

Non-threatened fauna species recorded utilising tree-hollows were:

- common brushtail possum (*Trichosurus vulpecula*)
- common ringtail possum (*Pseudocheirus peregrinus*)
- unidentified micro-bat
- galah (*Eolophus roseicapilla*)
- long-billed corella (*Cacatua tenuirostris*)
- eastern barn owl (*Tyto alba*)
- sulphur-crested cockatoo (*Cacatua galerita*)
- rainbow lorikeet (*Trichoglossus moluccanus*)
- Australia king parrot (*Alisterus scapularis*)
- eastern rosella (*Platycercus eximius*)
- nankeen kestrel (*Falco cenchroides*)
- laughing kookaburra (*Dacelo novaeguineae*)
- Australian owlet nightjar (*Aegotheles cristatus*)
- unidentified bird (too small to be owl)
- lace monitor (*Varanus varius*) and
- an unidentified frog.

Although non-target species were identified in some of the hollows inspected, this does not necessarily mean that they are not used by threatened species or that occupation by threatened species could not occur in future.

No raptor nests were identified during the surveys undertaken, however the threatened black falcon (*Falco subniger*) was identified flying over the north-west corner of the site. The threatened little eagle (*Hieraaetus morphnoides*) has also been identified in the Study Area during previous surveys undertaken.

3.4.6 Squirrel Glider Habitat Assessment

In accordance with the WSC Flora and Fauna Surveys Guidelines (Wyong Shire Council 2014), specific habitat assessment was undertaken for the squirrel glider (*Petaurus norfolcensis*) in accordance with Appendix 8.8 of these guidelines.

The vegetation occurring in the north of the Study Area is well connected to areas of surrounding vegetation to the east and west. The vegetation here largely comprises smooth-barked apple (*Angophora costata*) with a Melaleuca understory which is considered preferred habitat for this species. This remnant patch is slightly larger than 11 hectares in size.

The vegetation in the south of the Study Area is dominated by smooth-barked apple (*Angophora costata*) however has minimal understorey (with the exception of a narrow riparian strip along the southern boundary which is dominated by Melaleuca species). The southern vegetation has poor levels of connectivity to surrounding remnant vegetation. This remnant patch is approximately 11 hectares in size with the nearest remnant over 50 metres to the west.

Locations of corridors and potential habitat trees are provided in **Figure 3.3**. Appropriate hollow-bearing trees for this species are moderate in abundance in both the northern and southern vegetation.

A comparison of appropriate feed trees for this species and the species composition of the Study Area is provided below.

Table 3.7 Squirrel Glider Preferred Feed Trees (Wyong Shire Council 2014)

Genus	Species	Food Item	Presence in Study Area
Angophora	*costata*	Sap, nectar and pollen	High densities in Narrabeen Buttonderry Footslopes Forest (including Cleared Variant) Moderate densities in Narrabeen Buttonderry Footslopes Forest – Variant C Low densities in Alluvial Red Gum Footslopes Forest
Corymbia	*maculata*	Nectar and pollen	Very low densities in Narrabeen Buttonderry Footslopes Forest and Cleared variant
Eucalyptus	haemastoma	Sap, nectar and pollen	Very low densities in Narrabeen Buttonderry Footslopes Forest and Cleared variant
	racemosa	Sap, nectar and pollen	Not identified
	robusta	Sap, nectar and pollen	Not identified
	siderophloia	Sap, nectar and pollen	Not identified
	paniculata	Sap, nectar and pollen	Not identified

Genus	Species	Food Item	Presence in Study Area
	fibrosa	Sap, nectar and pollen	Very low densities in Narrabeen Buttonderry Footslopes Forest and Cleared variant
	gummifera	Sap, nectar and pollen	Not identified
Melaleuca	*linarifolia*	Nectar and Insect Bark Food	Moderate to high densities throughout Narrabeen Buttonderry Footslopes Forest (including Variant C) and Alluvial Melaleuca sedge forest
	nodosa	Nectar and Insect Bark Food	
	quinquinervia	Nectar and Insect Bark Food	
	sieberi	Nectar and Insect Bark Food	
Acacia	sp.	Seeds and Gum	Not identified
Banksia	*spinosa*	Nectar and pollen	Not identified
	serrata	Nectar and pollen	Not identified
	integrifolia	Nectar and pollen	Not identified
	oblongifolia	Nectar and pollen	Not identified
Xanthorrhoea	spp.	Nectar and potential gum	Where present were immature

Based on the above, the habitats of the north provide high value habitat for the squirrel glider (*Petaurus norfolcensis*), with remnant vegetation in the south providing reduced habitat value. Although the treed vegetation in the south provides moderate habitat value in terms of the canopy species, the shrub and ground layers are sparse (containing no feed species as a result of grazing). In addition, its isolation from other areas of vegetation is likely to provide a substantial barrier to the movement of this species and thus limit their ability to utilise this vegetation. Gaps in vegetation of greater than 35 metres are likely to be an impediment to squirrel glider (*Petaurus norfolcensis*) movement (LMCC 2015) and therefore gaps of (in some cases) greater than 150 metres from this southern fragment to nearby vegetation are likely to exclude occupation of this species in that area. A lack of records of this species, nor signs thereof (such as

scats) suggests this southern remnant is not likely to be utilised by this species. The highly linear nature of the thin strip of vegetation to the immediate south of the southern remnant of the Study Area is not likely to be of sufficient edge to area ratio to offer this species suitable cover for movement.

Habitat vulnerability has been assessed in accordance with the below criteria (taken from Appendix 8.8 of the guidelines):

1. Edge to width ratio: is the patch round shaped, oval shaped or a narrow linear fragment?

Neither the remnant northern or southern vegetation comprises a narrow-linear fragment of vegetation. Edge effects of both areas of remnant vegetation are moderate due to surrounding roads, agricultural lands and existing urban developments.

2. What percentage of the patch area has experienced disturbance by weed invasion, underscrubbing, fire or other understorey disturbance?

Fire does not appear to be impacting either the northern or the southern vegetation fragment.

The northern vegetation fragment is subject to grazing and the groundcover vegetation is for the most part moderately weed infested. Cattle grazing is suppressing natural regrowth in this area.

The southern fragment has been subject to substantial under scrubbing and is highly modified. Cattle grazing is suppressing regrowth in this area.

3. Is the fragment within 200 m of an existing or future residential development?

The northern remnant fragment is within 200 metres of existing residential development as well as future residential development.

The southern remnant fragment is within 200 metres of future residential development.

4. Presence/absence of resident breeding Squirrel Gliders in patch?

An unidentified glider species was identified in the northern remnant during the current survey however this was the only record (direct or indirect) of this species gained from the surveys completed across the Study Area for this species. Squirrel gliders (*Petaurus norfolcensis*) have been recorded in the general Warnervale area previously.

No breeding has been recorded within either the northern or southern remnants of the Study Area. The highly modified habitats and isolated nature of the southern remnant suggests it is unlikely that this species could regularly access or breed in this remnant. There is potential that a resident population could be present in or utilising the well-connected habitats within and adjoining the northern remnant, however evidence of this was not recorded during the surveys of the Study Area.

3.4.7 SEPP 44 Koala Habitat Assessment

Preferred koala (*Phascolarctos cinereus*) feed tree forest red gum (*Eucalyptus tereticornis*) comprised greater than 15 per cent of the canopy vegetation within the areas of Alluvial Red Gum Forest. As such this area is considered to comprise potential koala (*Phascolarctos cinereus*) habitat. No other areas of vegetation in the Study Area comprised more than 15 per cent of SEPP 44 feed trees in the canopy.

No koalas (*Phascolarctos cinereus*) or signs of their presence (scats, scratches etc.) were identified during the current survey or during previous studies undertaken. As such the Study Area does not comprise core koala (*Phascolarctos cinereus*) habitat.

3.5 Riparian Corridors

Riparian corridors within the Study Area are identified within **Figure 3.4**. This included vegetation surrounding the Alluvial Red Gum Forest – Cleared Understorey and the Alluvial Melaleuca Sedge Forest as well as a 50 metre surrounding buffer zone. These areas form part of a floodplain and the distinctions between the base of water courses and the elevation of the riparian vegetation (highest bank) are minimal.

These water courses are minor in nature with most ephemeral and not containing water during surveys undertaken.

3.6 Wetland Management

The location of the Porters Creek Wetland is provided in **Figure 3.4.** This vegetation is listed as a SEPP 14 Coastal Wetland. Under this policy, a person shall not clear, construct a levee, drain or fill any part of a SEPP 14 listed wetland, except with the consent of WSC.

For the purposes of this policy, 'clearing' relates to the destruction or removal in any manner of native plants growing on the land. However, this policy permits the destruction or removal of native plants, within three metres of the boundary between the lands owned or occupied by different persons and the wetland, for the purpose of erecting or maintaining a dividing fence between those lands. It also permits the destruction or removal of native plants, within 0.5 metre of the boundary between the lands owned or occupied by different persons, for the purpose of enabling a survey to be carried out along that boundary by a surveyor registered under the *Surveyors Act 1929*.

In accordance with assessment of impacts on coastal wetlands, the following aspects must be taken into account when assessing potential impacts of any project:

- environmental effects of the project on:
    - growth of native plant communities
    - survival of native wildlife populations
    - provision of quality habitat for indigenous and migratory species and
    - surface and groundwater characteristics of the site and surrounding area including salinity and water quality
- whether adequate safeguards and rehabilitation measures have been taken into account
- whether carrying out development will be consistent with the protection and preservation of this wetland
- whether this development is consistent with the 'National Conservation Strategy of Australia' as it relates to the conservation of 'living resources' of wetlands
- whether alternatives to the development have been taken into account
- representations of the Director of National Parks in relation to the project and

- wetlands surrounding the land to which the project relates and appropriateness of imposing conditions requiring the carrying out of works to preserve or enhance the value of those surrounding wetlands.

Any potential development of the Study Area will need to take the above issues into account in assessing potential impacts on the Porters Creek SEPP 14 wetland and this has been assessed within **Section 5.1**.

In a similar manner to SEPP 14, Chapter 3.10 – Wetland Management of the Wyong Shire Council Development Control Plan 2013 is also required to be considered. In this regard, although the Project will not directly impact SEPP 14 Wetland Porters Creek, it is within an area designated as a "Wetland Management Area" for this catchment. This being the case, the **Table 3.8** provides an assessment of the development against the requirements of Section 3.3 of Chapter 3.10 (Application for Development within Wetland Management Areas) of the DCP.

Table 3.8 Assessment of the Project against the Requirements for Application for Development within Wetland Management Areas

Criteria	Compliance
i. An assessment of the sites geomorphologic characteristics and established wetland conservation values and functions the land may perform or contribute having considered the Evaluation Chart contained in Appendix A to this Chapter	The Wetland Management Areas are largely comprised of Disturbed Grassland vegetation with a smaller extent of Open Forest vegetation. Surface and vegetation roughness of grassland areas is low and the surface and vegetation roughness of forested areas is moderate. All Wetland Management Areas comprise low rises which are unlikely to be regularly inundated by high velocity floodwater. Land slopes are typically between 2-4% and subsequently have moderate importance for nutrient and sediment filtering. A small extent of the vegetation in the north (Alluvial Red Gum Footslopes Forest and Alluvial Melaleuca Sedge Forest) contain slopes of less than 2% and comprise frequently waterlogged communities (high importance for nutrient and sediment filtering). The Wetland Management Areas are located downstream of established general residential areas in the north as well as bushland vegetation. Current water inflows are likely to have moderate pollutant load as a consequence. Most of the Wetland Buffers to the Porters Creek Wetland will not be disturbed by the Project and revegetation works will be undertaken as part of this Project to enhance the value of existing buffers. For the most part, buffers being disturbed by the Project comprise grassland areas. No core wetland Areas (E2) will be disturbed by the Project. The Wetland Management Areas proposed to be disturbed by the Project primarily comprise Wet Meadows (Disturbed Grasslands), with a small Drainage Line as well as a very small extent of Remnant Wetland in the north. The Wetland Management Areas in the Project Area will be partially retained within the proposed Park Area, with the majority of the remainder being cleared for the purposes of a residential development or for Constructed Wetlands. There is potential that these Wetland Management Areas provide habitat for threatened plants or animals and the areas of Alluvial Red Gum Footslopes Forest and Alluvial Melaleuca Sedge Forest both comprise EEC vegetation (albeit in modified degraded form). However, the vegetation types present are well represented within the local area, much of which is being retained if-not improved with areas zoned as either E2 – Environmental Conservation or E3 – Environmental Management.

Criteria	Compliance
ii. The developments relationship with the Wetland Management objectives provided in Section2 of this Chapter	Objective 1 – To protect the environmental values and functions of wetlands from the potential impacts of adjoining land uses The environmental values and functions of Porters Creek Wetland will be protected by the retention of vegetated buffers (including enhancement of the buffer to the south of the Impact Area by way of revegetation) and by appropriate storm water management of water collected from within the Impact Area. Objective 2 – To maintain or restore the physical, chemical and biological processes existing In wetlands by minimising existing impacts on or exacerbating changes to hydrology from land uses in catchment Grazing impacts from the Wetland Management Areas in the Impact Area will be removed and replaced with residential development. However the onsite water generated by the new development will be managed through new Constructed Wetlands which will improve the quality and dissipate the intensity of water volumes and flows prior to entering Porters Creek Wetland. Objective 3 – To ensure water entering into natural wetlands is of sufficient quality so that wetland conservation values and functions are not compromised Stormwater structure management in the form of Constructed Wetlands will be designed in a manner that increases their ecological value by providing or protecting habitat. These structures will improve the quality of stormwater prior to it entering Porters Creek Wetland. Objective 4 – To conserve biological diversity and ecological processes by giving consideration to appropriate fire management regimes and permanent hazard reduction techniques in wetland environments These areas will be subject to appropriate bushfire management as detailed within the Council Bush Fire Risk Management Plan (being developed for Precinct 7a by Council). Objective 5 – To preserve the aesthetic, social and economic values of wetlands areas Revegetation works within floodplain areas zoned as E3 – Environmental Management are proposed in the south of the Impact Area to enhance aesthetic value of these Wetland Management Areas and to increase remnant connectivity.

Criteria	Compliance
iii. A detailed description of the development including any environmental safeguards and mitigation measures	Environmental safeguards and mitigation measure that will be initiated within the Wetland Management Areas to minimise impacts to Porters Creek Wetland will include: • Implementation of sediment fences, settling ponds and containment bunds during the construction phase • appropriate and environmentally sensitive Constructed Wetlands which will: o Enhance ecological value and habitat in these areas o Slow onsite flows into the wetland o Improve quality of stormwaters generated onsite • Retention of buffer vegetation in E2 and E3 lands • Revegetation of floodplain areas to the south to reduce flow volumes and sediment/nutrient loads during flood and heavy rainfall events • Stormwater will be managed in accordance with Council's DCP standards in terms of quantity and quality (address in the Water Cycle Management Plan)
iv. A vegetation survey and map (defining the wetland boundaries)	See **Figure 3.4** and **Section 2.4**.

Criteria	Compliance
v. The environmental effects of the proposed development including, (but not limited to), the effect of the proposed development on: • The growth of native plant communities • The survival of native wildlife populations • The scenic value of the area • The surface and groundwater characteristics of the site to which the development is proposed and of the surrounding area, including water quality	The Project is not anticipated to inhibit growth of native plant communities outside of the Impact Areas. With impact mitigation measures provided in Section 6.0, the Project is not anticipated to significantly affect native wildlife populations. The scenic value of the area will be enhanced by revegetation works to the south as well as retention of the Park Area. With proposed stormwater management measures, the surface water characteristics of Porters Creek Wetland are not likely to be substantially altered. No groundwater changes are likely to occur as a result of the Project.
vi. Cumulative impacts resulting from a number of activities with similar impacts interacting with the environment in the same catchment	The Project will result in a new residential development in an area surrounded by a combination of existing general residential areas, as well as retained bushlands in areas zoned as either E2 – Environmental Conservation or E3 –Environmental Management. In order to construct the residential development, the lands that are being modified are primarily used for grazing which is likely to be currently impacting on the quality of water flowing from this area into Porters Creek Wetland. As the surface waters from this area are proposed to now be managed prior to their discharge, it is unlikely that the Project will lead to significantly increased cumulative impacts.
vii. The on-going environmental management commitments to the site, including any monitoring program and environmental management plan.	As part of the *Conservation Management Plan – Precinct 7A, Warnervale and Hamlyn Terrace NSW* (Umwelt 2014), monitoring of retained vegetation and revegetation areas will be undertaken to ensure no significant deterioration to habitat value of retained areas and to assess improvement to habitat quality of revegetated areas. Stormwater structure management will be maintained for the life of the residential development.

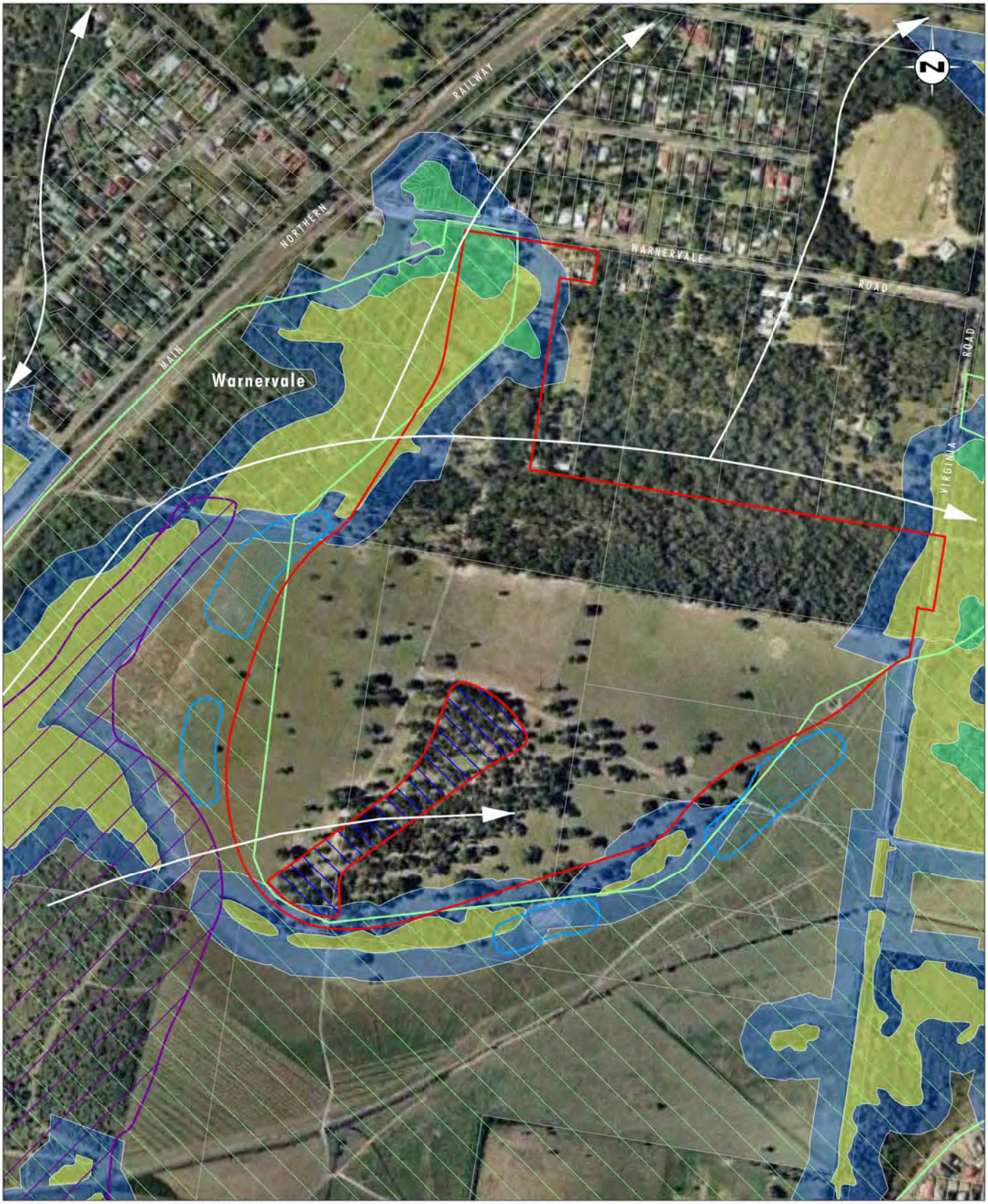

Image Source: Google Earth (2010)
Data Source: Wyong Shire Council (2010)

0 100 200 400m
1:7 500

Legend

- Impact Area
- Park Area
- Constructed Wetland
- SEPP 14 Wetland
- Alluvial Red Gum Footslopes Forest
- Alluvial Melaleuca Sedge Forest
- Riparian Area
- Corridor Pathways
- Wetland Management Area

FIGURE 3.4

Riparian Areas

File Name (A4): R02/3616_009.dgn
20170502 13.41

3.7 Corridor Assessment

Corridors present in the Study Area are provided in **Figure 3.4**, this figure identifies existing vegetation connectivity that is likely to provide vegetated corridor function for all groups of fauna species known to occur within the Study Area. This connectivity is present within the Study Area, as well as out of the Study Area to proximal habitat in some locations.

Current corridor function is considered to be relatively high, given the urban location of the Study Area. Connectivity in the north is good, and it is not likely that fauna groups would be impeded moving in an east-westerly direction. However connectivity of northern vegetation to vegetation in the south is poor and likely would only be utilised with highly mobile groups, such as large forest owls and macropods.

The nearest connected remnant to the southern vegetation is in Porters Creek Wetland to the west which is more than 50 metres away. This distance could be readily crossed by larger bird species and most mammals, however would potentially impede movement of small reptiles and amphibian species.

Remnant paddock trees with hollows are present throughout the Study Area that could be utilised to assist arboreal fauna moving between areas of habitat.

4.0 Impact Assessment

The following section addresses the impacts on the ecological features known and predicted to occur as a result of this Project.

4.1 Impacts to Vegetation Communities

The Project will involve impact to a total of the removal of up to 50.2 hectares of vegetation from the Impact Area (for the residential development and Constructed Wetlands). The vegetation likely to be removed includes:

- Narrabeen Buttonderry Footslopes Forest – 9.3 hectares
- Narrabeen Buttonderry Footslopes Forest – Cleared understory – 7.6 hectares
- Narrabeen Buttonderry Footslopes Forest – Variant C– 1.0 hectares
- Alluvial Red Gum Footslopes Forest – Cleared Understory (EEC) – 0.7 hectares
- Alluvial Melaleuca Sedge Forest (EEC) – 2.0 hectares
- Disturbed Grassland – 29.5 hectares
- Dam – 0.1 hectares.

The majority of impact (being 58.76 per cent) will occur within the Disturbed Grassland community. This is a highly disturbed non-native community, with high levels of introduced species (weeds and pasture improvement species) and severe impacts from grazing. A further 2.7 hectares of Narrabeen Buttonderry Footslopes Forest – Cleared Understorey and 0.2 hectares of Disturbed Grassland will be retained as a Park Area, whereby it is anticipated negligible ecological impacts will result to the vegetation as a result of ongoing general maintenance.

The remaining communities are native, however their history of grazing and clearing has resulted in low abundance and diversity in the shrub and groundcover layers compared to undisturbed areas. Most of this vegetation has moderate to high levels of weed infestation (particularly within the Alluvial Red Gum Footslopes Forest and Alluvial Melaleuca Sedge Forest). The vegetation communities identified within the Study Area tend to be locally common to the Warnervale area, particularly if considering pre-urbanisation composition.

The Project will result in impact to 2.7 hectares of vegetation commensurate with TECs listed under the TSC Act, primarily:

- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions – 2.0 hectares
- River-flat Eucalypt Forest on Coastal Floodplains – 0.7 hectares.

This issue is further addressed in **Section 4.4.1** below.

The Project will potentially involve the removal of up to 45 hollow-bearing trees from within the Impact Area (containing a combined total of 90 hollows of various sizes). These trees provide habitats for a range of locally common fauna species; however none have been confirmed as providing habitat for any threatened fauna species listed under either the TSC Act or EPBC Act.

4.2 Impacts to Fauna Habitat

Much of the native vegetation in the Study Area has been degraded as a result of grazing and other urban-related impacts. This has resulted in a reduction in the quality of the shrub and ground layers across vegetation communities present and thus a corresponding reduction in the value of these areas to fauna species. The loss of up to 20.6 hectares of modified native treed vegetation communities within the Impact Area (excluding the Disturbed Grassland) will reduce fauna habitat in the local area primarily for locally common fauna.

The key impact to fauna species as a result of the Project will be the loss of hollow resources. The Project will involve the removal of up to 45 hollow-bearing trees. Detailed surveys of these trees has identified 90 hollows in total, all of which have the potential to support threatened species such as micro-bats, gliders, parrots, cockatoos and owls (although no presence of threatened fauna was confirmed). Loss of hollows will result in a localised flow-on affect to threatened predatory species (large forest owls) where their prey species (such as possums, cockatoos and gliders) are impacted.

This issue is further addressed in **Section 4.4.3** below.

4.3 Impacts to Local Corridor Function

Figure 3.4 identifies the current two corridors of the Study Area. This connectivity is present within and throughout the Study Area, as well as out of the Study Area to proximal habitat in some locations. These comprise a corridor in the north that has a high degree of connectivity running in an east-west direction and the remnant vegetation in the south which is connected to Porters Creek Wetland in the west but does not go any further in a north, south or easterly direction than this fragment.

Such corridors are likely to be used by a variety of fauna groups (and species), depending on the dominant vegetation type in the corridor. The connectivity values of the swamp sclerophyll vegetation communities of the north are likely to be the most important link in the Study Area.

The Project will result in the fragmentation of a local east-west running corridor in the north of the Study Area that is comprised of modified forest habitats dominated by a dense layer of melaleucas with emergent eucalypts. This corridor is approximately 50 metres in width at its most narrow point.

The Project will also result in the removal of a section of the southern vegetation fragment located outside the Park Area, reducing the value of this area as a corridor. However this southern area of vegetation was already highly fragmented. Project commitments to rehabilitate this southern corridor will assist greatly in reducing the overall impacts of this development. Importantly, commitment to commence revegetation works prior to clearing of vegetation for the Project will greatly assist in reducing lag time between habitat loss and regeneration reaching sufficient maturity to provide compensatory habitat. Installation of fauna movement structures (such as glider poles and/or fauna overpasses/rope bridges) is another important commitment of the Project design. This will assist in minimising fragmentation and habitat loss impacts to key threatened species such as the squirrel glider (*Petaurus norfolcensis*).

4.4 Impacts under the Environmental Planning and Assessment Act 1979

The following threatened species and TECs have been identified utilising the habitats of the Study Area either as part of current surveys or previous survey:

- 2.0 hectares of grazed and modified Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions EEC (TSC Act)
- 0.7 hectares of grazed and modified River-flat Eucalypt Forest on Coastal Floodplains EEC (TSC Act)
- 2 individuals of heath wrinklewort (*Rutidosis heterogama*) (vulnerable under the TSC Act) identified in the northern vegetation identified during previous survey efforts that were not relocated during current surveys. Likely no longer present as a result of grazing activities
- wallum froglet (*Crinia tinnula*) (listed as vulnerable under the TSC Act), previously identified in the northern areas of vegetation (during the time of surveys areas of standing water here were minimal). This species was not identified during the current survey. This species is no longer likely to be extant in the Study Area unless it is utilising adjacent habitats and occasionally extending its range into the Study Area
- barking owl (*Ninox connivens*) - listed as vulnerable. A single record of this species was identified calling in the Study Area during 2015 surveys. No hollows were identified being utilised by this species
- black falcon (*Falco subniger*) – listed as vulnerable. A single record of this species was identified flying over the Study Area in the north-west however no nesting was identified
- little lorikeet (*Glossopsitta pusilla*) – listed as vulnerable. This record was identified during previous but not current surveys of the Study Area. Appropriate foraging habitat is present
- squirrel glider (*Petaurus norfolcensis*) – listed as vulnerable. This species has previously been confirmed in the Study Area. Unconfirmed glider records made during 2016 which as a precautionary approach have been assumed to be squirrel gliders (*Petaurus norfolcensis*) although more likely to have been locally common fauna species sugar glider (*Petaurus breviceps*)
- yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*) – listed as vulnerable. Confirmed Anabat records onsite
- Eastern freetail-bat (*Mormopterus norfolkensis*) – listed as vulnerable. Confirmed Anabat records onsite
- little bentwing-bat (*Miniopterus australis*) – listed as vulnerable. Confirmed Anabat records onsite
- greater broad-nosed bat (*Scoteanax rueppellii*) – listed as vulnerable. Confirmed Anabat records onsite
- Eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) – listed as vulnerable. Identified as part of a species group; however a precautionary approach has been undertaken and this species is assumed to occur
- Eastern cave bat (*Vespadelus troughtoni*) – listed as vulnerable. Identified as part of a species group; however a precautionary approach has been undertaken and this species is assumed to occur

- Eastern false pipistrelle (*Falsistrellus tasmaniensis*) – listed as vulnerable. Identified as part of a species group; however a precautionary approach has been undertaken and this species is assumed to occur and

- Southern myotis (*Myotis macropus*) – listed as vulnerable. Identified as part of a species group; however a precautionary approach has been undertaken and this species is assumed to occur.

Consideration has also been paid to the threatened leafless tongue orchid (*Cryptostylis hunteriana*), which has been reported by WSC as being recorded in private property to the north east of the Study Area) (Pers comm. Styman 2016). This issue has been addressed in **Section 4.4.2** below.

The following species, endangered populations and TECs provided in **Table 4.1** were subject to a Seven Part Test of Significance as required under the EP&A Act. These species, endangered populations and TECs were determined based on literature reviews and database searches and their known habitats and geographic distribution (as provided in greater detail in **Appendix 1**). Species were only assessed if there was considered to be a moderate potential or higher for them to occur.

Table 4.1 Threatened Species, Endangered Flora Populations and TECs subject to Assessment under the EP&A Act

Common Name	Scientific Name	TSC Act Status
small-flower grevillea	*Grevillea parviflora* susbp. *parviflora*	V
variable midge orchid	*Genoplesium insignis*	CE
thick-lipped spider orchid	*Caladenia tessellata*	E
netted bottle brush	*Callistemon linearifolius*	V
	Corunastylis sp. Charmhaven	CE
leafless tongue orchid	*Cryptostylis hunteriana*	V
	Maundia triglochinoides	V
biconvex paperbark	*Melaleuca biconvexa*	V
heath wrinklewort	*Rutidosis heterogama*	V
Wyong sun orchid	*Thelymitra* sp. *Adorata*	CE
	Eucalyptus parramattensis subsp. *parramattensis*	EP
wallum froglet	*Crinia tinnula*	V
black bittern	*Ixobrychus flavicollis*	V
little eagle	*Hieraaetus morphnoides*	V
black falcon	*Falco subniger*	V

Common Name	Scientific Name	TSC Act Status
Australasian bittern	*Botaurus poiciloptilus*	E
varied sittella	*Daphoenositta chrysoptera*	V
glossy black cockatoo	*Calyptorhynchus lathami*	V
swift parrot	*Lathamus discolor*	E
little lorikeet	*Glossopsitta pusilla*	V
powerful owl	*Ninox strenua*	V
masked owl	*Tyto novaehollandiae*	V
barking owl	*Ninox connivens*	V
regent honeyeater	*Anthochaera phrygia*	CE
scarlet robin	*Petroica boodang*	V
flame robin	*Petroica phoenicea*	V
koala	*Phascolarctos cinereus*	V
squirrel glider	*Petaurus norfolcensis*	V
eastern pygmy possum	*Cercartetus nanus*	V
grey-headed flying fox	*Pteropus poliocephalus*	V
eastern chestnut mouse	*Pseudomys gracilicaudatus*	V
yellow-bellied sheath tailed bat	*Saccolaimus flaviventris*	V
eastern freetail-bat	*Mormopterus norfolkensis*	V
little bentwing-bat	*Miniopterus australis*	V
eastern bentwing-bat	*Miniopterus schreibersii oceanensis*	V
eastern false pipistrelle	*Falsistrellus tasmaniensis*	V
southern myotis	*Myotis macropus*	V
greater broad-nosed bat	*Scoteanax rueppellii*	V
eastern cave bat	*Vespadelus troughtoni*	V

C Critically endangered
E Endangered
EP Endangered population
EPBC Act *Environment Protection and Biodiversity Conservation Act 1999*
TSC Act *Threatened Species Conservation Act 1995*
V Vulnerable

4.4.1 Impacts to EECs

The Project will involve the removal of up to 2.0 hectares of Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions and up to 0.7 hectares of River-flat Eucalypt Forest on Coastal Floodplains for the Study Area. Both of these areas of vegetation in the Study Area were in a highly modified form as they:

- had high levels of weed infestation
- were subject to grazing which was trampling native groundcover vegetation and suppressing recruitment of canopy, sub-canopy and shrub species and
- were missing strata (particularly the River-flat Eucalypt Forest which was missing a mid-storey).

Both of these EECs are known to have other local occurrences which are in a higher condition, some of which are conserved within Warnervale Precinct 7a.

As a result of each of the above, the Seven Part Tests of Significance determined that the Project would be unlikely to have a significant impact on either of these EECs.

4.4.2 Impacts to Threatened Flora Species and Endangered Flora Populations

Of the ten threatened flora species and one endangered flora population listed under the TSC Act that were subject to a Seven Part Test of Significance (**Table 4.1**), none were identified as extant populations within the Study Area during the current survey. The Project will remove up to 20.4 hectares of sub-optimal habitat for each of these species from the Impact Area. Groundcover vegetation in the Impact Area is highly modified.

If any of these species were to occur it was considered unlikely that they would be present in large numbers due to the extent of grazing that is onsite. Based on this information, it was considered unlikely that any of these species would be significantly impacted by the Project.

4.4.2.1 Record of Leafless tongue orchid (*Cryptostylis hunteriana*)

In March 2016, Umwelt was advised by WSC Staff (Sharyn Styman, Ecologist) that three individuals of the threatened leafless tongue orchid (*Cryptostylis hunteriana*) had been recorded "on a property at the south-western corner of Warnervale Road and Virginia Road, Warnervale". This property adjoins the north eastern corner of the Study Area (**Figure 4.1**). The exact location of the records is not currently known, however they were confirmed to be within part of a residential lot as identified in **Figure 4.1**.

Umwelt has been in communication with the ecologist who recorded this orchid in the field. The record was found in "mid-February". Umwelt completed surveys specifically for this species on 15 and 16 February 2016. This is the time at which this species was flowering immediately adjacent to the Study Area, thus timing of the Umwelt surveys was ideal. A highly experienced orchid ecologist (from Umwelt) surveyed 23 kilometres worth of meandering transects in suitable habitat for this species and it was not recorded within the Study Area.

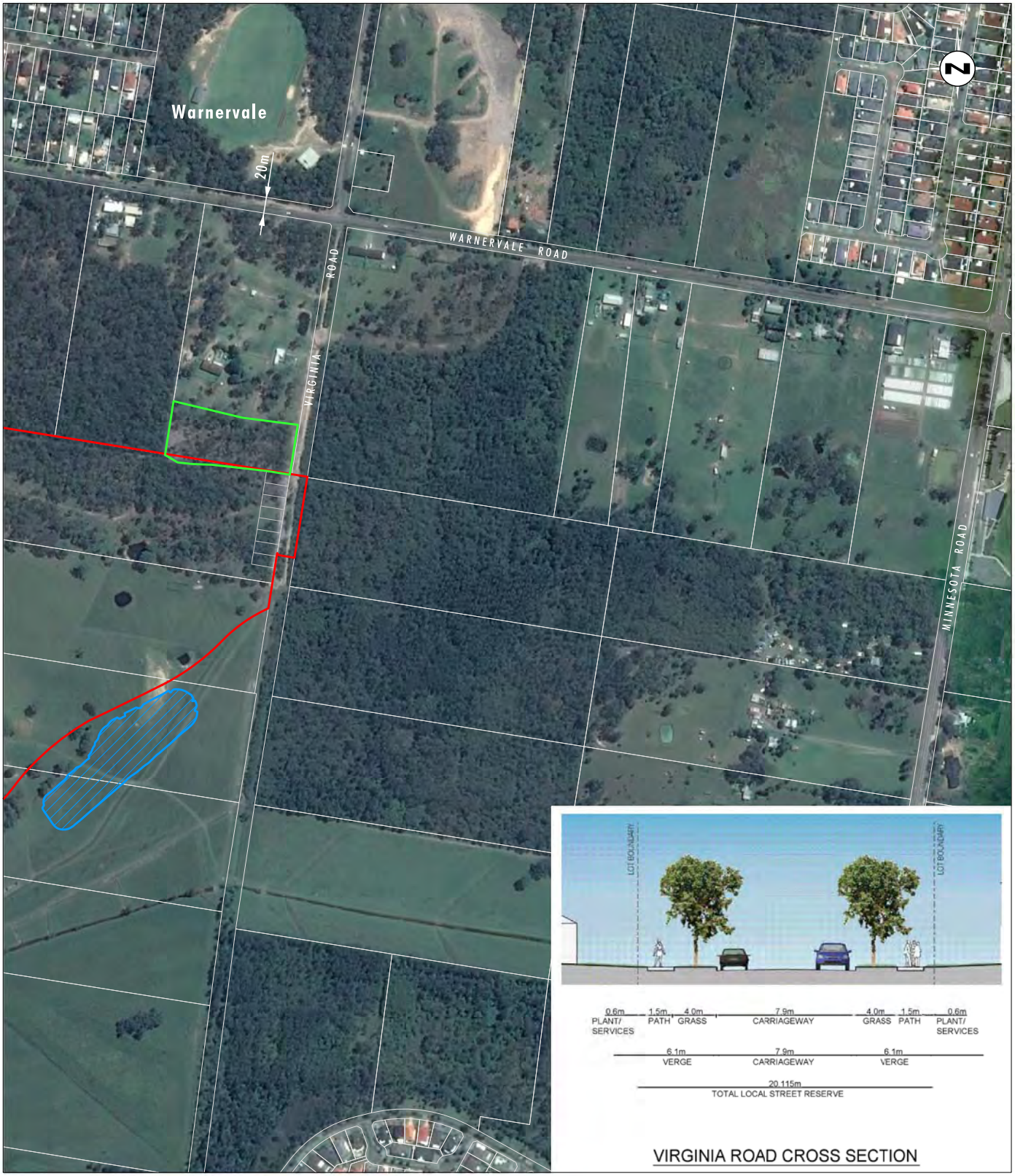

Image Source: Google Earth/CNES/Astrium (Jan/2016), ADW Johnson (2016)
Data Source: Wyong Shire Council (2010)

0 100 200 300m
1:7000

Legend

- Impact Area
- Area containing record of *Cryptostylis* prob.*hunteriana*
- Constructed Wetland

FIGURE 4.1

Location of *Cryptostylis* prob. *hunteriana* Record

The outcomes of various phone conversations with the ecologist who found this record (Mr Ian Benson of Anderson Environment and Planning (AEP)) are paraphrased below:

- the record comprised three individuals recorded in mid-February
- the records were not sent for expert identification (such as the Royal Botanic Gardens) as they were withered and in poor condition
- the identification has been based primarily on the absence of leaves on the individuals.
- AEP intend to revisit the location during the next flowering season to gain better samples and further information on this record and
- until then, AEP plan to refer to this record as *Cryptostylis* prob. *hunteriana* in any resulting documentation.

AEP have been conservative in their "Probable" identification, particularly in noting the withered condition of the specimen, rarity of the species and identifying the need for a return trip to gain more confidence in this record.

Since this time, Council has engaged ecological consulting group Biosis to resurvey this area during the appropriate flowering season for the purposes of increasing certainty around this record and were unable to locate any individuals.

Of importance to the current Project however is that this species has not been expertly identified, which is critical with threatened species such as orchids. Many threatened orchids are taxonomically very similar to other non-threatened species. Notably, two other *Cryptostylis* species have been recorded by Umwelt within the Study Area, one of which was flowering at the same time as these records.

Potential impacts from the Project to these 'probable' records have been raised by WSC as being fragmentation of pollination vectors. This species is insect pollinated, specifically by the male orchid dupe wasp (*Lissopimpla excelsa*) known to pollinate all members of this genus. While little is known about the ecological requirements of this wasp, it is assumed that native vegetated habitat is required for it to exist. It is not known what patch size or amount of habitat is required for this wasp to persist. Given the presence of other *Cryptostylis* species in the Study Area, it can be assumed that all local native vegetation would comprise habitat for this wasp.

The Project will impact vegetation within the Study Area immediately south of the known records which will remove a strip of habitat fronting Virginia Road of approximately 15 metres (width) by 120 metres (length). There is no habitat for this species further south within the Study Area. The Project will not impact habitat for pollination vectors to the north or west of these records.

Part of the Project will involve the formation of the gazetted Virginia Road, south from Warnervale Road to allow access to the eastern part of the Study Area. This road is identified as a Local Street, thus will provide for a 2.4 metre planting zone on each side. This road upgrade will comprise (as depicted in **Figure 4.1**):

- 7.9 metre wide carriageway
- 4.0 metre grassed section either side of road
- 1.5 metre pathway outside of the grassed section and
- 0.6 metre of plant/services before the lot boundary.

As such, the Project will create minor fragmentation only as a result of this road. AV Jennings has already incorporated plantings of native flowering trees (being smooth-barked apple (*Angophora costata*)) within the grassed sections of the road in order to assist in maintaining native vegetation connectivity for small insects. Similar plantings will also be incorporated into the landscaping for lots fronting the existing Virginia Road only. This will occur within the 4.5 metre front building setback of the approximately 15 metres (width) by 120 metres (length) area and will again include native flowering shrubs such as locally-sourced grevillea and callistemon. These actions will assist in keeping fragmentation as a result of the road to small traversable sections (path to grassed area) with a maximum width of 7.9 metres of road remaining.

In terms of potential cumulative impact for this species, the properties adjoining the *Cryptostylis* records are primarily R1, R2 and RE1 with some areas of E2 and E3 to the east. It is possible that these areas could be subject to development applications in the future, as is permissible within much of this zoning. It is not possible, however to pre-empt if or when such applications will be submitted, nor predict what potential impacts may result.

On assessing the loss of potential habitat for a 'probable' record of a threatened species which has not been recorded within the Study Area, and in considering the maximum fragmentation impacts will be approximately 7.9 metres of road carriageway leading to considerable habitat to the east of the Study Area, it is deemed unlikely that the Project will pose a significant impact on *Cryptostylis hunteriana*.

4.4.3 Impacts to Threatened Fauna Species

As the Study Area is only likely to provide foraging habitat or potential foraging habitat for the following as part of a wider foraging range the following species were not considered likely to be significantly impacted by the Project:

- black bittern (*Ixobrychus flavicollis*)
- little eagle (*Hieraaetus morphnoides*)
- black falcon (*Falco subniger*)
- Australasian bittern (*Botaurus poiciloptilus)*
- varied sittella (*Daphoenositta chrysoptera*)
- glossy black cockatoo (*Calyptorhynchus lathami*)
- swift parrot (*Lathamus discolor*)
- regent honeyeater (*Anthochaera phrygia*)
- little lorikeet (*Glossopsitta pusilla*)
- scarlet robin (*Petroica boodang*)
- flame robin (*Petroica phoenicea*)
- koala (*Phascolarctos cinereus*)
- grey-headed flying-fox (*Pteropus poliocephalus*) and
- eastern chestnut mouse (*Pseudomys gracilicaudatus*).

As a result of the Seven Part Tests of Significance the eastern pygmy possum (*Cercartetus nanus*) was considered unlikely to be significantly impacted as it had not been previously or currently identified in the Study Area and was subsequently considered to have a low potential for occurrence.

The wallum froglet (*Crinia tinnula*) was considered unlikely to be significantly impacted as the areas where it would occur (being the Alluvial Melaleuca Sedge Forest) are highly modified within the Study Area and would be subject to trampling by cattle. The Study Area is also adjacent (to the west) to a large tract of higher quality appropriate vegetation for this species to occur and if it was present in the Study Area would only likely be utilising the habitats present as part of a wider range.

The following micro-bats were considered unlikely to be significantly impacted as there are no appropriate cave-roosting habitats within the Study Area; and subsequently these species would only be utilising the habitats available for foraging as part of wider territories:

- little bentwing-bat (*Miniopterus australis*)
- Eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) and
- Eastern cave bat (*Vespadelus troughtoni*).

There is potential that the following threatened fauna species could be utilising the hollow-bearing trees in the Study Area; however no confirmed records of hollow use was made during surveys undertaken. If these species were utilising the hollows present they would potentially be important to locally occurring populations. However as hollow usage was not identified, impact assessment determined that the Project would be unlikely to have a significant impact on:

- yellow bellied sheathtail-bat (*Saccolaimus flaviventris*)
- Eastern freetail-bat (*Mormopterus norfolkensis*)
- Eastern false pipistrelle (*Falsistrellus tasmaniensis*)
- Southern myotis (*Myotis macropus*) and
- greater broad nosed bat (*Scoteanax rueppellii*).

The following species are hollow-dependent and have very large home ranges, and although known to occur within the local area were not identified utilising the hollows in the Study Area. As such the impact assessments determined that the Project was unlikely to have a significant impact on:

- powerful owl (*Ninox strenua*) and
- masked owl (*Tyto novaehollandiae*).

The barking owl (*Ninox connivens*) was identified in the Study Area during call playback surveys undertaken; however was not identified utilising any of the hollows present. Given the high levels of disturbance and modification in the Study Area, the habitats present are only a moderate quality for this species. There are records of the barking owl (*Ninox connivens*) within 10 kilometres of the Study Area (BioNet 2016), and given the more appropriate areas of habitat present in the local area for this species; there is only a low potential that this species would have breeding habitat in the Study Area. Given the latter, the impact assessment concluded there is a low potential that the Project would impact a local population of the barking owl (*Ninox connivens*).

The squirrel glider (*Petaurus norfolcensis*) has previously been identified in the Study Area (Umwelt 2013) and an unconfirmed record more likely to have been a sugar glider (*Petaurus breviceps*) was made during the Umwelt 2016 surveys. The vegetation in the north of the Study Area provides a potential movement corridor for this species connecting vegetation in the east and west and potential evidence of hollow usage of a single tree was evident in this area. The Project will involve nest box installation to compensate for hollow loss, as well as installation of glider poles and targeted revegetation to increase connectivity and feeding resources for this species. Based on the above, the impact assessment determined that it is unlikely that the Project would have a significant impact on a local population of the squirrel glider (*Petaurus norfolcensis*).

4.4.4 Key Threatening Processes

There are currently 38 key threatening processes (KTPs) listed under the schedules of the TSC Act, eight listed under the FM Act and 21 listed under the EPBC Act. The following key threatening processes are relevant to the potential impacts of the Project and are discussed where relevant within the Tests of Ecological Significance for individual species.

- bushrock removal (TSC Act)
- clearing of native vegetation (TSC and EPBC Act)
- loss of hollow-bearing trees (TSC Act) and
- removal of dead wood and dead trees (TSC Act).

Key to this Project is clearing of native vegetation (20.4 ha) and loss of hollow-bearing trees (90 recorded hollows within the Impact Area). This issue has been addressed in terms of mitigation in **Section 6.0**.

4.4.5 Critical Habitats

There are four areas of critical habitat currently registered under the TSC Act. None of these areas occur in the Study Area or in areas near to the Study Area.

The Project will not impact on any areas of declared critical habitat.

5.0 Matters of National Environmental Significance

Under the Commonwealth EPBC Act, the approval of the Commonwealth Minister for the Environment is required for any action that may have a significant impact on matters of national environmental significance (MNES). These matters are:

- listed threatened species and ecological communities
- migratory species protected under international agreements
- Ramsar wetlands of international importance
- the Commonwealth marine environment
- World Heritage properties
- National Heritage places
- Great Barrier Reef Marine Park
- nuclear actions and
- water resources.

The EPBC Act lists criteria which are used to determine whether an action is likely to have a significant impact on MNES. The only MNES considered to have potential to be impacted by the Project were threatened and migratory species. No other MNES were considered likely to be impacted by the Project.

The only MNES identified in the Study Area during the current study was the migratory species cattle egret (*Ardea ibis*); this species was identified in conjunction with grazing cattle in Disturbed Grassland vegetation.

Although the heath wrinklewort (*Rutidosis heterogama*) has previously been identified in the Study Area (two individual records), these records or other records of this species were not identified during the current survey and it has been assumed that this species is no longer extant on site due to the cattle grazing that is taking place and likely suppressing this species.

The following threatened and migratory species (**Table 5.1**) were subject to an Assessment of Significance as required under the EPBC Act. These threatened species and migratory species were determined based on literature reviews and database searches and their known habitats and geographic distribution (as provided in greater detail in **Appendix 1**). Species were only assessed if there was considered to be a moderate potential or higher for them to occur.

Table 5.1 Threatened and Migratory Species subject to Assessment under the EPBC Act

Common Name	Scientific Name	EPBC Act Status
small-flower grevillea	*Grevillea parviflora* susbp. *parviflora*	V
variable midge orchid	*Genoplesium insignis*	CE
thick-lipped spider orchid	*Caladenia tessellata*	V
	Corunastylis sp. Charmhaven	CE
leafless tongue orchid	*Cryptostylis hunteriana*	V
heath wrinklewort	*Rutidosis heterogama*	V
Wyong sun orchid	*Thelymitra* sp. *Adorata*	CE
Australasian bittern	*Botaurus poiciloptilus*	E
swift parrot	*Lathamus discolor*	E
regent honeyeater	*Anthochaera phrygia*	CE
koala	*Phascolarctos cinereus*	V
grey-headed flying fox	*Pteropus poliocephalus*	V
fork-tailed swift	*Apus pacificus*	MIG
oriental cuckoo	*Cuculus optatus*	MIG
white-throated needletail	*Hirundapus caudatus*	MIG
great egret	*Ardea alba*	MIG
Japanese snipe	*Galliango hardwickii*	MIG
osprey	*Pandion haliaetus*	MIG
black-faced monarch	*Monarcha melanopsis*	MIG
spectacled monarch	*Monarcha trivirgata*	MIG
satin flycatcher	*Myagria cyanoleuca*	MIG
rufous fantail	*Rhipidura albifrons*	MIG

C Critically endangered
E Endangered
EP Endangered population
EPBC Act *Environment Protection and Biodiversity Conservation Act 1999*
MIG Migratory
TSC Act *Threatened Species Conservation Act 1995*
V Vulnerable

This assessment determined that the Project would be unlikely to have significant ecological impacts on any of the threatened or migratory species listed under the EPBC Act.

This is primarily the result of the disturbed nature of the habitats present and ongoing grazing practices of the site, as well as higher quality habitats available for these species in the local area.

5.1 Impacts to SEPP 14 Wetlands

Adjacent SEPP 14 Wetlands will not be impacted as a result of the Project, all bunds and sediment basins constructed within the Study Area will be located around this feature, leaving an appropriate buffer so that impacts do not occur.

6.0 Management and Mitigation

A Vegetation Management Plan (VMP) has been requested for the Project in order to define the post-approval management commitments relative to the Study Area, particularly for the Park Area which will be retained within the post-development landscape. This VMP is intended to show how the proposed management and mitigation measures for this Project complement those within the Conservation Management Plan (CMP) (Umwelt 2014) prepared for the Precinct 7A Ecological Assessment (Umwelt 2013). That CMP provides a number of management commitments required for development within Precinct 7A (which the Study Area is a part of), and these actions are funded through an existing Contributions Plan. As such, the CMP provides for funded management actions aimed at compensating (in part) for the impacts derived from the development of Precinct 7A according to its current zoning.

The broad commitments of the VMP document are outlined in the sections below.

Details of the management actions required under the CMP, which AV Jennings have committed to are detailed in the sections below. In addition to this, AV Jennings has proposed a number of other management actions to address residual impacts from the development of the Study Area. These are considered to be additional to those required under the CMP, and are detailed in **Section 6.2**.

6.1 Requirements from Conservation Management Plan

6.1.1 Habitat and Native Vegetation Retention

Where possible, the retention of trees and habitat will be incorporated within the final landscape design. This will include preferential retention of hollow-bearing trees to retain as many of these as possible within the post-development landscape.

6.1.2 Revegetation Works

Revegetation works are currently committed to under the CMP. While this process is being managed by WSC (and funded through a Contributions Plan) it is understood that it is planned to revegetate the floodplain which runs through Precinct 7A mainly to the south of the Study Area. These works will address future habitat and connectivity loss (in the north) and will aim to restore floristic structure and diversity (where possible) to those vegetation communities previously present in that part of the Precinct. Where suitable, this composition will also target inclusion of key feed species for target threatened species (such as threatened gliders). AV Jennings will work with WSC to further define and plan these works.

6.1.3 Hollow-Replacement

All hollows removed during the clearing process will be replaced at a ratio of 1:1 with salvaged hollows or nest boxes in order to ensure no net loss of hollow resources within Precinct 7a. Hollows and nest boxes will be installed in secure habitats of the AV Jennings lands surrounding the Study Area that are proposed for transfer to WSC ownership, will be installed by suitably qualified ecologists and according to the Habisure system or similar.

Priority will be paid to the salvage and reinstatement of small to medium hollows as these sizes tend to be more durable and able to be handled, modified and reinstalled effectively. Larger hollows tend to be more fragile and much harder to handle in the reinstallation process. Hollows to be salvaged will be identified during the felling process. They will be salvaged with use of a chainsaw, capped with marine grade plywood (or similar) and will be reinstalled in suitably mature trees able to safely hold the hollow.

Nest boxes installed will be commensurate with the range of hollows being removed from the Study Area (i.e. large hollows will be replaced with specifically designed owl boxes, medium hollows will be replaced with possum/glider boxes etc). Nest box designs will follow those of industry best practice and materials used will be marine grade thick plywood designed for durability.

All salvaged hollow and nest box installation works will target areas within Precinct 7A which are lacking in hollow resources. Host trees will be mature enough to support hollows/boxes without sustaining damage. Hollows/boxes will be placed at recommended heights and aspects for the target species.

A monitoring program will be set up also, which will monitor the condition and content of these installed hollows/boxes for six monthly periods for at least three years (as recommended by WSC). This will ensure the boxes remain in place and structurally functional for this period, do not contain insect nests (such as wasps and bees) and are monitored for their efficacy.

6.1.4 Plantings and Landscaping

Where street trees and landscaping are planned as part of the Project design, these will include some native trees known from the Wyong LGA and including some known feed tree species for locally threatened species (particularly the squirrel glider (*Petaurus norfolcensis*)).

6.1.5 Pre-Clearing Surveys

Appropriate pre-clearing surveys will be completed in all areas subject to development in order to identify significant ecological features and make reasonable attempts to minimise impact. This process will also identify those features suitable to be salvaged and reused. Significant ecological features may include:

- threatened species or endangered populations
- hollow-bearing trees and hollows suitable for salvage
- other habitat trees
- vegetation containing significant seed resources (such as fruiting Acacia or Allocasuarina species that can be used as an endemic seed resource)
- hollow logs and stumps
- fallen timber
- farm dams and
- boulders.

Where feasible, these features should be salvaged and relocated in conservation lands defined within Precinct 7a.

6.1.6 Tree-felling Process

Where felling of habitat trees is deemed as necessary, a comprehensive tree-felling procedure will be implemented (in accordance with the CMP). This will ensure that:

- all habitat features present have been identified
- only necessary trees will be removed
- habitat trees will be removed during a time of year which minimises potential risk to inhabitants
- habitat trees removed are felled in a manner which minimises potential harm to inhabitants
- once felled habitat trees are inspected and any potentially injured inhabitants are captured and receive proper veterinary care or are relocated to nearby areas of appropriate habitat and
- trees with appropriate hollows will be identified for salvage and re-installation.

6.1.7 Weed Management and Feral Animal Control

Noxious weed management and feral animal control works are currently committed to under the CMP and this process is understood to be being managed by WSC (and funded through a Contributions Plan). Weed management works within the Study Area will aim to limit the current extent of noxious weeds and to limit the spread and colonisation of existing or new noxious weeds. The program will focus on blackberry (*Rubus fruticosus*) and lantana (*Lantana camara*), both of which are declared noxious weeds and have been recorded in the Study Area.

6.1.8 General Management Requirements

The following will be undertaken in accordance with the VMP (Umwelt in prep):

- management of key threatening processes
- facilitation of community stewardship, education and reporting – understood to be being managed by WSC under the CMP and funded as part of the Contributions Plan
- management of public access, fencing and signage – understood to be being managed by WSC under the CMP and funded as part of the Contributions Plan
- management of Aboriginal cultural values
- management of rubbish dumping and other prohibited uses
- bushfire and stormwater management
- habitat retention and enhancement and
- ecological monitoring.

6.2 Additional Mitigation Commitments outside of Conservation Management Plan

6.2.1 Squirrel Glider Poles

It has been identified that fragmentation of the northern vegetation remnant (in particular) may impact east/west connectivity for the threatened squirrel glider (*Petaurus norfolcensis*). This species has been identified in the local area, within the Study Area during previous surveys (LesryK Environmental Consultants 2000) and an unidentified Petaurid was recorded in a hollow in the northern remnant during the current surveys.

Existing commitments as part of the CMP will return hollows lost as a result of the Project at a ratio of 1:1. This will ensure no net loss of hollows for this species, as all returned hollows/nest boxes will be of the same size classes and species –specific design as those lost. In order to address fragmentation as a result of the Project, it is proposed to install glider poles (or structures with similar proven effect, such as fauna overpasses/rope bridges) in select locations to compensate for connectivity losses. Strategic locations for such structures will be negotiated with WSC, particularly focusing on those floodplain areas to be revegetated as part of the CMP. Establishing connectivity in such regeneration areas has the potential to restore connectivity in the south of the Study Area, from vegetation to the east of the Study Area into the habitats of the Porters Creek wetland.

It is currently planned that these structures be installed prior to impact so that connectivity is limited for as brief a time as possible, however the timing will be defined upon consultation with WSC as part of the larger CMP revegetation project.

6.2.2 Additional Revegetation Works (Not Applicable to Stage 1)

The requirements of the CMP already allow for a substantial floodplain revegetation program, which is funded by a Contributions Plan to which AV Jennings is a contributor. This Project will assist in restoring native habitat and connectivity disruption which has occurred as a result of historic clearing and land management practices.

In addition to the floodplain revegetation works, AV Jennings propose to revegetate the part of the RU6 zoned land excised from the Study Area (**Figure 1.2**). This will provide a valuable link from current vegetation in the north east and east of the Study Area in a south westerly direction into the future floodplain revegetation works. All revegetation works will be compatible to those being completed on the floodplain, and will target the restoration of floristic structure and diversity (where possible) of those vegetation communities previously present in that part of the Study Area. Where suitable, this composition will also target inclusion of key feed species for target threatened species (such as threatened gliders).

It is proposed to commence these revegetation works as soon as possible in the early stages of the Project as this will greatly assist in reducing lag time between habitat loss and regeneration reaching sufficient maturity to provide compensatory habitat.

AV Jennings will also work with WSC to identify future revegetation opportunities outside those planned under the CMP. This may include areas of AV Jennings land that are proposed for transfer to WSC ownership that are identified in the CMP as Integrated Water Cycle Management (IWCM) areas that are not needed for future use, or other strategic areas for connectivity restoration.

7.0 Conclusion

Key ecological features identified in the Study Area either as part of the current study or during previous surveys of the area included:

- Swamp Sclerophyll Forest EEC (TSC Act)
- River Flat Eucalypt Forest EEC (TSC Act)
- barking owl (*Ninox connivens*) (vulnerable TSC Act) foraging habitat and potential habitat for the powerful owl (*Ninox* strenua) and masked owl (*Tyto novaehollandiae*) (hollow-bearing trees were inspected and were not confirmed as being utilised by any of these species)
- black falcon (*Falco subniger*) (vulnerable TSC Act) foraging habitat; however no nests were identified
- unconfirmed current squirrel glider (*Petaurus norfolcensis*) habitat and
- known threatened micro-bat habitats (although no roosts were identified).

A number of mitigation and management have been committed to as part of the CMP for Precinct 7A (Umwelt 2013) and these will result in the following outcomes:

- no net loss of hollows, achieved through salvage of existing hollows and nest boxes
- detailed pre-clearing and tree felling process designed to minimise impact to flora and fauna as much as possible
- floodplain restoration works to return native vegetation communities and connectivity
- plantings and landscaping to use locally indigenous species
- weed and feral animal management and
- other general management strategies.

In addition to these works, this Project commits to further mitigation and management measures to further reduce potential impacts, including:

- installation of fauna movement structures targeted at restoring or maintaining connectivity specifically for the squirrel glider (*Petaurus norfolcensis*) and
- additional revegetation of strategic linkages outside of the floodplain works to further enhance connectivity throughout the Study Area.

These additional measures have been designed to further minimise the low potential that the Project could impact local populations of:

- barking owl (*Ninox connivens*) and
- squirrel glider (*Petaurus norfolcensis*).

In implementing the above commitments, it is unlikely that the Project would result in a significant impact to the above species, or other occurring or potentially occurring threatened or migratory species, endangered population or TECs.

As such, neither a Referral for the Project under the EPBC Act or a Species Impact Assessment (TSC Act) is considered necessary.

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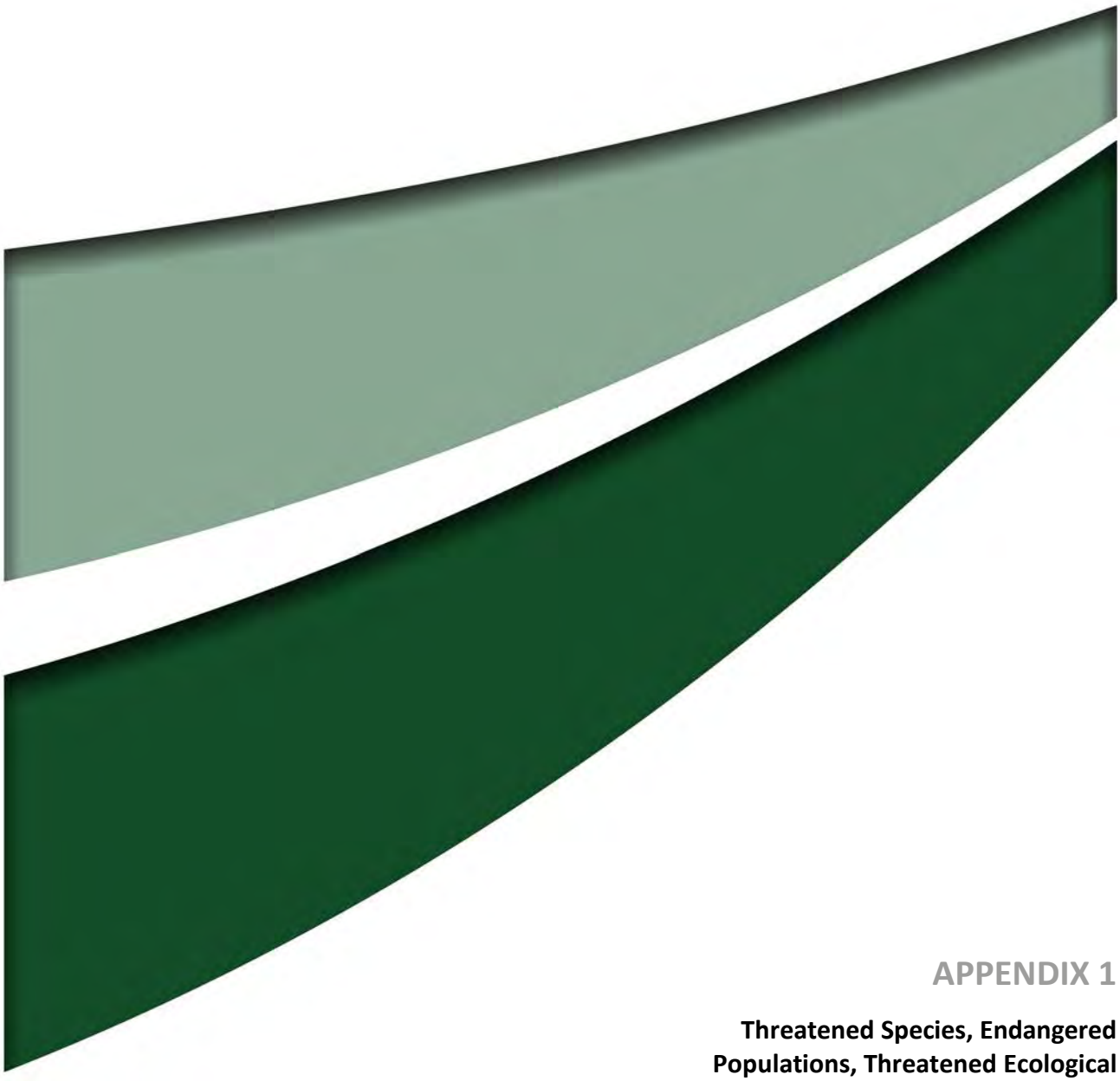

APPENDIX 1

Threatened Species, Endangered Populations, Threatened Ecological Communities and Migratory Species with Potential to Occur in the Study Area

Appendix 1 – Threatened and Migratory Species, Endangered Populations and Threatened Ecological Communities with Potential to Occur in the Study Area

Threatened and migratory species, endangered populations, and threatened ecological communities (TECs) identified as having potential to occur within the Study Area are listed in Tables 1 and 2 below. These tables include the results of the searches of the OEH Atlas of NSW Wildlife Database and DotE Protected Matters Database for a 10 kilometre radius of the Study Area, as well as results of literature review and professional opinion.

Tables A1.1 and **A1.2** contain the relevant ecological details of each listing (including their habitat requirements, known range and reservation within conservation reserves within the region), as well as an assessment as to whether there may be the potential for impact as a result of the project. Purely marine, aquatic or pelagic species have been omitted, due to a lack of potential habitat within the Study Area. For the purposes of these tables, the 'region' is broadly defined as the central coast region.

Information on threatened species was sourced from the OEH web site, Threatened Species Profiles (OEH 2016b). Additional references are cited where required.

Table A1.1 Threatened Flora Species, Endangered Flora Populations and TECS Known or with Potential to Occur

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
THREATENED FLORA SPECIES						
Bynoes wattle *Acacia bynoeana*	E (TSC) V (EPBC) 3VC (ROTAP)	Occurs in heath or dry sclerophyll forest on sandy soils. Often prefers open, sometimes slightly disturbed sites such as track margins, edges of roadside spoil mounds and in recently burnt patches.	This species has been found in central eastern NSW, from the lower Hunter district south to the Southern Highlands and west to the Blue Mountains. It has recently been found in the Colymea and Parma Creek areas west of Nowra. Generally occurs south from Freemans Waterhole, western Lake Macquarie, but is also known to occur as far west as Ellalong, near Cessnock.	Jilliby SCA Olney SF Wyong SF Yengo NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
downy wattle *Acacia pubescens*	V (TSC) V (EPBC) 3VCa (ROTAP)	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, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
tiny mosquito orchid *Acianthus exiguus*	3RC- (ROTAP)	This orchid grows in areas of moist, tall sclerophyll forest and littoral rainforest (Botanic Gardens Trust 2016b).	This orchid is known from the North Coast botanical subdivision. It is uncommon to rare throughout this area and is only found along coastal east areas. Records exist from as far North as Wardell to as far south as the Sydney area (Botanic Gardens Trust 2016b).	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Ancistrachne maidenii	V (TSC) 2KC (ROTAP)	Habitat requirements appear to be specific, with populations occurring in distinct bands in areas associated with a transitional geology between Hawkesbury and Watagan soil landscapes.	Restricted to northern Sydney, around St Albans - Mt White - Maroota - Berowra areas and to the Shannon Creek area south-west of Grafton.	Brisbane Water NP Dharug NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Charmhaven apple *Angophora inopina*	V (TSC) V (EPBC), 2R (ROTAP)	This species typically occurs on the shallow sandy soils of the Narrabeen Group, on exposed ridges and slopes with westerly or northerly aspect. It has also been recorded on shallow alluvial soils of this geological type, in upper catchments and in embedded clay soil lenses with sandstone. This species is known to naturally hybridise with rough-barked apple (*A. floribunda*), particularly around major drainage lines.	This species has a restricted distribution, being confined to the Wyong, Lake Macquarie, Port Stephens and Great Lakes LGAs of NSW. Pure forms of this species have been recorded from the Wallarah catchment in the south and north to the Toronto area. Disjunct populations have been identified at Karuah and south of Bulahdelah.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Apatophyllum constablei	E (EPBC) 2EC- (ROTAP)	Occurs in dry sclerophyll forest on slopes with a north to north-westerly aspect. It typically grows near cliffs (i.e. near the base or just above). The soils at sites are sandy and skeletal, mostly on Narrabeen sandstone.	Previously known from four sites, three of which are within Wollemi National Park near Gospers Mountain and Coorongooba Creek, the fourth of which is about 2 kilometres from Glen Davis.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Asterolasia elegans	E (TSC) E (EPBC) 2ECa (ROTAP)	This species occurs on Hawkesbury sandstone on the mid to lower slopes of valleys within sheltered forests. This species is typically associated with turpentine (*Syncarpia glomulifera* subsp. *glomulifera*), smooth-barked apple (*Angophora costata*), Sydney Peppermint (*Eucalyptus piperita*), forest oak (*Allocasuarina torulosa*) and Christmas bush (*Ceratopetalum gummiferum*).	This species is known to the Baulkham Hills, Hawkesbury and Hornsby LGAs and is predicted to occur in the Gosford LGA. Only six populations of this species are known, all of which are within either the Colo or Hawkesbury River Catchment. Only one of the known populations of this species occurs within a conservation reserve.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
thick-leaf star-hair *Astrotricha crassifolia*	V (TSC) V (EPBC) 2VC (ROTAP)	Occurs in dry sclerophyll woodland on sandstone.	Occurs near Patonga (Gosford LGA), and in Royal NP and on the Woronora Plateau (Sutherland and Campbelltown LGAs). There is also a record from near Glen Davis (Lithgow LGA). Also in Victoria.	Brisbane Water NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
dense cord-rush *Baloskion longipes*	V (TSC) V (EPBC) 3VC (ROTAP)	Commonly found in swamps or depressions in sandy alluvium, sometimes growing with sphagnum moss. Also occurs in swails within tall forest, and in Black Gum (*Eucalyptus aggregata*) Woodland.	Dense cord-rush has been recorded from the Kanangra-Boyd area to the Southern Tablelands but all populations are small. Populations have been recorded in Blue Mountains NP, Kanangra-Boyd NP, Penrose State Forest (in Hanging Rock Swamp), Morton NP (The Vines), the Clyde Mountain area and Ballalaba (south of Braidwood).	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Caladenia curtisepala	2KC- (ROTAP)	This species is restricted to dry sclerophyll forests on Hawkesbury Sandstone (Botanic Gardens Trust 2016b).	In NSW this orchid is restricted to Hawkesbury sandstone in the Central Coast botanical subdivision (although records have also been made from Victoria).	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Caladenia porphyrea	E (TSC) 2KC (ROTAP)	Grows in coastal areas. Observed in semi-shaded area (under *Melaleuca nodosa* for example). However, it has also been observed in altered headland vegetation adjacent to littoral rainforest.	In NSW, *Caladenia porphyrea* has a highly restricted geographic distribution. It has been recorded from two localities in the Wyong LGA (near Norah Head) and possibly also at Warnervale more recently.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
thick-lip spider orchid *Caladenia tessellata*	E (TSC) V (EPBC) 3V (ROTAP)	Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil.	Known to occur in the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. It was also recorded in the Huskisson area in the 1930s. The species occurs on the coast in Victoria from east of Melbourne to almost the NSW border. Known locally from Munmorah SRA, Soldiers Beach, Norah Head, Wyrrabalong NP, Wyong and Porters Creek Wetland (Wyong Ground Orchid Survey 2003).	Munmorah SCA Popran NP	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
netted bottle brush *Callistemon linearifolius*	V (TSC) 2RCi (ROTAP)	The species typically grows in dry sclerophyll forest on the coast and adjacent ranges (this includes Apple Palm-Gully Forest (Unit 39) of NPWS 2000 near Catherine Hill Bay).	Occurs chiefly from the Georges River to the Hawkesbury River.	Bouddi NP Brisbane Water NP Munmorah SCA	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the Project.	Yes
golden bearded form *Calochilus robertsonii*	uncommon form locally significant	This orchid grows in heath sclerophyll forests and scrubland (Botanic Gardens Trust 2016b).	This species is widespread; however this golden bearded form is locally significant in the Central Coast area. It is known to the coastal districts of NSW to as far west as Condobolin (PlantNET 2010). This species is also found in Queensland, Victoria, Tasmania, Western Australia, South Australia and the Northern Territory (Botanic Gardens Trust 2016b).	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
sand spurge *Chamaesyce psammogeton*	E (TSC)	Grows on fore-dunes and exposed headlands, often with spinifex (*Spinifex sericeus*).	Sand spurge is found sparsely along the coast from south of Jervis Bay (at Currarong, Culburra and Seven Mile Beach NP) to Queensland (and Lord Howe Island). Populations have been recorded in Wamberal Lagoon NR, Myall Lakes NP and Bundjalung NP.	Bouddi NP Bateau Bay FR Wamberal Lagoon NR	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Corunstylis sp. Charmhaven	CE (TSC) CE (EPBC)	This species typically grows in low woodland to heathland with a shrubby understorey and ground layer. It typically grows in association with black she-oak (*Allocasuarina littoralis*), prickly tea-tree (*Leptospermum juniperinum*), prickly-leaved paperbark (*Melaleuca nodosa*), narrow-leaved bottlebrush (*Callistemon linearis*) and Zig-zag Bog-rush (*Schoenus brevifolius*).	Corunastylis sp. Charmhaven is currently only known from the Wyong Shire of NSW where it is restricted to a single location in the Gorokan/Charmhaven area.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
red helmet orchid *Corybas dowlingii*	E (TSC)	This species typically grows in gullies of tall open forest on well-drained gravelly soil at elevations between 10 and 200 metres.	This species is restricted to NSW in distribution, and is known from the areas of Port Stephens, Bulahdelah and Freemans Waterhole. They have a highly restricted known extent of occurrence of less than 1,000 km².	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
leafless tongue orchid *Cryptostylis hunteriana*	V (TSC) V (EPBC) 3VC (ROTAP)	This species may favour moist soils on the flat coastal plains. However, there are few records on the Central Coast and at least one of these is on a broad crest in a dry woodland, whilst others are from dry sclerophyll forests/woodlands in the north of Wyong LGA. Occupies swamp heath, but also in sclerophyll forest and woodland, often on sandy soils. Typically found in communities containing *Eucalyptus haemastoma, E. capitellata* and *Corymbia gummifera*.	This species is known to occur in the Karuah Manning and Wyong CMA sub-regions in the Hunter Central Rivers region. Several probable *Cryptostylis hunteriana* records have been identified on a property at the south-western corner of Warnervale Road and Virginia Road, Warnervale (Pers comm. Styman 2016). This property adjoins the north eastern corner of the Study Area.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
white-flowered wax-plant *Cynanchum elegans*	E (TSC) E (EPBC) 3ECi (ROTAP)	This species occurs on soils with varying levels of fertility and lithology, usually on steeper slopes. It varies in altitude between approximately sea level and 600 metres above. It is typically found in habitats that have hot-humid summers with high rainfall and cool winters with low rainfall.	The distribution of this plant is restricted from Wollongong in NSW through to the south-east of QLD and as far west as Mt Dangar. This species is most common in the Kempsey region.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Darwinia biflora	V (TSC) V (EPBC) 2VCa (ROTAP)	This species occurs on intergrade habitats between weathered shale-capped ridges and Hawkesbury sandstone. It is usually found in either woodland, open forest or scrub-heath and is typically associated with *Eucalyptus haemastoma, Corymbia gummifera* and/or *Eucalyptus squamosa.*	This species is located in the Baulkham Hills, Hornsby, Ku-ring-gai and Ryde LGAs. All known locations are located in the north and north-western suburbs of Sydney.	Popran NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Darwinia glaucophylla	V (TSC) 2RCi (ROTAP)	Occurs in sandy heath, scrub and woodlands often associated with sandstone rock platforms or near hanging swamps and friable sandstone shallow soils.	Occurs between Gosford and the Hawkesbury River around Calga, Kariong and Mt Ku-ring-gai. Known from approximately 15 sites, several within or near to Brisbane Waters NP and one within Popran NP. Occurs entirely within the Gosford LGA of the Sydney Basin Bioregion.	Brisbane Waters NP (D Tierney, pers. obs.)	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Darwinia peduncularis	E (TSC) 3RCi (ROTAP)	This species is typically identified on or in proximity to rocky outcrops located on nutrient poor-sand soils.	This species is distributed across the NSW coast and has been recorded from the following locations: Bargo River, Berowra, Brooklyn, Galston Gorge, Glen Davis, Kings Tableland and Mount Boonbourwa. Although mostly coastal, several isolated populations have been identified in the Blue Mountains.	Olney SF	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
spider orchid *Dendrobium melaleucaphilum*	E (TSC)	Grows frequently on *Melaleuca styphelioides*, less commonly on rainforest trees or on rocks in coastal districts. Flowers July–October.	Occurs in coastal districts and nearby ranges, extending from Queensland to its southern distributional limit in the lower Blue Mountains. In NSW, it is currently known from seven recent collections. There has been no subsequent confirmation from the locations of three earlier (pre-1922) collections and it is possible that these are now extinct.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Diuris bracteata	E (TSC) EX (EPBC) 1X (ROTAP)	*Diuris bracteata* is now known from 15 sites currently considered likely to constitute 7 populations from Kulnura to Mangrove Mountain. It occurs in derived grasslands and some dry sclerophyll woodlands (Tierney & Tierney 2010).	*Diuris bracteata* was known only from the original collection near Gladesville, made before 1889. The absence of recent records meant *Diuris bracteata* was listed as Species presumed extinct on Part 4 of Schedule 1 of the Threatened Species Conservation Act. Since 1998 specimens from the Sydney Basin Bioregion have been confirmed as *Diuris bracteata*.	Brisbane Water NP	This species has not been recorded within the Study Area, despite multiple surveys over a number of years. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
rough double tail *Diuris praecox*	V (TSC) V (EPBC) 2VC (ROTAP)	On the Central Coast the species is known from coastal headlands and upslopes, typically in *Themeda* grasslands or open habitat within woodland or heath often on Munmorah claystone/Doyalson soil landscape.	Occurs between Ourimbah and Nelson Bay.	Munmorah SCA Wyrrabalong NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Epacris purpurascens var. purpurascens	V (TSC)	Found in a range of habitat types, most of which have a strong shale soil influence.	Recorded from Gosford in the north, to Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
heart-leaved stringybark *Eucalyptus camfieldii*	V(TSC) V (EPBC) 2VCi (ROTAP)	Occurs in poor coastal country in shallow sandy soils overlying Hawkesbury sandstone and 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. Associated species frequently include stunted species of *E. oblonga* (narrow-leaved stringybark), *E. capitellata* (brown stringybark) and *E. haemastoma* (scribbly gum).	Restricted distribution in a narrow band with the most northerly records in the Raymond Terrace Area south to Waterfall. Localised and scattered distribution includes sites at Norah Head (Tuggerah Lakes), Peats Ridge, Mt Colah, Elvina Bay Trail (West Head), Terrey Hills, Killara, North Head, Menai, Wattamolla and a few other sites in Royal NP.	Brisbane Water NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
slaty red gum *Eucalyptus glaucina*	V (TSC) V (EPBC) 3VCa (ROTAP)	This species grows in grassy woodland and dry eucalypt forest on deep, moderately fertile and well-watered soils.	Found only on the North Coast of NSW and in separate districts: near Casino (where it can be locally common) and further south, from Taree to Broke, west of Maitland. Scattered occurrences around Singleton.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Pokolbin mallee *Eucalyptus pumila*	V (TSC) V (EPBC) 2VCi (ROTAP)	The single known population occupies north-west-facing slopes derived from sandstone.	Currently known only from a few small populations west of Pokolbin in the Hunter Valley. Historical records also exist for Wyong and Sandy Hollow, however, has not been recorded recently in these areas.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
variable midge orchid *Genoplesium insignis*	CE (TSC) CE (EPBC)	Grows in patches of kangaroo grass (*Themeda australis*) amongst shrubs and sedges in heathland and forest.	Recorded from four localities between Chain Valley Bay and Wyong in Wyong LGA.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
small-flower grevillea *Grevillea parviflora* subsp. *parviflora*	V (TSC) V (EPBC)	Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest and a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Often occurs in open, slightly disturbed sites such as along tracks.	Sporadically distributed throughout the Sydney Basin mainly occurring around Picton, Appin, Bargo and possibly Moss Vale, as well as in the north from Putty to Wyong, Lake Macquarie, Cessnock and Kurri Kurri in the lower Hunter.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the Project.	Yes
Grevillea parviflora subsp. *supplicans*	E (TSC)	This species occurs in heathy woodland associations on skeletal sandy soils over massive sandstones .	NW of Sydney near Arcadia and the Maroota-Marramarra Creek area, in Hornsby and Baulkham Hills local government areas.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Grevillea shiressii	V (TSC) V (EPBC) 2VCit (ROTAP)	Grows along creek banks in wet sclerophyll forest with a moist understorey in alluvial sandy or loamy soils.	Known only from two populations near Gosford, on tributaries of the lower Hawkesbury River north of Sydney (Mooney Mooney Creek and Mullet Creek). Both populations occur within the Gosford LGA.	Brisbane Water NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
spreading guinea flower *Hibbertia procumbens*	E (TSC)	Majority of known populations occur within Banksia ericifolia–Angophora hispida–Allocasuarina distyla scrub/heath on skeletal sandy soils. May also be found associated with 'hanging swamp' vegetation communities on sandy deposits.	Within NSW, known from several locations only on the Central Coast in the Gosford and Wyong LGAs. These populations are at Bumble Hill near Yarramalong in Wyong LGA; Kulnura, Strickland State Forest, Mangrove Mountain, Somersby, Calga/Mt White and Peats Ridge in the Gosford LGA; and near Mogo Creek to the west of Mangrove Creek Dam.	Brisbane Water NP Popran NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Hibbertia puberula	E (TSC)	This plant is typically associated with sandy soils, usually derived from sandstones.	This species has not been recorded in over 40 years. The last known records were from around the areas of the: Blue Mountains, French's Forest, Hackling River, Hawkesbury River and South Coogee.	Popran NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Kunzea rupestris	V (TSC) V (EPBC) 2VCa (ROTAP)	*Kunzea rupestris* grows on large flat stone outcrops, and is typically found in short to tall shrubland or heathland.	This species has a highly restricted distribution. Most of the known populations are confined within the Maroota - Sackville -Glenorie area; however there is one outlier known to the Ku-ring-gai Chase National Park. All of the known records are confined to the Central Coast Botanical Subdivision of NSW.	The species occurs in Ku-ring-gai Chase NP and Marra Marra NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

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Lasiopetalum joyceae	V (TSC) V (EPBC) 2RC (ROTAP)	Grows in heath on sandstone.	Has a restricted range occurring on lateritic to shale covered ridgetops on the Hornsby Plateau south of the Hawkesbury River. It is currently known from 34 sites between Berrilee and Duffys Forest.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Leucopogon fletcheri subsp. *fletcheri*	E (TSC) 2RC (ROTAP)	Occurs in dry eucalypt woodland or in shrubland on clayey lateritic soils, generally on flat to gently sloping terrain along ridges and spurs. This threatened species flowers between August and September and fruits in October.	Restricted to north-western Sydney between St Albans in the north and Annangrove in the south, within the local government areas of Hawkesbury, Baulkham Hills and Blue Mountains.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

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Frasers screw fern *Lindsaea fraseri*	E (TSC)	This fern grows on poorly drained and infertile soils in swamp forests or open eucalypt forest, usually as part of a ferny understorey.	This fern is only known to two areas in NSW; one is near Hastings Point on the Tweed Coast and the other is near the Pillar Valley east of Grafton. It can also be found in the far north and south-east Queensland.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Maundia triglochinoides	V (TSC)	Grows in swamps, creeks or shallow freshwater 30-60 centimetres deep on heavy clay, low nutrients. This species is typically associated with wetland species such as water ribbons (*Triglochin procerum*) and flowers between November and January.	Restricted to coastal NSW and extending into southern Queensland. The current southern limit is Wyong; former sites around Sydney are now extinct.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the Project.	Yes

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biconvex paperbark *Melaleuca biconvexa*	V (TSC) V (EPBC)	Biconvex paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	Scattered and dispersed populations of this species are known to occur in the Karuah Manning and Wyong sub-regions of the Hunter/Central Rivers Catchment	Bouddi NP Wyrrabalong NP	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the Project.	Yes
Deanes Paperbark *Melaleuca deanei*	V (TSC) V (EPBC) 3RC- (ROTAP)	The species grows in heath on sandstone.	Deanes paperbark occurs in two distinct areas, in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas respectively. There are also more isolated occurrences at Springwood (in the Blue Mountains), Wollemi NP, Yalwal (west of Nowra) and Central Coast (Hawkesbury River) areas.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Groves paperbark *Melaleuca groveana*	V (TSC) 3RC- (ROTAP)	Groves paperbark grows in heath and shrubland, often in exposed sites, at high elevations, on rocky outcrops and cliffs. It also occurs in dry woodlands.	Widespread, scattered populations in coastal districts north of Port Stephens to southeast Queensland.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Micromyrtus blakelyi	V (TSC) V (EPBC) 2VCi (ROTAP)	Typically occurs within heathlands in shallow sandy soil in cracks and depressions of sandstone rock platforms.	Restricted to areas near the Hawkesbury River, north of Sydney. Distribution extends from north of Maroota in the north, to Cowan in the south. All known populations occur within the Baulkham Hills and Hornsby LGAs.	Popran NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Angus onion orchid *Microtis angusii*	E (TSC) E (EPBC) 1EK (ROTAP)	A known population of this species grows along a major roadside in Sydney and is subject to constant degradation and disturbance.	This orchid is currently only known from a single population of approximately 100 individuals in the Warringah/Pittwater area of North Sydney.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Olearia cordata	V (TSC) V (EPBC) 2VCi (ROTAP)	Populations are typically small and scattered. Grows in dry open sclerophyll forest and open shrubland, on sandstone ridges.	A NSW endemic with a scattered distribution generally restricted to the south-western Hunter Plateau, eastern Colo Plateau, and the far north-west of the Hornsby Plateau near Wisemans Ferry east of Maroota.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Omeo storks bill *Pelargonium* sp. *Striatellum*	E (TSC) E (EPBC)	Typically occurs just above the high water level of irregularly inundated or ephemeral lakes. During dry periods it is known to colonise dry lake beds.	This species is known to occur in both Victoria and NSW. It occurs within the south-eastern highlands and South East Corner IBRA Bioregions and the Hawkesbury-Nepean, Murrumbidgee, Southern Rivers and North East Natural Resource Management Regions.	This species is not known to occur in conservation reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
tall knotweed *Persicaria elatior*	V (TSC) V (EPBC)	This species normally grows in damp locations, especially beside lakes and streams. It has occasionally been known to occur in swamp forest as well as in association with disturbance.	This species is known to occur in two disjunct areas; in south-eastern NSW and northern NSW. In south-eastern NSW this species has been recorded from Mt Dromedary, Moruya State Forest, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. The records from northern NSW are from Raymond Terrace and the Grafton area. Tall knotweed has also been recorded from Queensland.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

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hairy geebung *Persoonia hirsuta*	E (TSC) E (EPBC) 3KCi (ROTAP)	Found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone. It is usually present as isolated individuals or very small populations.	Recorded in the Sydney coastal area (subsp. *hirsuta* - Gosford to Berowra to Manly to Royal National Park), the Blue Mountains area (subsp. *evoluta* - Springwood, Lithgow, Putty) and the Southern Highlands (subsp. *evoluta* - Balmoral, Buxton, Yanderra and Hill Top areas).	Dharug NP Yengo NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Austral pilwort *Pilularia novae-hollandiae*	E (TSC)	This species is predicted to be ephemeral and grows in shallow swamps/waterways. They typically grow in association with grasses and sedges. The Albury-Urana records of the Austral pillwort were from table-drains on the sides of roads.	Austral pillwort has been recorded from a range of NSW locations including: Sydney, Khancoban, the Riverina between Albury and Urana and Lake Cowal. The only currently known population of this species is the Lake Cowal. The species also occurs in ACT, Victoria, Tasmania, SA and WA.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

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Pimelea curviflora var. *curviflora*	V (TSC) V (EPBC)	Occurs on shale/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Flowers October to May.	Confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. Former range extended south to the Parramatta River and Port Jackson region including Five Dock, Bellevue Hill and Manly.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
tranquillity mintbush *Prostanthera askania*	E (TSC) E (EPBC) 2RCi (ROTAP)	Occurs in moist sclerophyll forest and warm temperate rainforest communities, and the ecotone between them. Frequently, it occurs in canopy gaps, forest edges or in more open/light filled areas. Recruits intensely from seed post-fire (Tierney unpublished data), although heat appears to kill seeds (Tierney 2006).	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 LGAs. Eight populations are known from the catchments of Ourimbah Creek, Narara Creek, Dog Trap Gully, Chittaway Creek and Berkeley Creek. A further two populations are known from the Erina Creek–Fires Creek catchment.	Popran NP Bouddi NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

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Singleton mint bush *Prostanthera cineolifera*	V (TSC) V (EPBC) 2K (ROTAP)	Grows in open woodlands on exposed sandstone ridges. Usually found in association with shallow or skeletal sands.	Restricted to only a few localities near Walcha, Scone and St Albans. The species was once known in Yengo NP; however, no records have been made here in many years.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Somersby mintbush *Prostanthera junonis*	E (TSC) E (EPBC) 2E (ROTAP)	The species is restricted to the Somersby Plateau. It occurs on both the Somersby and Sydney Town soil landscapes on gently undulating country over weathered Hawkesbury sandstone within open forest/low woodland/open scrub. It occurs in both disturbed and undisturbed sites.	This species has a north-south range of approximately 19 kilometres on the Somersby Plateau in the Gosford and Wyong LGAs.	Brisbane Water NP Popran NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

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Coastal headland pea *Pultenaea maritima*	V (TSC)	This species occurs in grasslands, shrublands and heath on exposed coastal headlands.	Occurs in NSW and Queensland. Within NSW, the species has been recorded from Newcastle north to Byron Bay on 16 headlands.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
eastern Australian underground orchid *Rhizanthella slateri*	V (TSC) E (EPBC) 3KC (ROTAP)	Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest. Highly cryptic given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. Therefore usually located only when the soil is disturbed.	Occurs from south-east Queensland to south-east NSW. In NSW, currently known from fewer than 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra.	Dharug NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

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heath wrinklewort *Rutidosis heterogama*	V (TSC) V (EPBC) 2VCa (ROTAP)	Occurs mostly in open grassy sites (typically *Themeda* dominated) , often along disturbed roadsides, and also in open forest, primarily in coastal districts.	In coastal districts from Maclean to the Central Coast and inland to Torrington. It has been recorded at Cooranbong and Warnervale on the Central Coast and extensively around the Cessnock district.	Munmorah SCA	No extant records of this species are known from the Study Area (although two records from previous studies are present in the north that could not be relocated), however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the Project.	Yes

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coast groundsel *Senecio spathulatus*	E (TSC)	Coast groundsel grows on primary dunes.	Occurs in Nadgee NR (Cape Howe) and between Kurnell in Sydney and Myall Lakes NP (with a possible occurrence at Cudmirrah).	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
rainforest cassia *Senna acclinis*	E (TSC) 3RC – (ROTAP)	This cassia grows in sub-tropical rainforest (Botanic Gardens Trust 2016b).	This species is currently very rare due to land clearing practices and was last collected from Balgownie in 1982 .It can be found in the NSW botanical subdivisions of the North Coast, Central Coast and Northern Tablelands (Botanic Gardens Trust 2016b).	Ourimbah SF	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

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Siahs backbone *Streblus pendulinus*	E (EPBC)	Found in warmer rainforests, mainly along watercourses with an altitudinal range between sea level and approximately 800 metres above sea level.	In Australia this species occurs from Cape York Peninsula to Milton, south-east NSW, as well as Norfolk Island. Globally it is found in Papua New Guinea, Micronesia, Vanuatu, New Caledonia, Fiji, Rapa and Hawaii.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
magenta lilly pilly *Syzygium paniculatum*	E (TSC) V (EPBC) 3VCi (ROTAP)	This species grows in subtropical and littoral rainforests on sandy soils or stabilised dunes near the sea and also some coastal valleys (in Wyong LGA).	Occurs in widely separated localities between Bulahdelah and Jervis Bay.	Bouddi NP Popran NP Wyrrabalong NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

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Tetratheca glandulosa	V (TSC) V (EPBC) 2VC (ROTAP)	Associated with shale-sandstone transition habitat where shale-cappings occur over sandstone, with associated soil landscapes such as Lucas Heights, Gymea, Lambert and Faulconbridge. Topographically, the plant occupies ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches. Soils are generally shallow, consisting of a yellow, clayey/sandy loam.	Restricted to the following LGAs: Baulkham Hills, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Pittwater, Ryde, Warringah, and Wyong. There are approximately 150 populations of this plant ranging from Sampsons Pass (Yengo NP) in the north to West Pymble (Lane Cove NP) in the south. The eastern limit is at Ingleside (Pittwater LGA) and the western limit is at East Kurrajong (Wollemi NP).	Brisbane Water NP Dharug NP Jilliby SCA Popran NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
black-eyed Susan *Tetratheca juncea*	V (TSC) V (EPBC) 3VCa (ROTAP)	Usually found in low open forest or woodland with a shrub understorey and grass groundcover on low nutrient soils, however it and has also been found in heathland and moist forest. This species generally prefers well-drained sites and ridges, although it also found on upper and mid-slopes and occasionally in gullies. There appears to be a preference for southerly aspects, although the species will occur on slopes with a variety of aspects.	This species is confined to the Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Cessnock LGAs. DSEWPAC has defined Important Habitat for this species.	Jilliby SCA Munmorah SCA Popran NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

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Wyong sun orchid *Thelymitra* sp. *adorata*	CE (TSC)	It is only known to occur in areas with an altitude between 10 and 40 metre ASL, usually in areas of woodland with a grassy understorey. It is found on well-drained clay-loam or shale derived soils. Most of the identified populations have been identified growing in Dooralong spotted Gum - Ironbark Forest.	This species is highly restricted in distribution and is currently only known to several occurrences bounded by Warnervale, Wyong and Wyongah and is restricted to NSW.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the Project.	Yes
Velleia perfoliata	V (TSC) V (EPBC) 2VC (ROTAP)	This plant grows in areas of heath on shallow sandy soils upon sandstone and flowers in spring.	This goodenia is only known to occur on the Central Coast in NSW. In NSW it is restricted to the Hawkesbury District and the Upper Hunter Valley of the Central Coast botanical subdivision. It is currently only known to occur in nine populations.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Zannichellia palustris	E (TSC) 3R+ (ROTAP)	Grows in fresh or slightly saline stationary or slowly flowing water. Prefers open sites with exposed rock or mud for establishment.	Known to occur in the Hunter, Karuah Manning and Wyong sub-regions of the Hunter/Central Rivers Catchment. Kooragang Island and Hexham Swamp contain the largest known populations.	Reported from Hexham Swamp/Ironbark Creek which is part of the Hunter Wetlands NP.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Zieria involucrata	E (TSC) V (EPBC) 2VCa (ROTAP)	*Zieria involucrata* grows in areas of wet sclerophyll forest (Botanic Gardens Trust 2016b).	This species is endemic to NSW and has a highly restricted geographic distribution. It is currently only known to 20 populations located between Yengo NP in the north and Marramarra NP in the south. It was once known to the Katoomba area but this population has not been recently confirmed.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
ENDANGERED FLORA POPULATIONS						
Eucalyptus parramattensis subsp. *parramattensis* in the Wyong and Lake Macquarie LGAs	EP (TSC)	This species is associated with low moist areas alongside drainage lines and adjacent to wetlands. It is often found in woodland on sandy soils. The endangered population occurs on sandy alluvium within a floodplain community which also supports *Eucalyptus robusta* (Swamp mahogany), *E. tereticornis* (Forest Red Gum), *E. gummifera* (Sydney Bloodwood) as well as Melaleuca (Paperbark) species.	The species usually occurs from the Goulburn Valley on the Central West slopes to Hill Top on the Central Coast. The endangered population in the Lake Macquarie and Wyong LGAs is at the north-eastern limit of the species range and is quite separate from other known populations. The majority of the population occurs within Wyong in the Porter's Creek and the Wallarah Creek catchments.	This population is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
THREATENED ECOLOGICAL COMMUNITIES						
Illawarra Subtropical Rainforest in the Sydney Basin Bioregion	EEC (TSC)	This community can be located on the Illawarra Coastal Plain and escarpment foothills; although it is rarely found on the upper escarpments of slopes. It is found on a wide range of rock types, however the most common is Permian volcanic rock. Characteristic species of this community are inclusive of brush bloodwood (*Baloghia inophylla*), flame tree (*Brachychiton acerifolius*), giant stinging tree (*Dendrocnide excelsa*), native tamarind (*Diploglottis australis*), *Ficus* spp., brown beech (*Pennantia cunninghamii*), and red cedar (*Toona ciliata*).	This community has been recorded from the LGAs of Kiama, Shellharbour, Shoalhaven and Wollongong; although it may occur elsewhere in the bioregion.	This EEC is not known to occur in any conservation reserves in the region.	This community has not been recorded from the Study Area and is highly unlikely to occur.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin Bioregion	EEC (TSC)	This EEC occurs in the central to lower Hunter Valley, principally on Permian geology. Their soils are generally relatively fertile yellow podzolic and solodic soils of the Lower Hunter soil landscapes of Aberdare, Branxton and Neath. However, recent investigations and analyses suggest it may occur in other areas (this is currently under review by OEH). The predominantly made up of spotted gum (*Corymbia maculata*) and narrow-leaved ironbark (*Eucalyptus fibrosa*). The understorey is dominated by the tall shrub silver-stemmed wattle (*Acacia parvipinnula*) and various prickly shrubs.	The EEC was considered to be restricted to a range of approximately 65 km by 35 km centred on the Cessnock – Beresfield area. It is likely, based on recent investigations that it occurs outside of this area.	This EEC is known from Werakata NP.	This community has not been recorded from the Study Area and is highly unlikely to occur.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney basin and South East Corner Bioregions	EEC (TSC)	Given its habitat, the community has an important role in maintaining river ecosystems and riverbank stability. Occurs on with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Generally occurs below 50 metres elevation, but may occur on localised river flats up to 250 metres above sea level. The composition of this EEC is highly variable, although typical species include forest red gum (*Eucalyptus tereticornis*), cabbage gum (*E. amplifolia*), rough-barked apple (*Angophora floribunda*) and broad-leaved apple (*A. subvelutina*).	This EEC occurs in numerous LGAs on the south coast of NSW. It is believed to be bounded to the north by Port Stephens, to the south by the NSW-VIC border and to occur no further west than Canberra.	Cattai NP Dharug NP	The community has been recorded in the Study Area and is potentially sensitive to the development.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregion	EEC (TSC)	Associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains. Generally occurs below 20 metres (rarely above 10 metres) elevation.	Known from parts of the LGAs of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes, Port Stephens, Maitland, Newcastle, Cessnock, Lake Macquarie, Wyong, Gosford, Pittwater, Warringah, Hawkesbury, Baulkham Hills, Hornsby, Lane Cove, Blacktown, Auburn, Parramatta, Canada Bay, Rockdale, Kogarah, Sutherland, Penrith, Fairfield, Liverpool, Bankstown, Wollondilly, Camden, Campbelltown, Wollongong, Shellharbour, Kiama, Shoalhaven, Eurobodalla and Bega Valley but may occur elsewhere in these bioregions. Major examples once occurred on the floodplains of the Clarence, Macleay, Hastings, Manning, Hunter, Hawkesbury, Shoalhaven and Moruya Rivers.	Wamberal Lagoon NR	This community has not been recorded from the Study Area and is highly unlikely to occur.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC (TSC)	Associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Generally occurs below 20 metres (though sometimes up to 50 metres) elevation. The composition of the community is primarily determined by the frequency and duration of water logging and the texture, salinity nutrient and moisture content of the soil, and latitude. The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic grasses, vines and forbs.	This community is known to occur in numerous LGAs, but is believed to be restricted to the areas of coastal NSW; no further south than the Shoalhaven LGA and as far north as the NSW-Queensland border, but no further west than Bathurst. The Study Area is not within the known distribution of this EEC.	This EEC is not known to occur in conservation reserves in the region.	The community has been recorded in the Study Area and is potentially sensitive to the development.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Sydney Freshwater Wetlands in the Sydney Basin Bioregion	EEC (TSC)	This EEC is restricted to freshwater swamps located in swales and sand dune depressions. These areas are typified by a low soil nutrient content and are found in coastal areas. These areas are usually found on the Tuggerah and Warriewood soil landscapes. Characteristic vegetation is inclusive of *Eleocharis sphacelata*, *Baumea juncea*, *Baumea rubiginosa*, jointed twig rush (*Baumea articulata*), red-fruit saw-sedge (*Gahnia sieberiana*), water primrose (*Ludwigia peploides* subsp. *montevidensis*) and *Persicaria* spp.	This community is known to occur in the LGAs of Botany, Gosford, Lake Macquarie, Pittwater, Randwick, Rockdale, Sutherland, Warringah, Waverly, Wollongong, Woolahrah and Wyong.	Porters Creek Wetland	This community has not been recorded from the Study Area and is highly unlikely to occur.	No

Note

a	adequately reserved
C	in a conservation reserve
CEEC	critically endangered ecological community
E	endangered species
EEC	endangered ecological community
EP	endangered population
EPBC	Environment Protection Biodiversity Conservation Act
i	inadequately reserved
K	Poorly known
LGA	Local Government Area
NP	National Park
NR	Nature Reserve
PD	preliminary determination
R	Rare
ROTAP	Rare or Threatened Australian Plants
SF:	State Forest
t	total population reserved
TSC:	Threatened Species Conservation Act
V	vulnerable
X	extinct
2	found over < 100 km
3	found over > 100 km
-	species recorded from a reserve but population size unknown
+	taxon has a natural occurrence overseas

Table A1.2 Threatened Fauna and Migratory Species with Potential to Occur

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
THREATENED FAUNA SPECIES						
INSECTS						
giant dragonfly *Petalura gigantea*	E (TSC)	This species is typically located in permanent swamps and bogs, with some degree of free water and open vegetation. The adult dragonflies spend the majority of their time on vegetation which is low and either on or adjacent to the body of water. Male giant dragonflies sometimes congregate in wait of breeding partners. The eggs of the giant dragonfly are laid into moss or other soft riparian vegetation.	This species is distributed across the east coast of NSW following from the Victoria border through to northern NSW. Specific locations are in the Blue Mountains, Southern Highlands, the Clarence River Catchment and several coastal swamps between just north of Grafton and Nadgee. This species is not known to occur west of the Great Dividing Range.	Brisbane Waters NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
FISH						
Macquarie perch *Macquaria australasica*	V (FM) E (EPBC)	Slow rivers with deep holes, lakes. Bottom to mid water dwellers, not at all territorial.	Two separate populations of a dwarf form of the Macquarie perch exist in NSW, east of the Great Dividing Range in the Shoalhaven and Hawkesbury River systems.	This species is not known to occur in any reserves in the region.	The Study Area does not provide suitable habitat for this species and it has not been recorded there. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Australian greyling *Prototroctes maraena*	P (FM). V (EPBC)	Australian grayling occur in freshwater streams and rivers, especially clear gravelly streams with a moderate flow, as well as estuarine areas.	Australian grayling occur in streams and rivers on the eastern and southern flanks of the Great Dividing Range from Sydney southwards to the Otway Ranges in Victoria, and Tasmania. Australian grayling do not occur in the inland Murray–Darling Basin system.	This species is not known to occur in any reserves in the region.	The Study Area does not provide suitable habitat for this species and it has not been recorded there. There is no potential for a significant impact on this species.	No
black cod *Epinephalus daemelii*	V (FM)	Black cod is a marine species found in temperate to subtropical waters with NSW being the centre of its distributional range in Australia (Fisheries Scientific Committee undated.b).	Black cod have been recorded from the waters of Australia, Kermadec Islands, New Zealand and Norfolk Island (Fisheries Scientific Committee undated.b). In Australia its range extends from Kangaroo Island in the south to southern Queensland in the north (Fisheries Scientific Committee undated.b).	This species is not known to occur in any reserves in the region.	The Study Area does not provide suitable habitat for this species and it has not been recorded there. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
AMPHIBIANS						
wallum froglet *Crinia tinnula*	V (TSC)	Wallum froglets are found only in acid paperbark swamps and sedge swamps of the coastal 'wallum' country.	This species is known to occur in the Hunter, Karuah Manning, Wyong and Macleay Hastings sub-regions of the Hunter/Central Rivers Catchment.	Munmorah SCA Wyrrabalong NP	No extant records of this species are known from the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the project.	Yes
giant burrowing frog *Heleioporus australiacus*	V (TSC) V (EPBC)	Found in heath, woodland and open forest with sandy soils.	Occurs from the NSW Central Coast to eastern Victoria, but is most common on the Sydney sandstone. It has been found from the coast to the Great Dividing Range.	Brisbane Water NP Jilliby SCA McPherson SF Olney SF Ourimbah SF Popran NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
stuttering frog *Mixophyes balbus*	E (TSC) V (EPBC)	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range.	Occur along the east coast of Australia from southern Queensland to the north-eastern Victoria.	Jilliby SCA Olney SF Ourimbah SF	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
giant barred frog *Mixophyes iteratus*	E (TSC) E (EPBC)	This species forages and lives amongst deep, damp leaf litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1 000 m. They breed around shallow, flowing rocky streams.	Coast and ranges from south-eastern Queensland to the Hawkesbury River in NSW. North-eastern NSW, particularly the Coffs Harbour-Dorrigo area, is now a stronghold.	Jilliby SCA	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
red-crowned toadlet *Pseudophryne australis*	V (TSC)	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.	This species is confined to the Sydney Basin, from Pokolbin in the north, the Nowra area to the south, and west to Mt Victoria in the Blue Mountains.	Bouddi NP Brisbane Water NP Dharug NP Jilliby SCA McPherson SF Olney SF Ourimbah SF Popran NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
green and golden bell frog *Litoria aurea*	E (TSC) V (EPBC)	Occurs amongst emergent aquatic or riparian vegetation and amongst vegetation, fallen timber, including grassland, cropland and modified pastures. Breeds in still or slow flowing waterbodies with some vegetation such as *Typha* spp. and *Eleocharis* spp.	NSW North Coast near Brunswick Heads, southwards along the NSW Coast to Victoria where it extends into east Gippsland.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
green-thighed frog *Litoria brevipalmata*	V (TSC)	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.	Isolated localities along the coast and ranges from the NSW central coast to south-east Queensland.	Jilliby SCA Olney SF Ourimbah SF	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
littlejohns treefrog *Litoria littlejohnii*	V (TSC) V (EPBC)	Occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops.	Distribution includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest south to Buchan in Victoria.	Olney SF Ourimbah SF	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
REPTILES						
Rosenberg's goanna *Varanus rosenbergi*	V (TSC)	Found in heath, open forest and woodland. Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component. Individuals require large areas of habitat.	Occurs on the Sydney Sandstone in Wollemi NP to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south. There are records from the South West Slopes near Khancoban and Tooma River.	Brisbane Water NP Dharug NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
pale-headed snake *Hoplocephalus bitorquatus*	V (TSC)	Found mainly in dry eucalypt forests and woodlands, cypress woodland and occasionally in rainforest or moist eucalypt forest. Favours streamside areas, particularly in drier habitats.	A patchy distribution from north-east Queensland to north-east NSW. In NSW it occurs from the coast to the western side of the Great Divide as far south as Tuggerah.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
broad-headed snake *Hoplocephalus bungaroides*	E (TSC) V (EPBC)	This species is nocturnal and shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 metres of escarpments in summer.	The broad-headed snake is largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within approximately 250 kilometres of Sydney.	Dharug NP Olney SF	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Stephens banded snake *Hoplocephalus stephensii*	V (TSC)	Occurs in rainforest and eucalypt forests and rocky areas up to 950 metres in altitude.	Coast and ranges from southern Queensland to Gosford in NSW.	Jilliby SCA Olney SF	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
BIRDS						
magpie goose *Anseranas semipalmata*	V (TSC) MAR (MAR)	Prefers shallow (<1 m) wetland habitats with dense rush and/or sedge growth. Can also be located foraging on the land for bulbs and rhizomes.	This species is commonly distributed across the northern tropics of Australia. Typically magpie geese are only seen sporadically in the areas of central and northern NSW, and are rarely identified in the south-east of NSW.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
freckled duck *Stictonetta naevosa*	V (TSC)	This species prefers permanent freshwater swamps and creeks with heavy growth of cumbungi, lignum or tea-tree. During drier times it moves from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. This species generally rests in dense cover during the day, usually in deep water. Nesting usually occurs between October and December but can take place at other times when conditions are favourable. The nests are usually located in dense vegetation at or near water level.	The freckled duck is found primarily in south-eastern and south-western Australia, occurring as a vagrant elsewhere. This species may also occur as far as coastal NSW and Victoria during such times.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
blue-billed duck *Oxyura australis*	V (TSC)	This species is completely aquatic and favours deep permanent wetlands and swamps with dense aquatic vegetation. The blue-billed duck generally swims low in the water along the edge of dense vegetation and during the day forages far from the shore of the water-body. The blue-billed duck constructs a bowl-shaped nest, normally in cumbungi over deep water or in trampled vegetation in Lignum, sedges or Spike-rushes.	Widespread in NSW, but most common in the southern Murray-Darling Basin area.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
cotton pygmy-goose *Nettapus coromandelianus*	E (TSC)	The cotton pygmy-goose prefers freshwater lakes, lagoons, swamps and dams. In particular it favours the aforementioned water bodies which are vegetated with waterlillies, and other aquatic vegetation which is either floating or submerged. This species roosts and nests in the hollows of standing dead-trees in close proximity to water.	This species is rarely identified in NSW and is relatively uncommon in Queensland.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
black bittern *Ixobrychus flavicollis*	V (TSC)	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.	Records of the species are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland.	Dharug NP Munmorah SCA	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the project.	Yes
Australasian bittern *Botaurus poiciloptilus*	E (TSC) E (EPBC)	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleoacharis* spp.).	This species may be found over most of the state except for the far north-west.	Dharug NP	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the project.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
black-necked stork *Ephippiorhynchus asiaticus*	E (TSC)	Inhabits permanent freshwater wetlands including margins of billabongs, swamps, shallow floodwaters, and adjacent grasslands and savannah woodlands; can also be found occasionally on inter-tidal shorelines, mangrove margins and estuaries.	This species is widespread across coastal northern and eastern Australia, becoming uncommon further south into NSW, and rarely found south of Sydney.	Munmorah SCA	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
eastern osprey *Pandion cristatus*	V (TSC) MIG (EPBC)	Favours coastal areas, especially the mouths of large rivers, lagoons and lakes.	Ospreys are found right around the Australian coast line, 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.	Munmorah SCA Bouddi NP Brisbane Water NP Wamberal Lagoon NR Wyrrabalong NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
square-tailed kite *Lophoictinia isura*	V (TSC)	Found in a wide range of timbered habitats with a preference for timbered watercourses (although has been previously sighted in stony areas of chenopods and grass ground-cover, with open acacia scrub and patches of low open eucalypt woodland). This species tends to pick prey from along the outer-foliage of trees and hunts passerines (particularly honeyeater nestlings) and canopy insects. This species generally nests in forks or large horizontal limbs located along or near water courses.	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.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
little eagle *Hieraaetus morphnoides*	V (TSC)	This species is typically identified in open eucalypt forests, woodlands and open woodlands, and other areas where prey are plentiful. The nest in tall living trees within remnant patches.	The little eagle is distributed throughout mainland Australia except for the most densely forested parts of the Great Dividing Range escarpment.	Brisbane Water NP Dharug NP Jilliby SCA	The species has been recorded in the Study Area and is potentially sensitive to the development.	Yes
black-breasted buzzard *Hamirostra melanosternon*	V (TSC)	Lives in a range of inland habitats, especially along timbered watercourses which is the preferred breeding habitat. Hunts over grasslands and sparsely timbered woodlands.	Found sparsely in areas of less than 500mm rainfall, from north-western NSW and north-eastern South Australia to the east coast at about Rockhampton, then across northern Australia south almost to Perth, avoiding only the WA deserts.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
red goshawk *Erythrotriorchis radiatus*	CE (TSC) V (EPBC)	In NSW, the red goshawk is mainly found along or near watercourses, in swamp forest and woodlands on the coastal plain. It favours patches of dense forest interspersed with open woodland or cleared land and often frequents forest edges.	Across northern Australian south through eastern Queensland to far north-east NSW. The species is very rare in NSW. Most records are from the Clarence River Catchment, with a few about the lower Richmond and Tweed Rivers.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
Black falcon *Falco subniger*	V (TSC)	This species is found along tree-lined watercourses and in isolated woodlands, mainly in arid and semi-arid areas. It roosts in trees at night and often on power poles by day.	This species is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referable to the Brown Falcon. In New South Wales there is assumed to be a single population that is continuous with a broader continental population.	This species is not known to occur in any reserves in the region.	This species has been recorded in the Study Area and is potentially sensitive to the development.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Eastern bristlebird *Dasyornis brachypteris*	E (TSC) E (EPBC)	The eastern bristlebird inhabits low, dense vegetation across a variety of habitats inclusive of sedgeland, heathland, swampland, shrubland, sclerophyll forest and woodland, and rainforest. This species occurs in coastal areas, tablelands and ranges.	This species occurs in three geographically separate areas of south-east Australia; a northern population in south-eastern Queensland and north-eastern NSW; a central population on the central coast of NSW; and a southern population in the south-east of NSW and eastern Victoria. There are no known records of this species within 20 kilometres of the centre of the Study Area.	This species is not known to occur in conservation reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
red-backed button quail *Turnix maculosa*	V (TSC)	This quail inhabits grasslands, woodlands and cropped lands of warm temperate areas that annually receive 400 millimetres or more of summer rain. Observations of populations in other parts of its range suggest the species prefers sites near water, including grasslands and sedgelands near creeks, swamps and springs, and wetlands. Red-backed button-quail usually breed in dense grass near water, and nests are made in a shallow depression sparsely lined with grass and ground litter.	In NSW, the majority of red-backed button-quail records are from the North Coast Bioregion with a small number of records south as far as Sydney. Three outlying records are known from western NSW.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Fairy tern *Sternula nereis nereis*	V (EPBC)	Small fish-eating bird that nests on sandy beaches, spits and banks above the high-tide line and below vegetation. The subspecies has been found in embayments of a variety of habitats including offshore, estuarine or lacustrine (lake) islands, wetlands and mainland coastline.	In Australia, it occurs along the coasts of Victoria, Tasmania, SA and WA; occurring as far north as the Dampier Archipelago near Karratha. It was previously known from coastal NSW however there have been no recent records. Globally, it is distributed between Australia, New Caledonia and New Zealand.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
black-tailed godwit *Limosa limosa*	V (TSC) MIG (EPBC) Mar (EPBC)	Primarily a coastal species. Usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. Further inland, it can also be found on mudflats and in water less than 10 centimetres deep, around muddy lakes and swamps. Individuals have been recorded in wet fields and sewerage treatment works.	This species is migratory, flying to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the north and south coast, and inland. This species has been recorded within the Murray-Darling Basin, on the western slopes of the Northern Tablelands and in the far north-western corner of the state.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
sanderling *Calidris alba*	V (TSC) MIG (EPBC) MAR (EPBC)	Often found in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons; individuals are rarely recorded in near-coastal wetlands.	A regular summer migrant from Siberia and other Arctic breeding grounds to most of the Australian coastline. It is uncommon to locally common along the NSW coast, with occasional inland sightings.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
comb-crested jacana *Irediparra gallinacea*	V (TSC)	Inhabits permanent wetlands with a good surface cover of floating vegetation, especially water-lilies.	Occurs throughout coastal Australia and well inland in the north from the Kimberley to Sydney. Vagrants occasionally appear further south, possibly in response to unfavourable conditions further north in NSW.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
broad-billed sandpiper *Limicola falcinellus*	V (TSC) MIG (EPBC) MAR (EPBC)	Favours sheltered parts of the coast such as estuarine sand-flats and mudflats, harbours, embayment's, lagoons, saltmarshes and reefs as feeding and roosting habitat. Occasionally, individuals may be recorded in sewage farms or within shallow freshwater lagoons. Broad-billed Sandpipers roost on banks on sheltered sand, shell or shingle beaches.	Most records from Hunter River estuary, with birds occasionally reaching the Shoalhaven estuary.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Australian painted snipe *Rostratula australis*	E (TSC) V (PBC) MIG (EPBC)	Favours the fringes of swamps, dams and nearby marsh areas with associated grass, lignum, low-scrub or open-timber vegetation. This species nests amongst tall ground vegetation in created scrapes lined with leaves and grasses. The painted snipe forages in mud-flats and shallow waters.	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowal, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
bush stone-curlew *Burhinus grallarius*	E (TSC)	This species inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber. The bush stone curlew is largely nocturnal, being especially active on moonlit nights. It nests on the ground in a scrape or small bare patch laying two eggs in spring and early summer.	The bush tone-curlew is 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 south-east it is either rare or extinct throughout its former range.	Jilliby SCA	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
varied sittella *Daphoenositta chrysoptera*	V (TSC)	The varied sittella can typically be found in eucalypt forests and woodlands, especially of rough-barked species and mature smooth-barked gums with dead branches, it can also be identified in mallee and acacia woodlands. This species builds a cup shaped nest made of plant fibres and spiders webs which is placed at the canopy level in the fork of a living tree.	The varied sittella is a sedentary species that inhabits the majority of mainland Australia with the exception of the treeless deserts and open grasslands. Its NSW distribution is basically continuous from the coast to the far west.	Bouddi NP Brisbane Water NP Dharug NP Jilliby SCA Popran NP Wyrrabalong NP	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the project.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Wompoo fruit dove *Ptilinopus magnificus*	V (TSC)	Occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests.	Occurs along the coast and coastal ranges from the Hunter River in NSW to Cape York Peninsula. It is rare south of Coffs Harbour.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
rose-crowned fruit dove *Ptilinopus regina*	V (TSC)	Occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful.	Coast and ranges of eastern NSW and Queensland, from Newcastle to Cape York. Vagrants are occasionally found further south to Victoria.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
superb fruit dove *Ptilinopus superbus*	V (TSC) MAR (EPBC)	Inhabits rainforest and similar closed forests where it forages high in the canopy. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees.	This species occurs principally from north-eastern in Queensland to north-eastern NSW. It is much less common further south, where it is largely confined to pockets of suitable habitat as far south as Moruya.	Brisbane Water NP Wyrrabalong NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
glossy black-cockatoo *Calyptorhynchus lathami*	V (TSC)	Habitat for this species includes forests on low-nutrient soils, specifically those containing key *Allocasuarina* feed species. It will also eat seeds from eucalypts, angophoras, acacias, cypress pine and hakeas, as well as eating insect larvae. Breeding occurs in autumn and winter, with large hollows required.	The glossy black-cockatoo has a sparse distribution along the east coast and adjacent inland areas from western Victoria to Rockhampton in Queensland. In NSW, it has been recorded as far inland as Cobar and Griffith.	Bouddi NP Brisbane Water NP Dharug NP Jilliby SCA McPherson SF Olney SF Ourimbah SF Popran NP	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the project.	Yes
gang-gang cockatoo *Callocephalon fimbriatum*	V (TSC)	In summer this species occurs in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter this species moves to drier more open eucalypt forests and woodlands. It favours old growth trees for nesting and roosting.	In NSW this species occurs from the south east coast to the Hunter region and inland to the Central Tablelands and South-west Slopes.	Bouddi NP Dharug NP Jilliby SCA McPherson SF Olney SF Popran NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
swift parrot *Lathamus discolor*	E (TSC) E (EPBC)	This species often visits box-ironbark forests, feeding on nectar and lerps. In NSW, typical tree species in which it forages include mugga ironbark, grey box, swamp mahogany, spotted gum, red bloodwood, narrow-leaved red ironbark, forest red gum and yellow box. This bird is a migratory species that breeds in Tasmania during the spring and summer, and migrates to the mainland during the cooler months of the year.	In NSW this species has been recorded from the western slopes region along the inland slopes of the Great Dividing Range, as well as forests along the coastal plains from southern to northern NSW. The Study Area is within the known distribution of this species.	Brisbane Water NP Wyrrabalong NP	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the project.	Yes
turquoise parrot *Neophema pulchella*	V (TSC)	This species lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. It nests in tree hollows, logs or posts, from August to December.	The turquoise parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range.	Brisbane Water NP Olney SF	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
little lorikeet *Glossopsitta pusilla*	V (TSC)	This species can be found in dry-open eucalypt forests and woodlands, and have been identified in remnant vegetation, old growth vegetation, logged forests, and roadside vegetation. The little lorikeet usually forages in small flocks, not always with birds of their own species. They nest in hollows, mostly in living smooth-barked apples (*Angophora costata*).	This species is distributed from just north of Cairns, around the east coast of Australia down to Adelaide. In NSW this species is found from the coast to the western slopes of the Great Dividing Range, extending as far west as Albury, Dubbo, Parkes and Narrabri.	Bouddi NP Brisbane Water NP Dharug NP Jilliby SCA Munmorah SCA Popran NP	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the project.	Yes
powerful owl *Ninox strenua*	V (TSC)	The powerful owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. It generally requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation.	The powerful owl occurs in eastern Australia, mostly on the coastal side of the Great Dividing Range, from south western Victoria to Bowen in Queensland.	Bouddi NP Brisbane Water NP Dharug NP Jilliby SCA Munmorah SCA Olney SF Ourimbah SF Popran NP McPherson SF	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the project.	Yes
barking owl *Ninox connivens*	V (TSC)	Habitat for this species includes dry forests and woodlands, often in association with hydrological features such as rivers and swamps.	The barking owl is distributed sparsely throughout temperate and semi-arid areas of mainland Australia; however it is most abundant in the tropical north. Most records for this species occur west of the Great Dividing Range.	Bouddi NP Brisbane Water NP Dharug NP	The species has been recorded in the Study Area and is potentially sensitive to the development.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
sooty owl *Tyto tenebricosa*	V (TSC)	Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Nests in very large tree hollows.	Occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands.	Bouddi NP Brisbane Water NP Dharug NP Jilliby SCA McPherson SF Olney SF Ourimbah SF Popran NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
masked owl *Tyto novaehollandiae*	V (TSC)	This species is generally recorded from open forest habitat with sparse mid-storey but patches of dense, low ground cover. It is also recorded from ecotones between wet and dry eucalypt forest, along minor drainage lines and near boundaries between forest and cleared land.	The masked owl occurs sparsely throughout the continent and nearby islands, including Tasmania and New Guinea.	Bouddi NP Brisbane Water NP Dharug NP Jilliby SCA Olney SF	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the project.	Yes
brown treecreeper (eastern subspecies) *Climacteris picumnus victoriae*	V (TSC)	Typical habitat for this species includes drier forests, woodlands and scrubs with fallen branches; river red gums on watercourses and around lake-shores; paddocks with standing dead timber; and margins of denser wooded areas. This species prefers areas without a dense understorey.	This species occurs over central NSW, west of the Great Dividing Range and sparsely scattered to the east of the divide in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond, and Snowy River valleys.	Jilliby SCA	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
spotted harrier *Circus assimilis*	V (TSC)	Their habitat of choice is open grassy woodland, grassland, inland riparian woodland and shrub steppe. Although mostly associated with native grasslands it has also been identified in agricultural farmland. Their nest is made in a tree and composed of sticks.	The spotted harrier can be found throughout mainland Australia except for areas of dense forest on the coast, escarpments and ranges and rarely ever in Tasmania.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
speckled warbler *Chthonicola sagittata*	V (TSC)	The speckled warbler occurs in eucalypt-dominated communities that have a grassy understorey, leaf litter and shrub cover, often on rocky ridges or in gullies.	Patchy distribution throughout south-eastern Queensland, eastern half of NSW and into Victoria, as far west as the Grampians.	Dharug NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
regent honeyeater *Anthochaera phrygia*	CE (TSC) E (EPBC) MIG (EPBC)	This species generally occurs in temperate eucalypt woodlands and open forests of south eastern Australia. It is commonly recorded from box-ironbark eucalypt associations; wet lowland coastal forests dominated by swamp mahogany (*Eucalyptus robusta*), spotted gum (*Corymbia maculata*) and riverine casuarina woodlands. An apparent preference exists for the wettest, most fertile sites within these associations, such as creek flats, river valleys and foothills.	Once recorded between Adelaide and the central coast of Queensland, its range has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland.	Brisbane Water NP Dharug NP Olney SF	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the project.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
white-fronted chat *Epthianura albifrons*	V (TSC)	This bird can mostly be found in temperate to arid climates (rarely ever sub-tropical areas). It is typically identified in lowlands and foothills below 1000 metres above sea level. They seem to prefer habitats near waterways and damp areas (particularly wetlands containing salt marsh that are bordered by grassland or lightly timbered woodland).	The white-fronted chat is distributed across the southern half of Australia from the southern end of Queensland to the southern areas of Tasmania and across to WA. In NSW this species is mostly known from the southern half of the state and is most densely recorded along the coast from Newcastle down to the Victorian border; although records of the species have been made from as far west as the NSW-SA border, the far north-west corner of the state and Inverell in the north-east. Records of this species are sparse in the Hunter region (excluding Newcastle) as well as the North Coast Bioregion and the North Western Plains Bioregion.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
black-chinned honeyeater (eastern subspecies) *Melithreptus gularis gularis*	V (TSC)	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially mugga ironbark (*Eucalyptus sideroxylon*), white box (*E. albens*), grey box (*E. moluccana*), yellow box (*E. melliodora*) and forest red gum (*E. tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees.	The subspecies is widespread, from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range, although regularly observed from the Richmond River district. It has also been recorded at a few scattered sites in the Hunter, Central Coast and Illawarra regions.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
painted honeyeater *Grantiella picta*	V (TSC) V (EPBC)	Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests.	The greatest concentrations of this bird species and almost all breeding occur on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
grey-crowned babbler (eastern subspecies) *Pomatostomus temporalis temporalis*	V(TSC)	Open box-gum woodlands on the slopes. Box-cypress-pine and open box woodlands on alluvial plains. Also found in acacia shrubland and adjoining areas.	Occurs throughout northern and south-eastern Australia. In NSW, this species occurs on the western slopes of the Great Dividing Range and on the western plains reaching as far west as Louth and Hay. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW.	Munmorah SCA	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
scarlet robin *Petroica boodang*	V (TSC)	This robin can be found in woodlands and open forests from the coast through to inland slopes. The birds can sometimes be found on the eastern fringe of the inland plains in the colder months of the year. Woody debris and logs are both important structural elements of its habitat. It forages from low perches on invertebrates either on the ground or in woody debris or tree trunks.	The scarlet robin can be found in south-eastern Australia, from Tasmania to the southern end of Queensland, to western Victoria and south SA. In NSW it is found throughout the eastern areas of the state, no further than 500 kilometres from the coast.	Brisbane Water NP Dharug NP Jilliby SCA	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the project.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
flame robin *Petroica phoenicea*	V (TSC)	This species is known to breed in moist eucalypt forests and woodlands. It can usually be seen on ridges and slopes in areas where there is an open understorey layer. This species migrates during the winter to more lowland areas such as grasslands where there are scattered trees, as well as open woodland of the inland slopes and plains.	This robin is located in south-eastern Australia from the Queensland border to Tasmania and into Victoria as well as south-east SA. In NSW it has been recorded from the coast to as far west as the NSW-Victoria border at Mildura. The Study Area is within the known distribution of this species.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the project.	Yes
diamond firetail *Stagonopleura guttata*	V (TSC)	Habitat includes a range of eucalypt dominated communities with a grassy understorey, including woodland, forest and mallee. It appears that populations are unable to persist in areas where there are no vegetated remnants larger than 200 hectares.	The diamond firetail occurs through central and eastern NSW, north into southern and central Queensland and south through Victoria to South Australia. In NSW it mainly occurs west of the Great Dividing Range, although populations are known from drier coastal areas such as the Cumberland Plain and the Hunter, Clarence, Richmond and Snowy River valleys.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
MAMMALS						
spotted-tailed quoll *Dasyurus maculatus*	V (TSC) E (EPBC)	Habitat for this species is highly varied, ranging from sclerophyll forest, woodlands, coastal heathlands and rainforests. Records exist from open country, grazing lands and rocky outcrops. Suitable den sites including hollow logs, tree hollows, rocky outcrops or caves.	In NSW the spotted-tailed quoll occurs on both sides of the Great Dividing Range, with the highest densities occurring in the north east of the state. It occurs from the coast to the snowline and inland to the Murray River.	Bouddi NP Brisbane Water NP Dharug NP Jilliby SCA McPherson SF Olney SF Popran NP Wyrrabalong NP	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
brush-tailed phascogale *Phascogale tapoatafa*	V (TSC)	Prefers dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest.	This species has a patchy distribution around the coast of Australia. In NSW it is more frequently found in forest on the Great Dividing Range in the north-east and south-east of the state. There are also a few records from central NSW.	Dharug NP	This species has not been recorded within the Study Area. It is highly unlikely that this species occurs within the Study Area with any regularity, as such there is very low potential for impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
common planigale *Planigale maculata*	V (TSC)	The common planigale is usually found close to water in areas where there is surface cover in habitats ranging from rainforest, eucalypt forest, heathland, marshland and rocky areas. During day hours they refuge in saucer-shaped nests built in crevices, hollow-logs, beneath bark and under logs. The common planigale is nocturnal and constructs a nest made of grass, eucalyptus leaves and/or shredded bark.	Coastal north-eastern NSW, coastal east Queensland and Arnhem Land. The species reaches its southern distribution limit on the NSW lower north coast.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
southern brown bandicoot (eastern) *Isoodon obesulus obesulus*	E (TSC) E (EPBC)	Crepuscular in nature, they are generally found in heath or open forest with a heathy understorey on sandy or friable soils. They nest during the day in shallow depressions in the ground covered by leaf litter, grass or other plant matter.	The Southern Brown Bandicoot has a patchy distribution. It is found in south-eastern NSW, east of the Great Dividing Range south from the Hawkesbury River, southern coastal Victoria and the Grampian Ranges, south-eastern South Australia, south-west Western Australia and the northern tip of Queensland.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
koala *Phascolarctos cinereus*	V (TSC) V (EPBC)	This species inhabits eucalypt forest and woodland, with suitability influenced by tree species and age, soil fertility, climate, rainfall and fragmentation patterns. The species is known to feed on a large number of eucalypt and non-eucalypt species, however it tends to specialise on a small number in different areas. *Eucalyptus tereticornis, E. punctata, E. cypellocarpa, E. viminalis, E. microcorys, E. robusta, E. albens, E. camaldulensis* and *E. populnea* are some preferred species.	The koala has a fragmented distribution throughout eastern Australia, with the majority of records from NSW occurring on the central and north coasts, as well as some areas further west. It is known to occur along inland rivers on the western side of the Great Dividing Range.	Bouddi NP Brisbane Water NP Dharug NP Jilliby SCA Olney SF Ourimbah SF	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the project.	Yes
eastern pygmy possum *Cercartetus nanus*	V (TSC)	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.	This species is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extends from the coast inland as far as the Pillaga, Dubbo, Parkes and Wagga Wagga on the western slopes.	Brisbane Water NP McPherson SF Munmorah SCA Olney SF	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the project.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
yellow-bellied glider *Petaurus australis*	V (TSC)	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.	The yellow-bellied glider is found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria.	Bouddi NP Dharug NP Jilliby SCA McPherson SF Olney SF Ourimbah SF	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
squirrel glider *Petaurus norfolcensis*	V (TSC)	Inhabits a variety of mature or old growth habitats, including box, box-ironbark woodlands, river red gum forest, and blackbutt-bloodwood forest with heath understorey. It prefers mixed species stands with a shrub or acacia mid-storey, and requires abundant tree hollows for refuge and nest sites.	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria.	Bouddi NP Brisbane Water NP Dharug NP Jilliby SCA Munmorah SCA Olney SF Popran NP Wyrrabalong NP	The species has been recorded in the Study Area during previous studies. During current surveys a glider (*Petaurus* sp) was identified that may have been either this species or the locally common sugar glider (*Petaurus breviceps*). This species is potentially sensitive to the development.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
long-nosed potoroo *Potorous tridactylus*	V (TSC) V (EPBC)	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.	This species is found on the south-eastern coast of Australia, from Queensland to eastern Victoria and Tasmania, including some of the Bass Strait islands. In NSW it is generally restricted to coastal heaths and forests east of the Great Dividing Range.	Brisbane Water NP Jilliby SCA	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
parma wallaby *Macropus parma*	V (TSC)	Preferred habitat for this species is moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest. It typically feeds at night on grasses and herbs in more open eucalypt forest and the edges of nearby grassy areas. During the day it shelters in dense cover.	Although it once occurred from north-eastern NSW to the Bega area in the southeast, its range is now confined to the coast and ranges of central and northern NSW.	Jilliby SCA Olney SF Ourimbah SF	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
brush-tailed rock-wallaby *Petrogale penicillata*	E (TSC) V (EPBC)	This species occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. It browses on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. This species shelters or bask during the day in rock crevices, caves and overhangs and is most active at night.	The brush-tailed rock-wallaby was once abundant and ubiquitous throughout the mountainous country of south-eastern Australia. Its distribution roughly followed the Great Dividing Range for 2500km from the Grampians in West Victoria to Nanango in south-east Queensland, with outlying populations in coastal valleys and ranges to the east of the divide, and the slopes and plains as far west as Cobar in NSW and Injune (500 km NW of Brisbane) in Queensland.	Jilliby SCA Olney SF	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
red-legged pademelon *Thylogale stigmatica*	V (TSC)	Inhabits forest with a dense understorey and ground cover, including rainforest, moist eucalypt forest and vine scrub. Wet gullies with dense, shrubby ground cover provide shelter from predators. In NSW, the red-legged pademelon is rarely found outside forested habitat.	Patchily distributed along coastal and sub-coastal eastern Australia from Cape York to the Hunter Valley in NSW.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
grey-headed flying-fox *Pteropus poliocephalus*	V (TSC) V (EPBC)	This species 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.	Grey-headed flying-foxes are found within 200 km of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria.	Bouddi NP Brisbane Water NP Dharug NP Jilliby SCA Munmorah SCA Popran NP Wyrrabalong NP	This species has not been recorded within the Study Area, however appropriate habitat is present. There is potential that this species could occur within the Study Area and be impacted by the project.	Yes
yellow-bellied sheathtail bat *Saccolaimus flaviventris*	V (TSC)	This species forages for insects, flies high and fast over the forest canopy, but lower in more open country. It forages in most habitats across its very wide range, with and without trees; and appears to defend an aerial territory. It roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to use mammal burrows.	The yellow-bellied sheathtail-bat is a wide-ranging species found across northern and eastern Australia. In the most southerly part of its range - most of Victoria, south-western NSW and adjacent South Australia - it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes.	Bouddi NP Ourimbah SF	The species has been recorded in the Study Area and is potentially sensitive to the development.	Yes
eastern freetail-bat *Mormopterus norfolkensis*	V (TSC)	This species occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. It roosts mainly in tree hollows but will also roost under bark or in man-made structures.	The eastern freetail-bat is found along the east coast from south Queensland to southern NSW.	Bouddi NP Brisbane Water NP Dharug NP Jilliby SCA Popran NP	The species has been recorded in the Study Area and is potentially sensitive to the development.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
golden-tipped bat *Kerivoula papuensis*	V (TSC)	Found in rainforest and adjacent sclerophyll forest. Roosts in abandoned hanging yellow-throated scrubwren and brown gerygone nests located in rainforest gullies on small first- and second-order streams. Will fly up to two km from roosts to forage in rainforest and sclerophyll forest on upper-slopes.	The golden-tipped bat is distributed along the east coast of Australia in scattered locations from Cape York Peninsula in Queensland to Bega in southern NSW.	Jilliby SCA McPherson SF Olney SF	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
little bentwing bat *Miniopterus australis*	V (TSC)	Prefers moist eucalypt forest, rainforest or dense coastal banksia scrub. This species 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.	Occurs in coastal north-eastern NSW and eastern Queensland. In NSW it mostly occurs along the coast from the Queensland border to Sydney at its south-most, and to the west Ulan is the known western geographic distributional limit. One outlying record exists in NSW to the east of Mildura	Bouddi NP Jilliby SCA	The species has been recorded in the Study Area and is potentially sensitive to the development.	Yes
eastern bentwing-bat *Miniopterus schreibersii oceanensis*	V (TSC)	This species hunts in forested areas and uses caves as the primary roosting habitat, but also uses derelict mines, storm-water tunnels, buildings and other man-made structures. It forms discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.	Eastern bentwing-bats occur along the east and north-west coasts of Australia. In NSW they are found both east and west of the Great Dividing Range, but typically no further than 300 kilometres from the coast. (NSW Government 2009)	Bouddi NP Brisbane Water NP Dharug NP Jilliby SCA Munmorah SCA Olney SF Popran NP Wamberal Lagoon NR Wyrrabalong NP	The species has been recorded in the Study Area and is potentially sensitive to the development.	Yes

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eastern long-eared bat (SE form) *Nyctophilus timoriensis*	V (TSC) V (EPBC)	Inhabits a variety of vegetation types, including mallee, bulloak (*Allocasuarina leuhmanni*) and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. Roosts in tree hollows, crevices, and under loose bark.	Overall, the distribution of the south eastern form coincides approximately with the Murray Darling Basin with the Pilliga Scrub region being the distinct stronghold for this species.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area. It is highly unlikely that this species occurs within the Study Area with any regularity, as such there is very low potential for impact on this species.	No
large-eared pied bat *Chalinolobus dwyeri*	V (TSC) V (EPBC)	The large-eared pied bat is generally found in a variety of drier habitats, including dry sclerophyll forests and woodlands, however, it probably tolerates a wide range of habitats. It tends to roost in the twilight zones of mines and caves, generally in colonies or common groups.	This species has a distribution from south western Queensland to NSW from the coast to the western slopes of the Great Dividing Range.	Bouddi NP Jilliby SCA Olney SF	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
eastern false pipistrelle *Falsistrellus tasmaniensis*	V (TSC)	Habitat for this species includes sclerophyll forest. It prefers wet habitats, with trees over 20 metres high, and generally roosts in tree hollows or trunks.	This species has a range from south eastern Queensland, through NSW, Victoria and into Tasmania, and occurs from the Great Dividing Range to the coast.	Brisbane Water NP Olney SF Popran NP	The species was potentially recorded in the Study Area and is potentially sensitive to the development.	Yes

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southern myotis *Myotis macropus*	V (TSC)	This species generally roosts 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. It forages over streams and pools catching insects and small fish by raking its feet across the water surface.	This species occurs along coastal Australia from the north-west of Australia, across the Top End and south to western Victoria. In NSW it generally occurs east of the great dividing range, with scattered inland records in the south west of the state.	Dharug NP Jilliby SCA Popran NP Wyrrabalong NP	The species has been potentially recorded in the Study Area and is potentially sensitive to the development.	Yes
greater broad-nosed bat *Scoteanax rueppellii*	V (TSC)	The greater broad-nosed bat appears to prefer moist environments such as moist gullies in coastal forests, or rainforest. They have also been found in gullies associated with wet and dry sclerophyll forests and open woodland. It roosts in hollows in tree trunks and branches and has also been found to roost in the roofs of old buildings.	The greater broad-nosed bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however it does not occur at altitudes above 500 metres.	Bouddi NP Brisbane Water NP Dharug NP Jilliby SCA Olney SF Popran NP Wyrrabalong NP	The species has been recorded in the Study Area and is potentially sensitive to the development.	Yes

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eastern cave bat *Vespadelus troughtoni*	V (TSC)	This bat is a cave-roosting (and disused mine dwelling) species that is usually located in dry-open forest and woodland in close proximity to cliffs and rocky over-hangs. Colonies can be up to 500 individuals in size. The eastern cave bat is occasionally located in wet eucalypt forest and rainforests along cliff-lines.	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.	This species is not known to occur in any reserves in the region.	The species has been potentially recorded in the Study Area and is potentially sensitive to the development.	Yes
eastern chestnut mouse *Pseudomys gracilicaudatus*	V (TSC)	In NSW the eastern chestnut mouse is mostly found, in low numbers, in heathland and is most common in dense, wet heath and swamps. Optimal habitat appears to be in vigorously regenerating heathland burnt from 18 months to four years previously. By the time the heath is mature, the larger swamp rat becomes dominant, and eastern chestnut mouse numbers drop again.	The eastern chestnut mouse is scattered along the east coast from Townsville to Brisbane Water NP; in the south-east region it is found at Jervis Bay.	Brisbane Water NP McPherson SF	This species has not been recorded within the Study Area. There is the potential this species could use the habitats of the Study Area, at least intermittently.	Yes

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New Holland mouse *Pseudomys novaehollandiae*	V (EPBC)	Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey and vegetated sand. The New Holland Mouse is a social animal, living predominantly in burrows shared with other individuals. The species peaks in abundance during early to mid stages of vegetation succession typically induced by fire.	The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. In 2006 there were known to be 6-8 meta populations of the species (NSW Atlas of Wildlife, VIC Atlas of Wildlife, TAS Natural Values Atlas). Across the species' range, the total population size of mature individuals estimated to be less than 10,000 individuals	Olney SF	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the project will result in an impact to this species.	No
Migratory Species						
Fork-tailed swift *Apus pacificus*	MIG	The fork-tailed swift is mostly found in Australia through the months of October through to April. This swift spends most of its time when in flight ahead of storm fronts and updraughts.	The fork-tailed swift can be found throughout Australia during migrating. In Australia it is most common west of the Great Dividing Range. This species is uncommon in Tasmania.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area. There is the potential this species could use the habitats of the Study Area, at least intermittently.	Yes

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Cattle egret *Ardea ibis*	MIG	The cattle egret can be found in grasslands, wetlands and woodlands and has never been identified in arid areas. These birds are commonly sighted at garbage dumps and pastures in croplands (especially where poor drainage is present).	The cattle egret is distributed throughout Asia, Africa, Europe and Australia. It is most commonly found in north-eastern WA, the NT and in south-eastern Australia from Bundaberg Queensland through to Port Augusta SA. It has also been identified in Tasmania.	This species is not known to occur in any reserves in the region.	The species has been potentially recorded in the Study Area and is potentially sensitive to the development.	Yes
Great egret *Ardea alba*	MIG	The great egret typically inhabits areas of shallow, flowing waters, but also uses damp grasslands and other watered areas. They can be observed both in flocks and on their own, and roost during the night in groups.	The great egret is distributed throughout the world, and is common throughout most areas of Australia, with exception to extremely arid areas.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area. There is the potential this species could use the habitats of the Study Area, at least intermittently.	Yes

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Oriental cuckoo *Cuculus optatus*	MIG	This species is found in many wooded habitats (such as open and dry woodland and forest) with a range of understoreys from grasses to shrubs or heath. Sometimes found near clearings and in recently logged or burnt forests. Found in farmland with some trees, orchards, vineyards and urban parks and gardens.	In Australia, Horsfield's Bronze-Cuckoo is found in all regions, including some islands. It is widespread on the eastern side of the Great Dividing Range in Queensland, and is found down through New South Wales and Victoria to Tasmania and South Australia, but not on the Nullarbor Plain. Widespread in the Northern Territory and Western Australia except in the most arid areas (also found on Ashmore Reef). It is also found from the Malay Peninsula to the lesser Sundas, Indonesia and, rarely, Aru Island and southern New Guinea.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area. There is the potential this species could use the habitats of the Study Area, at least intermittently.	Yes
White-throated needletail *Hirundapus caudatus*	MIG	This species only occurs in Australia between the months of October and May. It forages on flying insects and drinks whilst in flight. Feeding is typically associated with rising thermal currents typical with storm fronts and bushfires.	This species is distributed over eastern and northern Australia	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area. There is the potential this species could use the habitats of the Study Area, at least intermittently.	Yes

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Rainbow bee-eater *Merops ornatus*	MIG	The preferred habitat of the rainbow bee-eater is open forests and woodlands, shrublands, and cleared or semi-cleared areas (commonly farmland). These areas are usually in proximity to permanent water, however, during migration this bird may fly over areas of non-preferential habitat.	This species is distributed throughout most of mainland Australia as well as several near-shore islands. It is not found in Tasmania and has only been identified in a thin strip in the most arid regions of central WA.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Ruddy turnstone *Arenaria interpres*	MIG	This species is usually found on the coastline (rarely inland) in small groups. It prefers shallow pools located on areas of rock or reef, as well as beaches.	This species is known to inhabit most coast lines around the world, and breeds off the northern coasts of Asia, Europe and North America. The ruddy turnstone is distributed around the coast of mainland Australia as well as its offshore islands.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Sharp-tailed sandpiper *Calidris acuminata*	MIG	This species prefers the grassy edges of shallow inland freshwater wetlands. It is also found around sewage treatment plants, flooded fields, mudflats, mangroves, rocky shores and beaches.	This species is a summer migrant from Arctic Siberia, being found on wetlands throughout Australia.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

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Red knot *Calidris canutus*	MIG	This species gathers in large flocks on the coast in sandy estuaries with tidal mudflats.	This species is widespread around the Australian coast, less in the south with a few inland records.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Japanese snipe *Galliango hardwickii*	MIG	Lathams snipe can be found in permanent and ephemeral wetlands up to 2000 m above sea level. These water bodies are usually freshwater with low, dense vegetation. It forages in areas of mud with some vegetation cover and roosts nearby. Lathams snipe does not breed in Australia, only passing through for migration.	This species has been recorded from Cape York through to south-east SA. The range of this species extends from inland of the eastern tablelands in south-east Queensland to west of the Great Dividing Range in NSW. Richmond River, NSW is a favourite area for non-breeding birds.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area. There is the potential this species could use the habitats of the Study Area, at least intermittently.	Yes
Eastern curlew *Numenius madagascariensis*	MIG	This species is typically found in areas of sheltered coasts, particularly bays, coastal lagoons, estuaries, bays, harbours and inlets. It tends to feed on soft-sheltered intertidal sand or mudflats. It is rarely seen in grassy areas and roosts on sandy spits and islets.	In Australia this species can be found in all states, but generally along the north, east or south-east coasts. It has been recorded on Lord Howe and Norfolk Islands.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

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Osprey *Pandion haliaeetus*	MIG	Favours coastal areas, especially the mouths of large rivers, lagoons and lakes.	Ospreys are found around the Australian coast line, 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.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area. There is the potential this species could use the habitats of the Study Area, at least intermittently.	Yes
Black-faced monarch *Monarcha melanopsis*	MIG	This bird occurs in coastal scrub, damp gullies, eucalypt woodlands and rainforests. It can be seen foraging for insects amongst foliage, and builds a deep, cup-shaped nest in a tree fork (3 to 6 m above the ground) which is made up of cobwebs, casuarinas needles, bark, moss and roots.	The black-faced monarch is distributed along the eastern coast of Australia, gradually becoming less common towards the south.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area. There is the potential this species could use the habitats of the Study Area, at least intermittently.	Yes
Spectacled monarch *Monarcha trivirgatus*	MIG	This bird is migratory and can typically be identified in dense understories of rainforests, as well as mangroves, riparian vegetation and wet gullies.	The spectacled monarch is distributed from Cape York in Queensland to Port Stephens in NSW. As well as some islands of northern Queensland, the Moluccas, Papua New Guinea and Timor	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area. There is the potential this species could use the habitats of the Study Area, at least intermittently.	Yes

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Yellow wagtail *Motacilla flava*	MIG	This species occurs in a variety of damp or wet habitats with low vegetation, from rushy pastures, meadows, hay fields and marshes to damp steppe and grassy tundra	In Australia, this species can be found nearly everywhere except t far south-west Western Australia.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Satin flycatcher *Myagria cyanoleuca*	MIG	This species typically inhabits wet areas of tall forests, particularly in gullies. The satin flycatcher moves north in the winter and is seldom seen in NSW, Tasmania, Victoria or SA during these times. It nests in loose colonies in broad-based cup-shaped nests on a bare horizontal branch. These nests are constructed from bark, grass, lichen and cobwebs.	The satin flycatcher can be found in both Australia and New Guinea. In Australia it is distributed along the east coast from Cape York through to Tasmania, also covering parts of south-eastern SA.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Rufous fantail *Rhipidura albifrons*	MIG	The rufous fantail typically inhabits areas of dense wet forest, mangrove, rainforest or swamp woodlands. It prefers areas where there is intense shade available and is often seen close to ground. In winter it is seldom found in NSW or Victoria. Nests are about 5 m from the ground in a small cup shape and constructed from thin grasses held together by cobwebs.	This species is distributed across the north and eastern coast of Australia, but is also found in Guam, New Guinea, the Solomon Islands and Sulawesi.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Common sandpiper *Actitis hypoleucos*	MIG	This species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats.	This species is found along all coastlines of Australia and in many areas inland, the common sandpiper is widespread in small numbers. The population when in Australia is concentrated in northern and western Australia.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Sanderling *Calidris alba*	MIG	Often found in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons. Individuals are rarely recorded in near-coastal wetlands.	A regular summer migrant from Siberia and other Arctic breeding grounds to most of the Australian coastline. It is uncommon to locally common along the NSW coast, with occasional inland sightings.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Curlew Sandpiper *Calidris ferruginea*	MIG	This species is mostly identified in areas of sheltered coastline on intertidal mudflats. They forage in mudflats and nearby shallow waters.	In Australia the curlew sandpiper is distributed across the coasts as well as certain inland areas in smaller numbers. In NSW this species is widely known to the east of the Great Dividing Range, mostly in coastal areas; however, some birds have been recorded in the Tablelands, Riverina and the south-west of the state.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Pectoral sandpiper *Calidris melanotos*	MIG	This species is usually found in shallow fresh waters with low grass or swamp margins, flooded pastures, sewage ponds, occasionally tidal areas and saltmarsh.	This species is a summer migrant to Australia and mainly occurs along the coast with some occurrences in inland Australia.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Great Knot *Calidris tenuirostris*	MIG	Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sand flats, including inlets, bays, harbours, estuaries and lagoons. Often recorded on sandy beaches with mudflats nearby, sandy spits and islets and sometimes on exposed reefs or rock platforms.	This species has been recorded at scattered sites along the coast to about Narooma. It has also been observed inland at Tullakool, Armidale, Gilgandra and Griffith.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Greater Sand-plover *Charadrius leschenaultii*	MIG	Almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks.	This species has been recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Lesser Sand-plover *Charadrius mongolus*	MIG	Almost entirely coastal in NSW, favouring the beaches of sheltered bays, harbours and estuaries with large inter-tidal sandflats or mudflats; occasionally occurs on sandy beaches, coral reefs and rock platforms.	Most common in the Gulf of Carpentaria, and along the east coast of Queensland and northern NSW. Individuals are rarely recorded south of the Shoalhaven estuary, and there are few inland records.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No
Broad-billed Sandpiper *Limicola falcinellus*	MIG	Favours sheltered parts of the coast, such as estuarine sandflats and mudflats, harbours, embayments lagoons, saltmarshes and reefs as feeding and roosting habitat. Occasionally, individuals may be recorded in sewage farms or within shallow freshwater lagoons. Broad-billed sandpipers roost on banks on sheltered sand, shell or shingle beaches.	Most records from Hunter Estuary, with birds occasionally reaching the Shoalhaven Estuary.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Study Area	Reservation in the Region	Occurrence in Study Area and Potential for Significant Impact	Assessment of Significance Required?
Black-tailed Godwit *Limosa limosa*	MIG	Primarily a coastal species. Usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. Further inland, it can also be found on mudflats and in water less than 10 cm deep around muddy lakes and swamps. Individuals have also been recorded in wet fields and sewerage treatment works.	This species is migratory, flying to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently recorded at Kooragang Island and Stockton Sandspit, with occasional records elsewhere along the north and south coast, and inland. This species has been recorded within the Murray-Darling Basin, on the western slopes of the Northern Tablelands and in the far north-western corner of the state.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Study Area, and is unlikely to occur. It is highly unlikely that the Project will result in an impact to this species.	No

Note

ASL:	above sea level
B	Bonn Convention
C	CAMBA Convention
CD:	conservation dependent
E:	endangered
EP:	endangered population
EPBC:	Environment Protection Biodiversity Conservation Act
EX	extinct
FM	Fisheries Management Act
J	JAMBA
K	ROKAMBA Convention
LGA:	Local Government Area
MAR:	Marine
MIG:	Migratory
NP:	National Park
NR:	Nature Reserve
P	protected
PD:	preliminary determination
SF:	State Forest
SCA:	State Conservation Area
TSC:	Threatened Species Conservation Act
V:	vulnerable

APPENDIX 2

Flora Species List

Appendix 2 – Flora Species List

The following list was developed from current and previous surveys undertaken of the Study Area as detailed in **Section 2.0** of the main report. It includes all species of vascular plants observed in the Study Area during the field surveys. Not all species are readily detectable at any one time of the year; therefore the list will not necessarily include all plant species likely to occur in the Study Area. Many species flower only during restricted periods of the year, and some flower only once in several years. In the absence of flowering material (particularly in the presence of heavy grazing) many of these species cannot be identified or even detected.

Names of classes and families follow a modified Cronquist (1981) System.

Any species that could not be identified to the lowest taxonomic level are denoted in the following manner:

- sp. specimens that are identified to genus level only.

The following abbreviations or symbols are used in the list:

- asterisk (*) denotes species not indigenous to the Study Area;
- subsp. subspecies;
- **bold** text is used to indicate a threatened species or endangered populations; and
- var. variety.

All vascular plants recorded or collected were identified using keys and nomenclature in Harden (1992, 1993, 2000 & 2002) and Wheeler *et al.* (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from *PlantNET* (Botanic Gardens Trust 2016b), the on-line plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 & 2002) where available, and draw on other sources such as local names where these references do not provide a common name.

Table A2.1 Flora Species List

Family	Scientific Name	Common Name	Flora Surveys Undertaken during Prior Surveys													Flora Surveys as part of Current Study										
			WYNA7	WYNA8	WYNA9	WYNB1	WYNB2	WYNB3	WYNB4	WYNB5	WYNB6	WYNB7	WYNB8	Umwelt 1	R03 Umwelt	Opportunistic	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	Opportunistic
Filicopsida (Ferns)																										
Adiantaceae	*Adiantum aethiopicum*	maidenhair fern																								2	
Adiantaceae	*Cheilanthes sieberi* subsp. *sieberi*	poison rock fern									2																
Dennstaedtiaceae	*Hypolepis muelleri*	harsh ground fern																									
Dennstaedtiaceae	*Pteridium esculentum*	bracken								2	2	2	1	1							2	2					
Dicksoniaceae	*Calochlaena dubia*	common ground fern												2													
Gleicheniaceae	*Gleichenia microphylla*	parasol fern																				1					
Lindsaeaceae	*Lindsaea linearis*	screw fern												1													
Magnoliopsida (Flowering Plants) – Liliidae (Monocots)																											
Anthericaceae	*Caesia parviflora* var. *parviflora*	pale grass-lily							1				2									2					
Anthericaceae	*Thysanotus juncifolius*	branching fringe lily								2	2	2															
Arecaceae	*Livistona australis*	cabbage palm																								1	
Asparagaceae	*Asparagus aethiopicus**	asparagus fern																								1	
Commelinaceae	*Commelina cyanea*	native wandering Jew													2												
Cyperaceae	*Carex* sp.														2												
Cyperaceae	*Cyperus brevifolius**	Mullumbimby couch	2																								

Family	Scientific Name	Common Name	Flora Surveys Undertaken during Prior Surveys														Flora Surveys as part of Current Study										
			WYNA7	WYNA8	WYNA9	WYNB1	WYNB2	WYNB3	WYNB4	WYNB5	WYNB6	WYNB7	WYNB8	Umwelt 1	R03 Umwelt	Opportunistic	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	Opportunistic
Cyperaceae	*Cyperus congestus**			1																							
Cyperaceae	*Cyperus polystachyos*		2		2															2						3	
Cyperaceae	*Cyperus* sp.																				2						
Cyperaceae	*Gahnia aspera*	rough saw-sedge		1		2	1	1	2	1																	
Cyperaceae	*Gahnia clarkei*	tall saw-sedge												2													
Cyperaceae	*Gahnia* sp.																					1					
Cyperaceae	*Lepidosperma gunnii*													4													
Cyperaceae	*Lepidosperma laterale*						1				2		2	3								2					
Cyperaceae	*Schoenoplectiella mucronata*																		2								
Cyperaceae	*Schoenus apogon*	fluke bogrush					2			2	2	2	2							2							
Iridaceae	*Patersonia longifolia*	purple flag									2	2															
Juncaceae	*Juncus cognatus**		3	2	2		2	2																			
Juncaceae	*Juncus continuus*								2																		
Juncaceae	*Juncus planifolius*		3																								
Juncaceae	*Juncus prismatocarpus*			1			1		3				2														
Juncaceae	*Juncus usitatus*																2			2						3	
Lomandraceae	*Lomandra glauca*	pale mat-rush											1														
Lomandraceae	*Lomandra longifolia*	spiny-headed mat-rush					1	1	1					1													
Lomandraceae	*Lomandra multiflora*	many-flowered mat-rush		2				1																			
Lomandraceae	*Lomandra sp.*																					2					

Family	Scientific Name	Common Name	Flora Surveys Undertaken during Prior Surveys														Flora Surveys as part of Current Study										
			WYNA7	WYNA8	WYNA9	WYNB1	WYNB2	WYNB3	WYNB4	WYNB5	WYNB6	WYNB7	WYNB8	Umwelt 1	R03 Umwelt	Opportunistic	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	Opportunistic
Orchidaceae	*Arthrochilus prolixus*																										X
Orchidaceae	*Calochilus robertsonii*	purplish beard orchid					1		1																		
Orchidaceae	*Cryptostylis erecta*	bonnet orchid																			1						
Orchidaceae	*Cryptostylis subulata*	large tongue orchid											1														X
Orchidaceae	*Microtis* sp.											2															
Orchidaceae	*Spiranthes australis*																										X
Orchidaceae	*Thelymitra* sp.					1													1								
Orchidaceae	*Thelymitra ixioides* x *pauciflora*																										X
Phormiaceae	*Dianella caerulea*	blue flax lily												2													
Phormiaceae	*Dianella longifolia*	blueberry flax lily								2	2		2														
Phormiaceae	*Thelionema umbellatum*	lemon flax lily									2																
Poaceae	*Andropogon virginicus**	whisky grass																	1								
Poaceae	*Axonopus fissifolius**	narrow-leaved carpet grass															2		3					2	2		
Poaceae	*Briza maxima**	quaking grass																	2								
Poaceae	*Briza minor**	shivery grass	3	2	3	2	2	2	2									2	1	2					2		
Poaceae	*Bromus* sp.*																						2	3	2		
Poaceae	*Chloris* sp.																							3			
Poaceae	*Cynodon dactylon*	common couch													2										3		
Poaceae	*Dichelachne micrantha*	shorthair plumegrass				2	2	2	2	2	2	2	2				2	2						1			

Family	Scientific Name	Common Name	Flora Surveys Undertaken during Prior Surveys													Flora Surveys as part of Current Study										
			WYNA7	WYNA8	WYNA9	WYNB1	WYNB2	WYNB3	WYNB4	WYNB5	WYNB6	WYNB7	WYNB8	Umwelt 1	R03 Umwelt	Opportunistic	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	Opportunistic
Poaceae	*Digitaria ciliaris**	summer grass													2												
Poaceae	*Digitaria parviflora*	small-flowered finger grass												3			2		2								
Poaceae	*Echinopogon caespitosus var. caespitosus*	tufted hedgehog grass				2	2	2	3	2	2	2	2				2		2							2	
Poaceae	*Echinopogon ovatus*	forest hedgehog grass													2		2										
Poaceae	*Ehrharta erecta**	panic veldtgrass													2												
Poaceae	*Entolasia stricta*	wiry panic		2		2	2	2	2	3	2	3	3	3			2				3	2					
Poaceae	*Imperata cylindrica*	blady grass								3	2	3	2														
Poaceae	*Imperata cylindrica* var. *major*	blady grass												2													
Poaceae	*Lolium perenne**	perennial ryegrass															3						3	3			
Poaceae	*Microlaena stipoides*	weeping grass	2		2																1						
Poaceae	*Microlaena stipoides* var. *stipoides*	weeping grass												2			2					2					
Poaceae	*Oplismenus aemulus*	basket grass													3											3	
Poaceae	*Paspalum dilatatum**	paspalum	2		2																						
Poaceae	*Pennisetum clandestinum**	kikuyu																4					4				
Poaceae	*Poa sieberiana*										2	2	2														
Poaceae	*Rytidosperma fulva*	wallaby grass		2		5	5	2	2	2	2	2	2				2										
Poaceae	*Rytidosperma* sp.																		2								
Poaceae	*Setaria parviflora**																		2								

Family	Scientific Name	Common Name	Flora Surveys Undertaken during Prior Surveys													Flora Surveys as part of Current Study										
			WYNA7	WYNA8	WYNA9	WYNB1	WYNB2	WYNB3	WYNB4	WYNB5	WYNB6	WYNB7	WYNB8	Umwelt 1	R03 Umwelt	Opportunistic	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	Opportunistic
Poaceae	*Stenotaphrum secundatum**	buffalo grass	6	3	6	5	5	6	6																2		
Poaceae	*Themeda triandra*	kangaroo grass		3		5	3	2	2	3	3	3	3				2		2								
Magnoliopsida (Flowering Plants) – Magnoliidae (Dicots)																											
Amaranthaceae	*Alternanthera denticulata*	lesser joyweed																								2	
Amaranthaceae	*Amaranthus* sp.		1		1																						
Apiaceae	*Centella asiatica*	pennywort		2		2	2	3	3	2	2	2	2							2						2	
Apiaceae	*Platysace linearifolia*										2		2														
Apocynaceae	*Parsonsia straminea*	common silkpod												2	3						1	1				2	
Asteraceae	*Brachycome angustifolia*									2	2	2	2									2					
Asteraceae	*Calotis lappulacea*	yellow burr-daisy		2		2		2			2	2	2														
Asteraceae	*Cirsium vulgare**	spear thistle																			1					2	
Asteraceae	*Conyza* sp.*																		2		2		2				
Asteraceae	*Cotula australis*	common cotula																						1		1	
Asteraceae	*Craspedia variabilis*	common billy-buttons									1	3	1														
Asteraceae	*Epaltes australis*	nut-heads																	2								
Asteraceae	*Gamochaeta purpurea**																			2				2			
Asteraceae	*Hypochaeris radicata**	catsear	2	2	2	2	2	2	2	1	1	1	1	1	2			3	2	2	2						
Asteraceae	*Pseudognaphalium luteoalbum*	Jersey Cudweed	2		2																						
Asteraceae	***Rutidosis heterogama*[1]**	**Heath wrinklewort**														**X**											

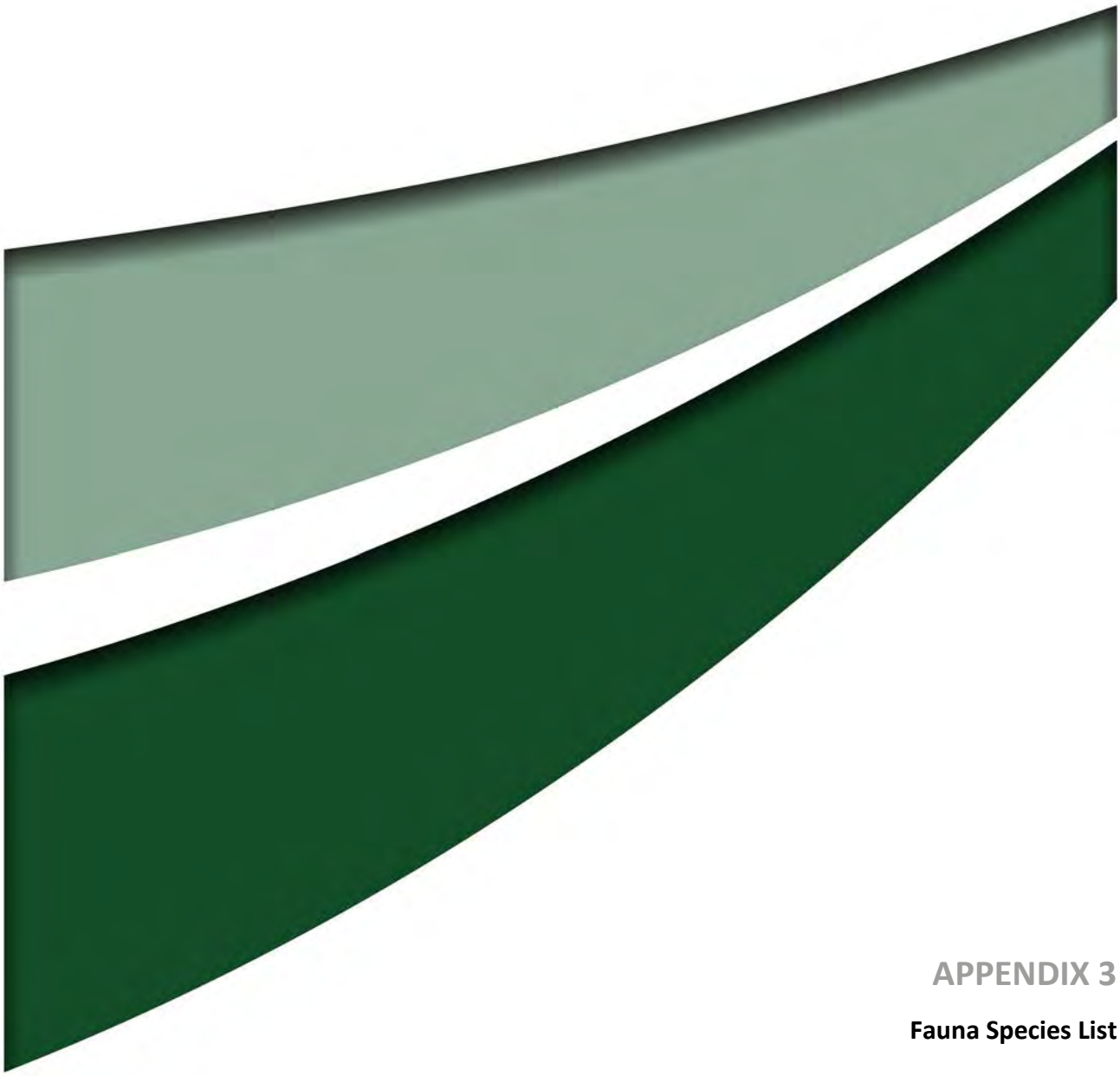
Family	Scientific Name	Common Name	Flora Surveys Undertaken during Prior Surveys													Flora Surveys as part of Current Study										
			WYNA7	WYNA8	WYNA9	WYNB1	WYNB2	WYNB3	WYNB4	WYNB5	WYNB6	WYNB7	WYNB8	Umwelt 1	R03 Umwelt	Opportunistic	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	Opportunistic
Asteraceae	*Senecio madagascariensis**	Fireweed	2	1	2			1	1						1		2	2	2	2	2		3	2	2		
Asteraceae	*Taraxacum officinale**	dandelion																			1						
Bignoniaceae	*Pandorea pandorana subsp. pandorana*	Wonga Wonga vine												1													
Brassicaceae	*Cardamine hirsuta**	common bittercress																								1	
Caprifoliaceae	*Lonicera japonica**	Japanese honeysuckle																									
Caryophyllaceae	*Cerastium glomeratum**	mouse-eared chickweed																2					2				
Casuarinaceae	*Allocasuarina littoralis*	black sheoak						1			2	1	1	3								3					
Casuarinaceae	*Allocasuarina torulosa*	forest oak												3													
Convolvulaceae	*Dichondra repens*	kidney weed													2											2	
Convolvulaceae	*Polymeria calycina*													2								2					
Droseraceae	*Drosera spatulata*																	2									
Epacridaceae	*Epacris pulchella*	wallum heath					1			2	2	3										1					
Euphorbiaceae	*Phyllanthus hirtellus*	thyme spurge								2	2	3	2														
Euphorbiaceae	*Phyllanthus hirtellus* forma *A*													2													
Fabaceae (Caesalpinoideaea)	*Senna pendula* var. *glabrata**																									2	
Fabaceae (Faboideae)	*Daviesia ulicifolia*	gorse bitter pea		1		2		1		1							2										
Fabaceae (Faboideae)	*Hardenbergia violacea*	false sarsaparilla				2				2		1															

Family	Scientific Name	Common Name	Flora Surveys Undertaken during Prior Surveys													Flora Surveys as part of Current Study										
			WYNA7	WYNA8	WYNA9	WYNB1	WYNB2	WYNB3	WYNB4	WYNB5	WYNB6	WYNB7	WYNB8	Umwelt 1	R03 Umwelt	Opportunistic	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	Opportunistic
Fabaceae (Faboideae)	*Lotus suaveolens**	hairy birds-foot trefoil	1																							
Fabaceae (Faboideae)	*Medicago* sp.*																		2							
Fabaceae (Faboideae)	*Oxylobium scandens*	netted shaggy pea								2	2															
Fabaceae (Faboideae)	*Phyllota phylicoides*	heath phyllota								3	3	3	3													
Fabaceae (Faboideae)	*Trifolium repens**	white clover																3			2		4	4	3	2	
Fabaceae (Mimosoideae)	*Acacia longifolia*							1																			
Gentianaceae	*Centaurium tenuiflorum**		2	2	2	2	2	2	2	2	2	2	2					2									
Geraniaceae	*Geranium* sp.																									2	
Goodeniaceae	*Glycine clandestina*													2													
Goodeniaceae	*Goodenia bellidifolia* subsp. *bellidifolia*									3	3	3	3														
Goodeniaceae	*Goodenia dimorpha*			2		2	2	2	2																		
Goodeniaceae	*Goodenia heterophylla*					2	2	2	2	3	2	2	2														
Haemodoraceae	*Haemodorum corymbosum*						1					2															
Haloragaceae	*Gonocarpus teucrioides*	raspwort		2		2	2	1	3	3	2	2	3														
Hypoxidaceae	*Hypoxis hygrometrica*	golden weather-grass						2	2																		
Lauraceae	*Cassytha glabella* forma *glabella*										2			3													
Lauraceae	*Cinnamomum camphora**	camphor laurel																				2				2	
Lobeliaceae	*Pratia purpurascens*	whiteroot		2		2	2	2	2	2	2	2	2	1					2		2						

Family	Scientific Name	Common Name	Flora Surveys Undertaken during Prior Surveys													Flora Surveys as part of Current Study										
			WYNA7	WYNA8	WYNA9	WYNB1	WYNB2	WYNB3	WYNB4	WYNB5	WYNB6	WYNB7	WYNB8	Umwelt 1	R03 Umwelt	Opportunistic	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	Opportunistic
Malvaceae	*Sida rhombifolia**	Paddy's lucerne													2											
Myrtaceae	*Angophora costata*	Sydney red gum							1	2	2		1	3					3		3	3				
Myrtaceae	*Angophora floribunda*	rough-barked apple							1																	
Myrtaceae	*Corymbia maculata*	spotted gum		2		2	3	2		1	2	1	2	1	2		3		3					1		
Myrtaceae	*Eucalyptus capitellata*	brown stringybark				1			1	1	1		1						2		2					
Myrtaceae	*Eucalyptus fibrosa*	red ironbark								1							1									
Myrtaceae	*Eucalyptus haemostoma*	broad-leaved scribbly gum																				1				
Myrtaceae	*Eucalyptus resinifera* subsp. *resinifera*	red mahogany												2												
Myrtaceae	*Eucalyptus tereticornis*	forest red gum							1						3									3	1	
Myrtaceae	*Leptospermum polygalifolium*	tantoon									1															
Myrtaceae	*Melaleuca nodosa*						2	2		3	3	3		4	4							2			2	4
Myrtaceae	*Melaleuca sieberi*									2		2	2	3	4							2		1		
Myrtaceae	*Melaleuca* sp.																			1						
Myrtaceae	*Melaleuca* sp. 2																							2		
Myrtaceae	*Melaleuca thymifolia*				1				1													1				
Oleaceae	*Ligustrum sinense**	small-leaved privet																							2	
Pittosporaceae	*Billardiera scandens* var. *scandens*													1												
Plantaginaceae	*Plantago debilis*																2			2						

Family	Scientific Name	Common Name	Flora Surveys Undertaken during Prior Surveys													Flora Surveys as part of Current Study										
			WYNA7	WYNA8	WYNA9	WYNB1	WYNB2	WYNB3	WYNB4	WYNB5	WYNB6	WYNB7	WYNB8	Umwelt 1	R03 Umwelt	Opportunistic	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	Opportunistic
Plantaginaceae	*Plantago lanceolata**	lamb's tongues	2	2	1	2	2	2	2	2	2	2	2		1		2	2	2				2		2		
Polygonaceae	*Comesperma ericinum*						1			2			1														
Polygonaceae	*Persicaria strigosa*	spotted knotweed																								2	
Polygonaceae	*Rumex brownii*	swamp dock																							4		
Primulaceae	*Anagallis arvensis**	scarlet pimpernel			2																		2				
Proteaceae	*Lambertia formosa*	mountain devil		2		2								1													
Proteaceae	*Persoonia levis*	broad-leaved geebung												2													
Pteridaceae	*Cheilanthes austrotenuifolia*																					2				2	
Ranunculaceae	*Ranunculus inundatus*	river buttercup															2			2						3	
Rosaceae	*Rubus fruticosus**	blackberry																								2	
Rubiaceae	*Opercularia diphylla*			1																							
Scrophulariaceae	*Veronica plebeia*	trailing speedwell															2										
Stylidiaceae	*Stylidium graminifolium*	grass triggerplant								2		2	1														
Thymelaeaceae	*Pimelea linifolia*										2	2	1								2	2					
Verbenaceae	*Lantana camara**	lantana																			1						
Verbenaceae	*Verbena bonariensis**																							1			
Violaceae	*Viola hederacea*																									2	

[1] This species was identified opportunistically as part of surveys undertaken previously (not by Umwelt). These records were searched for during current Study and could not be relocated.



APPENDIX 3

Fauna Species List

Appendix 3 – Fauna Species List

The following list was developed from surveys of the Study Area detailed in **Section 2.4** of the main report and threatened species identified during previous surveys within the Warnervale Precinct 7A Study Area. It includes all species of vertebrate fauna observed during fieldwork.

The following abbreviations or symbols are used to identify the method of detection in the appendix table:

- ✓ Identified from visual sighting or characteristic call;
- C 'Definite' identification by Echo Ecology;
- P 'Probable' identification by Echo Ecology; and
- Po 'Possible' identification by Echo Ecology.

Any species that could not be identified to the species taxonomic level are denoted in the following manner:

- sp. specimens that are identified to genus level only.

The following abbreviations or symbols are used in the list:

- asterisk (*) denotes species not indigenous to the Study Area
- MIG Listed migratory species under the EPBC Act and
- V Vulnerable under Schedule 2 of the TSC Act or under the EPBC Act.

Birds recorded were identified using descriptions in Slater *et al.* (2009) and the scientific and common name nomenclature of BirdLife Australia (2016). Reptiles recorded were identified using keys and descriptions in Cogger (2014), Swan *et al*. (2004) and Wilson and Swan (2010) and the scientific and common name nomenclature of Cogger (2014).

Amphibians recorded were identified using keys and descriptions in Cogger (2014) and Robinson (2002) and the scientific and common name nomenclature of Cogger (2014). Mammals recorded were identified using keys and descriptions in Van Dyke and Strahan (2008), Churchill (2008) and Menkhorst and Knight (2011) and the scientific and common name nomenclature of Van Dyke and Strahan (2008).

Table A3.1 Fauna Species Identified in the Study Area

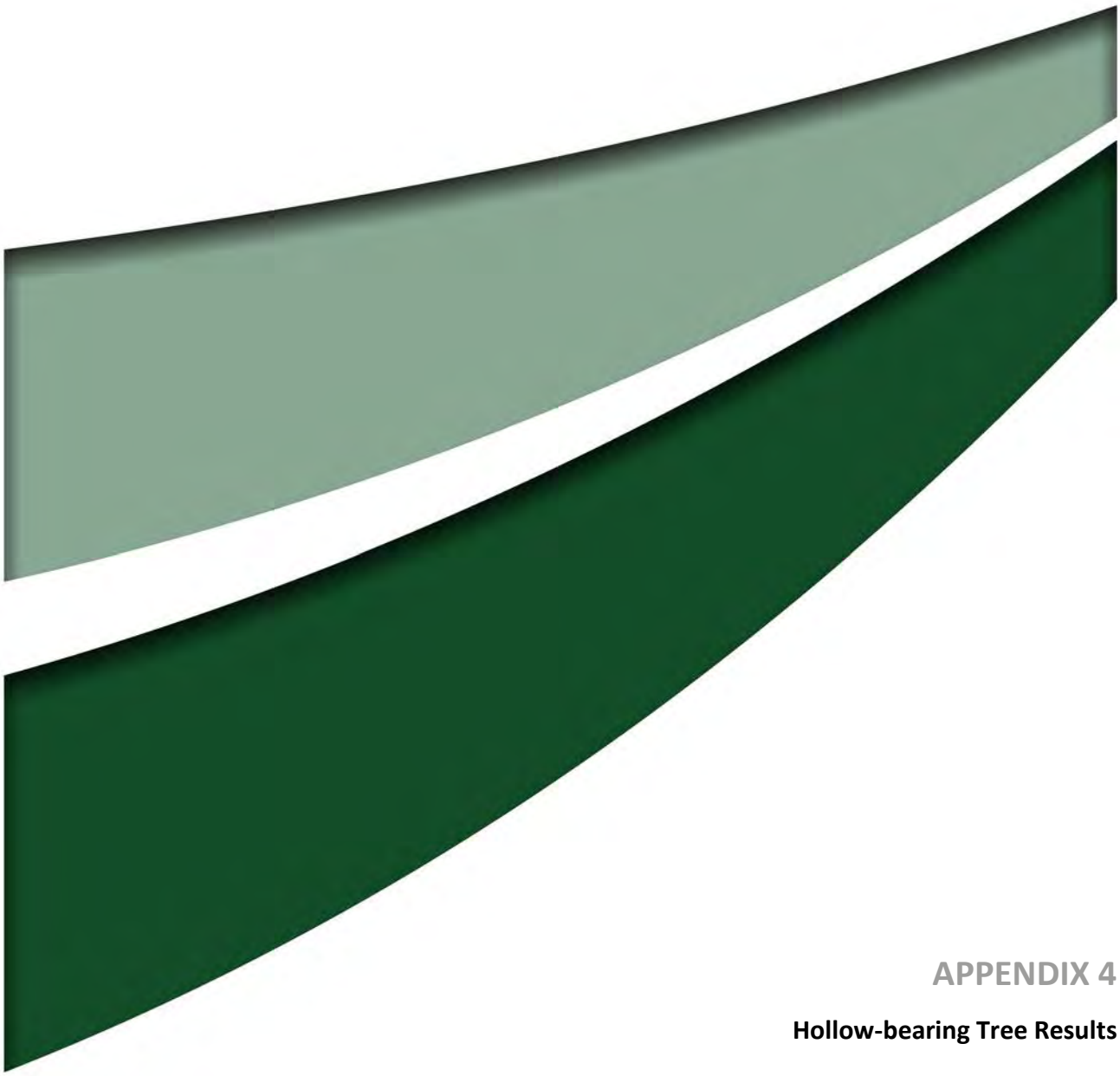
Scientific Name	Common Name	Conservation Status		Identified During Current Survey in Study Area	Identified as part of Survey or Literature (Umwelt 2013) within Study Area
		TSC Act	EPBC Act		
Amphibians					
Myobatrachidae					
Crinia tinnula	Wallum froglet	V			X
Crinia signifera	brown froglet			X	
Hylidae					
Litoria fallax	green reed frog, dwarf tree frog			X	
Litoria peronii	Peron's tree frog			X	
Reptiles					
Cheloniidae					
Chelodina longicollis	snake-necked turtle			X	
Varanidae					
Varanus varius	lace monitor			X	
Scincidae					
Saiphos equalis	three-toed skink			X	
Birds					
Anatidae					
Chenonetta jubata	Australian wood duck			X	
Columbidae					
Ocyphaps lophotes	crested pigeon			X	
Podargidae					
Podargus strigoides	tawny frogmouth			X	
Tytonidae					
Tyto alba	Eastern barn owl			X	
Aegothelidae					
Aegotheles cristatus	Australian owlet-nightjar			X	
Phalacrocoracidae					
Phalacrocorax melanoleucos	little pied cormorant			X	
Ardeidae					
Ardea ibis	cattle egret		MIG	X	

Scientific Name	Common Name	Conservation Status		Identified During Current Survey in Study Area	Identified as part of Survey or Literature (Umwelt 2013) within Study Area
		TSC Act	EPBC Act		
Accipitridae					
Hieraaetus morphnoides	little eagle	V			X
Falconidae					
Falco cenchroides	nankeen kestrel			X	
Falco longipennis	Australian hobby			X	
Falco subniger	black falcon	V		X	
Charadriidae					
Vanellus miles	masked lapwing			X	
Cacatuidae					
Cacatua roseicapillus	galah			X	
Cacatua sanguinea	little corella			X	
Cacatua galerita	sulphur-crested cockatoo			X	
Psittacidae					
Trichoglossus haematodus	rainbow lorikeet			X	
Alisterus scapularis	Australian king-parrot			X	
Platycercus eximius	eastern rosella			X	
Cuculidae					
Eudynamis orientalis	eastern koel			X	
Scythrops novaehollandiae	channel-billed cuckoo			X	
Strigidae					
Ninox connivens	barking owl	V		X	
Ninox novaeseelandiae	southern boobook			X	
Halcyonidae					
Dacelo novaeguineae	laughing kookaburra			X	
Coraciidae					
Eurystomus orientalis	dollarbird			X	
Climacteridae					
Corombates leucophaea	white-throated treecreeper			X	
Meliphagidae					

Scientific Name	Common Name	Conservation Status		Identified During Current Survey in Study Area	Identified as part of Survey or Literature (Umwelt 2013) within Study Area
		TSC Act	EPBC Act		
Lichenostomus chrysops	yellow-faced honeyeater			X	
Manorina melanocephala	noisy miner			X	
Anthochaera carunculata	red wattlebird			X	
Philemon corniculatus	noisy friarbird			X	
Artamidae					
Cracticus nigrogularis	pied butcherbird			X	
Gymnorhina tibicen	Australian magpie			X	
Rhipiduridae					
Rhipidura albiscapa	grey fantail			X	
Rhipidura leucophrys	willie wagtail			X	
Corvidae					
Corvus coronoides	Australian raven			X	
Monarchidae					
Grallina cyanoleuca	magpie-lark			X	
Corcoracidae					
Corcorax melanorhamphos	white-winged chough			X	
Sturnidae					
*Sturnus trisitis**	common myna			X	
Estrildidae					
Neochmia temporalis	red-browed finch			X	
Mammals					
Petauridae					
Petaurus breviceps	sugar glider			X	
Petaurus norfolcensis	squirrel glider	V			X
Petaurus sp.	Unidentified glider	V?		X	
Pseudocheiridae					
Pseudocheirus peregrinus	common ringtail possum			X	
Phalangeridae					
Trichosurus vulpecula	common brushtail possum			X	

Scientific Name	Common Name	Conservation Status		Identified During Current Survey in Study Area	Identified as part of Survey or Literature (Umwelt 2013) within Study Area
		TSC Act	EPBC Act		
Emballonuridae					
Saccolaimus flaviventris	yellow-bellied sheathtail-bat	V		Probable	
Molossidae					
Mormopterus norfolkensis	eastern freetail-bat	V		Definite	
Mormopterus ridei				Definite	
Nyctinomus australis	white-striped freetail-bat			Definite	
Unidentified Microbat				X	
Vespertilionidae					
Miniopterus australis	little bentwing-bat	V		Definite	
Miniopterus schreibersii oceanensis	eastern bentwing-bat	V			X
Chalinolobus gouldii	Gould's wattled bat			Definite	
Chalinolobus morio	chocolate wattled bat			Definite	
Myotis macropus	Southern myotis	V			X
Scoteanax rueppellii	greater broad-nosed bat	V		Probable	
Vespadelus pumilus	eastern forest bat			Definite	
Vespadelus vulturnus	little forest bat			Probable	
Canidae					
*Canis lupus familiaris**	dog			X	
*Vulpes vulpes**	fox			X	
Bovidae					
Bos taurus	cow			X	
Microbat Species Groups					
Chalinolobus gouldii / ***Mormopterus norfolkensis*** / *Mormopterus ridei*		V		X	
Chalinolobus gouldii / *Mormopterus ridei*				X	
Chalinolobus gouldii / ***Scoteanax rueppellii***		V		X	

Scientific Name	Common Name	Conservation Status		Identified During Current Survey in Study Area	Identified as part of Survey or Literature (Umwelt 2013) within Study Area
		TSC Act	EPBC Act		
Chalinolobus morio / *Vespadelus pumilus* / *Vespadelus vulturnus* / ***Vespadelus troughtoni***	V			X	
Falsistrellus tasmaniensis / *Scotorepens orion*	V			X	
Falsistrellus tasmaniensis / *Scotorepens orion* / ***Scoteanax rueppellii***	V			X	
Miniopterus australis / *Vespadelus pumilus*	V			X	
Miniopterus schreibersii oceanensis / *Vespadelus darlingtoni* / *Vespadelus regulus*	V			X	
Mormopterus norfolkensis / *Mormopterus ridei*	V			X	
Myotis macropus / *Nyctophilus geoffroyi* / *Nyctophilus gouldi*	V			X	
Vespadelus pumilus / *Vespadelus vulturnus* / ***Vespadelus troughtoni***	V			X	



APPENDIX 4

Hollow-bearing Tree Results

The following table presents the results of tree hollow surveys undertaken during 2016 surveys. The following Symbols are used within this table:

- A appropriate aspect (i.e. not west facing)
- D appropriate depth for target species usage
- E appropriate diameter of hollow entrance for target species usage
- H height of hollow above the ground was appropriate for target species usage
- S hollow was solid (i.e. was not cracked or rotted)

Table A4.1 Hollow Bearing Trees identified during Surveys of the Study Area

GPS ID	Coordinates (MGA56)		DBH mm	Tree Species	Hollow Size (mm)					Aspect	Height off ground (m)	Depth (mm)	Condition	Sign	Species Observed/ inferred	Comments	Remote camera installed	Potential Owl Tree	Potential Glider Tree
	Eastings	Northings			Tiny<25	Small 26-50	Medium 51-100	Large 100-300	Massive 301+										
1	355960	6319431	756	Angophora costata		1				W	10							H	E, HD
1								1		N	6.5	<300	Solid	Nil	Nil	Full of water - spout hollow		E, H, A	H, A, D
2	355806	6319313	793	Eucalyptus capitulata			1			W	10	>1000	Solid	egg	?	photo		D, H, S	E, H, S D
2							1			E	7	300-1000	Solid	Nil	Nil			D, H, S, A	E, H, S, A, D
2								1		N	10	>1000	Solid	fresh wear on entrance	Nil			E, H, A, D	H, A, D
2								1		W	12	300-1000	Solid	?	Aust. Owlet nightjar	photo		H,E, DS	HD
3	355758	6319309	98	Angophora costata			1			N	8	>1000	S	couldn't see bottom	Nil		31	H, A, DS	H, A, DS
3									1	SE	20						31	E, H, A	H, A
4	355685	6319259	1150	Angophora costata				1		S	6	<300	Rotten	Nil	Nil			E, H, A	H, A, D
5	355643	6319248	734	Angophora floribunda				1		N	10	300-1000	Solid	Nest	dead eastern rosella?			E, H, A, DS	H, A, DS
6	355565	6319239	900	Angophora costata			1			S	8	Blind	Cracks	Nil	Nil			A, H	E, A, H
6									1	N	6	300-1000	Cracks	leaves in hollow	possum species			E, A, H, D	H, A, D
7	355718	6319448	400	Eucalyptus fibrosa?			1			N	5	300-1000	Cracks	Nil	Nil	can't see very far	33	D, H, A	E, H, A, D
7							1			E	3.5	300	Solid	feathers	Nil	dead branch	33	S, A	E, H, A, DS
7							1			S	4	<300	Solid	spider webs, wasp nests	Nil		33	H, S, A	E, H, S, A, D
7							1			S	5	>1000	Solid	Nil	Nil	dead branch	33	D, H, S, A	E, H, S, A, D
7							1			W	6	<300	Solid	Nil	Nil		33	H, S	E, H, S, D
8	356060	6319424	714	Stringybark			1			W	5	<300	Cracks	Nil	Nil	Dead wood, white ants		H	E, H, D

GPS ID	Coordinates (MGA56)		DBH mm	Tree Species	Hollow Size (mm)					Aspect	Height off ground (m)	Depth (mm)	Condition	Sign	Species Observed/ inferred	Comments	Remote camera installed	Potential Owl Tree	Potential Glider Tree
	Eastings	Northings			Tiny<25	Small 26-50	Medium 51-100	Large 100-300	Massive 301+										
8									1	NE	4.5	<300	Cracks	Nil	Nil	Not actual hollow - almost blind		E, H, A	H, A, D
9	356068	6319567	475	Stag		1				E	5							H, A	E, H, A
11	356123	6319672	1125	Angophora costata		1				W	4							H	E, H
12	355795	6319756	856	Stag				1		S	7	300-1000	Solid	bird nest - rosella/lorikeet	Nil	no eggs or chicks	36	E, H, A, DS	H, A, DS
12									1	W	5	300-1000	Solid	Nil	Nil			HEDS	HDS
13	355594	6319717	994	Angophora costata			1			S	6	300-1000	Cracks	Nil	Nil	dead branch		D, H, A	E, H, A, D
13								1		E	4	>1000	Solid	Nil	Nil	Vertical rising - dead branch		E, H, A, DS	H, A, DS
14	355528	6319611	980	Stringybark (not capitulata)			1			S	7	<300	Solid	Nil	Nil			H, S, A	E, H, S, A, D
14						1				S	7	>1000	Solid	parrot feathers	Nil			H, A, DS	E, H, A, DS
15	355530	6319348	986	Angophora costata			1			N	20							H, A	E, H, A
16	355430	6319311	1520	Angophora costata		1				W	8	>300	Cracks	feathers	Nil	Vertical (up) entrance	8	HD	E, HD
16							1			N	20						8	H, A	E, H, A
16							1			E	20						8	H, A	E, H, A
16								1		E	20						8	E, H, A	H, A
16								1		E	20						8	E, H, A	H, A
16									1	E	20						8	E, H, A	H, A
17	355715	6320035	800	Angophora costata			1			E	8	<300	S	Nil	Nil			H, S, A	E, H, S, A, D
17							1			E	9	<300	S	Nil	Nil			H, S, A	E, H, S, A, D
17								1		N	12	300-1000	S	Nil	Nil			E, H, A, DS	H, A, DS
17									1	W	8	<300	S	Nil	Nil			HES	HDS

GPS ID	Coordinates (MGA56)		DBH mm	Tree Species	Hollow Size (mm)					Aspect	Height off ground (m)	Depth (mm)	Condition	Sign	Species Observed/ inferred	Comments	Remote camera installed	Potential Owl Tree	Potential Glider Tree
	Eastings	Northings			Tiny<25	Small 26-50	Medium 51-100	Large 100-300	Massive 301+										
17								1		S	11	<300	S	Nil	Nil			E, H, AS	H, A, DS
17									1	S	12	<300	S	Nil	Nil			E, H, AS	H, A, DS
18	355697	6320088	943	Stag				1		E	10	300-1000	S	ringtail possum observed	ringtail possum	photo		E, H, A, DS	H, A, DS
19	355743	6320142	744	Melaleuca stag			1			E	4	<300	S	bedding material	Nil			H, S, A	E, H, S, A, D bedding material
19							1	1		S	7	<300	S	Nil	Nil			E, H, A, S	E, H, A, D, S
19					1					S	10	300-1000	S	Can't see end	Nil			H, A, D, S	H, A, D, S
10	355868	6319776	902	Angophora costata				1									34 and 32	E, H, A	H, A
20	355868	6319781	608	Stag					1	N	6	<300	Solid	Nil	Aust. Owlet nightjar	termite nest at bottom		E, H, A, S	H, A, D, S
20									1	E	6	300-1000	Solid	leaf nest	probable possum	open spout hollow		E, H, A, D, S	H, A, D, S
21	355869	6319766	1045	Stag			1											H, A	E, H, A
23	355660	6320068	870	Melaleuca (large)					1	SW	6	300-1000	S	nesting material	Nil	photo		E, H, A, D, S	H, A, D, S
23									1	S	10	300-1000	S	nesting material	Nil			E, H, A, D, S	H, A, D, S
23								1		N	12	<300	S	Nil	Nil			E, H, A, S	H, A, D, S
23								1		S	15	<300	S	Nil	Nil			E, H, A, S	H, A, D, S
31	355735	6319259	850	Angophora costata				1		N	10	300-1000	Solid	Nil	Nil	full of sap		E, H, A, D, S	H, A, D, S
31								1		W	15	300-1000	Solid	Nil	Nil	full of sap		E, H, D, S	H, D, S
32	355706	6319253	689	Angophora costata			1			S	12	300-1000	Solid	leaf nest and feather	Nil	2 photos		D, H, S, A	E, H, S, A, D Leaf nest
32						1				SW	3	<300	Cracks	Nil	Nil			H, A	E, H, A, D
33	355571	6319291	514	Angophora costata					1	N	8	>1000	Solid	Nil	Nil			E, H, A, D, S	H, A, D, S

GPS ID	Coordinates (MGA56)		DBH mm	Tree Species	Hollow Size (mm)					Aspect	Height off ground (m)	Depth (mm)	Condition	Sign	Species Observed/ inferred	Comments	Remote camera installed	Potential Owl Tree	Potential Glider Tree
	Eastings	Northings			Tiny<25	Small 26-50	Medium 51-100	Large 100-300	Massive 301+										
34	355629	6319295	450	Angophora costata		1				N	10	<300	Solid	Nil	Nil			H, A, S	E, H, A, D, S
36	355686	6319331	690	Eucalyptus tereticornis			1	1		N	14						6	E, H, A	E, H, A
37	356004	6319451	809	Angophora costata					1	W	6.5	300-1000	Solid	Nil	Nil	Full of water		H, E, D, S	H, D, S
37								1		NW	8	<300	Solid	parrot type nest - bark chips	rainbow lorikeets hanging around tree			E, H, A, S	H, A, D, S
38	356062	6319524	470	Angophora costata				1		S	5.5	300-1000	Solid	Nil	Nil			E, H, A, D, S	H, A, D, S
38									1	S	5.5	300-1000	Solid	bird feathers	Nil	has puddle of water in it		E, H, A, DS	H, A, D, S
39	356063	6319525	521	Stag		1				N	10						40	H, A	E, H, A
40	355953	6319662	635	Angophora costata		1				S	8							H, A	E, H, A
41	355820	6319699	906	Angophora costata					1	E	4	300-1000	Solid/Rotten	parrot nest	Rainbow lorikeet	turns narrow close to entry	35	E, H, A, D, S	H, A, D, S
41									1	S	4	300-1000	Solid	Nil	Nil	turns narrow close to entry, deep	35	E, H, A, D, S	H, A, D, S
41								1		S	5	300-1000	Solid	Nil	Nil	narrows close to entrance	35	E, H, A, D, S	H, A, D, S
42	355784	6319703	635	Stag		1				W	10	Blind	Solid	Nil	Nil			H, S	E, H, S
4735	355768	6319917	725	Stag				1		E	5	<300	Cracks	Nil	Nil	narrows to smaller cracks and holes		E, H, A	H, A, D
43	355765	6319862	450	Angophora costata		1?				W	15							H	E, H, D
44	355732	6319844	830	Melaleuca large		1?				N	9							H, A	E, H, A
44						1?				N	10							H, A	E, H, A
45	355507	6319235	555	Angophora costata				1		W	10	300-1000	Cracks	Nil	Nil	old hollow		H, E, D	H

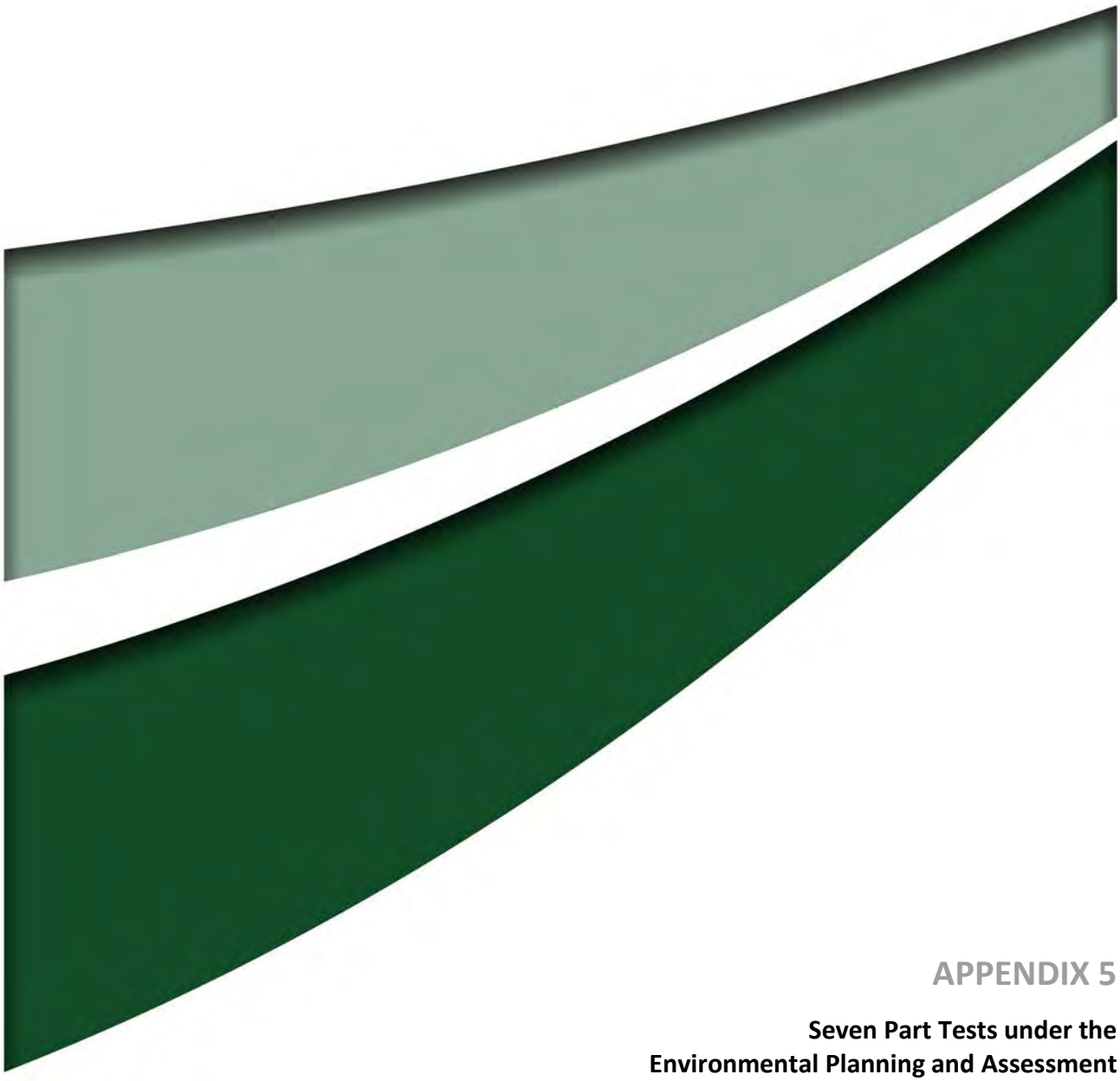
GPS ID	Coordinates (MGA56)		DBH mm	Tree Species	Hollow Size (mm)					Aspect	Height off ground (m)	Depth (mm)	Condition	Sign	Species Observed/ inferred	Comments	Remote camera installed	Potential Owl Tree	Potential Glider Tree
	Eastings	Northings			Tiny<25	Small 26-50	Medium 51-100	Large 100-300	Massive 301+										
46	355443	6319243	800	Angophora costata			1			W	10	<300	Solid	lorikeet chick	Rainbow lorikeet			H, S	E, H, S, D
46						1				N	6	<300	Solid	leaves in hollow	Nil			H, A, S	E, H, A, D, S
47	355432	6319278	1370	Angophora costata				1		W	16	>1000	Solid	Nil	Barn owl			E, H, D, S	H, D, S
47								1		S	5	<300	Solid	Nil	Nil			E, H, A	E, H, A, D
48	355415	6319498	635	Stringybark			1			W	8	300-1000	Solid	parrot feathers	Nil			D, H, S	E, H, S, D
48						1				E	4	<300	Solid	spider webs	Nil			H, A	E, H, A, D
49	355753	6320025	879	Angophora costata			1			SW	8	3000	S	Nil	Nil	very deep, potential for owl	37	E, H, A, D	E, H, A, D, Glider Sp identified
50	355710	6320125	600	Melaleuca large			1			N	8	300-1000	S	signs of use by parrots, feathers	Nil			D, H, S, A, D	E, H, S, A, D
50							1			W	10	<300	Rotten	Nil	Nil			H	E, H, D
51	355710	6320125	375	Stag			1?			N	9							H, A	E, H, A
52	355718	6320166	735	Angophora costata				1		NW	12	300	S	a few leaves	Nil	photo		E, H, A	H, D
52									1	N	15	>1000	S	Disused bee hive	lorikeets hanging around			E, H, A, D	H, A, D
52								1		S	15	<300	S	Nil	Nil			E, H, A	H, A, D
53	355433	6319813	400	Stag				1		N	5.5	<300	Rotten	termite nests	Nil			E, H, A	H, A, D
53									1	N	6	<300	Rotten	termite nests	Nil			E, H, A	H, A, D
54	355446	6319824	700	Stag					1	SW	6	300-1000	Cracks	Slight signs of use - depression lays in bottom	Nil			E, H, A, D	H, A, D
54									1	E	6	300-1000	Cracks	Slight signs of use - depression lays in bottom	Nil			E, H, A, D	H, A, D

GPS ID	Coordinates (MGA56)		DBH mm	Tree Species	Hollow Size (mm)					Aspect	Height off ground (m)	Depth (mm)	Condition	Sign	Species Observed/ inferred	Comments	Remote camera installed	Potential Owl Tree	Potential Glider Tree
	Eastings	Northings			Tiny<25	Small 26-50	Medium 51-100	Large 100-300	Massive 301+										
54									1	N	6	<300	Cracks	Slight signs of use - depression lays in bottom	Nil			E, H, A	H, A, D
54								1		N	5.5	300-1000	S	old broken egg	Nil	photo		E, H, A, D	H, A, D
54								1		N	6	<300	Cracks	termite nests	Nil			E, H, A	H, A, D
55	355549	6319920	1000	Angophora costata				1		SE	6.5	300-1000	Solid	Nil	Nil		38	E, H, A, D	H, A, D
55								1		S	3.5	300-1000	Rotten	termite nests	Nil		38	E, H, A, D	H, A, D
55									1	S	4	300-1000	Solid	Nil	Nil	Decent hollow	38	E, H, A, D	H, A, D
55									1	SW	6	300-1000	Rotten	Nil	Nil		38	E, H, A, D	H, A, D
55									1	N	4.5	Blind	Rotten	termite nests	Nil		38	E, H, A	H, A
55								1		N	7	<300	Solid	Nil	Nil		38	E, H, A	H, A, D
56	355552	6319961	350	mahogany?			1			E	6							H, A	E, H, A
57	355548	6320004	1000	Melaleuca				1		E	5	<300	Solid	Nil	Nil	Almost blind		E, H, A	H, A, D
57								1		N	5	300-1000	Solid	Nil	Nil	good deep hollow		D, E, H, S, A	H, S, A, D
58	355575	6320038	1000	Melaleuca			1			NE	5	Blind	S	Nil	Nil			H, S, A	E, H, S, A
58								1		NE	5.5	300-1000	S	Nil	Nil			H, A, D	H, A, D
59	355614	6320068	600	Melaleuca			1			S	3							A	E, H, A
60	355606	6320063	900	Eucalyptus tereticornis			1			SW	4	Blind	Solid	Nil	Nil		39	H, S, A	E, H, S, A
60							1			E	4.5	300-1000	Cracks	Nil	Nil	Deep, dead branch	39	D, H, A	E, H, A
60								1		S	5	can't tell	Solid	probable glider nest near entrance	glider species	photos - dead branch		E, H, A, S	H, A, D, S
60						1				E	4	<300	Solid	Nil	Nil	dead branch	39	H, A, S	E, H, A, D, S
61	355619	6320120	1200	Eucalyptus tereticornis			1			W	4	300-1000	Solid	bird feathers	rainbow lorikeets inside on first day			D, H, S	E, H, S, D

GPS ID	Coordinates (MGA56)		DBH mm	Tree Species	Hollow Size (mm)					Aspect	Height off ground (m)	Depth (mm)	Condition	Sign	Species Observed/ inferred	Comments	Remote camera installed	Potential Owl Tree	Potential Glider Tree
	Eastings	Northings			Tiny<25	Small 26-50	Medium 51-100	Large 100-300	Massive 301+										
62	355639	6320177	900	Stag				1		SE	7	300-1000	Solid	Nil	Nil	water inside - photos		D, E, H, S, A	H, S, A
63	355359	6319548	600	Stag				1		SE	5	300-1000	Solid	Nil	Nil			D, E, H, S, A	H, S, A
63								1		N	6.5							E, H, A	H,A
64	355344	6319572	400			1				E	6	300-1000	Solid	scratching at entrance, nest inside	parrot species	photo		A, D, S	E, A, H, S
64						1				W	8	<300	Solid	Nil	Nil			H, S	H, E, D, S
65	355422	6319198	500	Angophora costata				1		E	7	>300	Solid	Nil	Nil			D, E, H, S, A	H, S, A
65						1				W	8	Blind	Solid	Nil	Nil			H, S	H, E, S
65						1				E	15	>300	Solid	Lorikeet feathers	Rainbow lorikeet			H, A, S	E, H, A, S
66	355470	6319189	500	Angophora costata		1				N	7	<300	Solid	Nil	Nil			H, A, S	E, H, A, S
66						1				E	6	<300	Solid	Nil	Nil			H, A, S	E, H, A, S
67	355478	6319192	800	Angophora costata				1		SE	10	>300	Solid	Nil	Insects		5 and 3	E, H, A, S	H, A, S
67						1				S	9	<300	Solid	Mud wasp nest	Nil		5 and 3	H, A, S	E, H, A, S
67							1			E	6						5 and 3	H, A, S	H, A, S
68	355488	6319176	1300	Angophora costata		1				E	4	<300	Solid	Nest	Indian myna (?) - seen carrying food items			H, A, S	E, H, A, S
68							1			S	7	>300	Solid	Nil	Nil			D, H, S, A	E, H, S, A
68								1		S	8	>300	Solid	Long-billed corella in hollow	Long-billed corella			E, H, A, S	H, A, S
68						1				W	7	<300	Solid	Nil	Nil			H, S	H E, D, S
68						1				S	10	>300	Solid	Nil	Nil			H, A, S	E, H, A, S
69	355558	6319206	800	Angophora costata		1				W	6							H, S	E, H, S
69							1			E	3	300-1000	Cracks	Some chewing inside hollow	Nil			D, A	E, A, H
69								1		S	15	300-1000	Solid	Nil	Aust. Owlet nightjar in	too high to inspect		E, H, A, D, S	A, H, S

GPS ID	Coordinates (MGA56)		DBH mm	Tree Species	Hollow Size (mm)					Aspect	Height off ground (m)	Depth (mm)	Condition	Sign	Species Observed/ inferred	Comments	Remote camera installed	Potential Owl Tree	Potential Glider Tree
	Eastings	Northings			Tiny<25	Small 26-50	Medium 51-100	Large 100-300	Massive 301+										
															entrance				
69						1				N	8	<300	Solid	leaves in hollow				H, A, S	E, H, A, S
70	355593	6319208	1000	Corymbia maculata			1			W	4							H	E, H
70								1		S	4	Blind	Cracks	Nil	Nil	potentially suitable for micro-bats		E, H, A	H, A
70								1		E	4	<300	Rotten	Nil	Nil			E, H, A	H, A, D
70								1		SE	4.5							E, H, A	H, A
71	355672	6319222	1400	Angophora costata					1	W	7						2	E, H	H
71									1	W	6						2	E, H	H
71									1	N	8						2	E, H, A	H, A
71									1	S	10	Blind	Rotten	Nil	Nil		2	E, H, A	H, A
71								1		E	9						2	E, H, A	H, A
72	355697	6319208	900	Angophora costata				1		S	4	300-1000	Solid	Nil	Nil			E, H, A, D, S	H, A, S
72								1		W	7	Blind	Solid	Nil	Nil	photo		H, E, S	H, D, S
72								1		S	7	<300	Rotten	leaves in hollow	Nil	photo		H, A	H, A
73	355705	6319197	600	Angophora costata				1		E	4	<300	Rotten	Nil	Nil			E, H, A	H, A, D
74	355780	6319260	500	Stringybark			1			SE	5.5	300-1000	Solid	leaves and feathers	Nil	photo		D, H, S, A	E, H, S, A
74								1		E	5.5	300-1000	Solid	leaves and feathers	Rainbow lorikeet	photo		D, E, H, S, A	H, S, A
75	355906	6319262	700	Angophora costata					1	W	5.5	300-1000	Solid	signs of use/wear by birds	Nil	multi-chambered		E, H, D, S	H, D, S
75								1		W	5	300-1000	Rotten	signs of use/wear by birds	Nil	semi-rotten, semi spout		E, H, D	H, D
75								1		S	6	<300	Solid	Nil	Nil	quite shallow, bits of wood in it		E, H, A, S	H, A, S
80	355468	6319249							1	W	10	>1000	Solid	parrots have chewed bark suggesting nesting	Nil			H, D, S	H, D, S

GPS ID	Coordinates (MGA56)		DBH mm	Tree Species	Hollow Size (mm)					Aspect	Height off ground (m)	Depth (mm)	Condition	Sign	Species Observed/ inferred	Comments	Remote camera installed	Potential Owl Tree	Potential Glider Tree
	Eastings	Northings			Tiny<25	Small 26-50	Medium 51-100	Large 100-300	Massive 301+										
81	355762	6319289	900	Angophora costata	1					E	20	300-1000	Solid	Nil	Nil	full of water/mud - photo		E, H, A, D, S	H, A, S
81								1		SW	6							E, H, A	H, A
81								1		W	6							E, H	H
82	355675	6319301	1100	Corymbia maculata		1				W	12	>1000	Solid	Nil	Nil			H, D, S	H, E, D, S
82								1		N	10							E, H, A	H, A
82									1	N	10							E, H, A	H, A
82									1	W	10							E, H	H
83	355743	6319867	500	Stag				1		N	2							E, A	A, H
83								1		N	4							E, H, A	H, A
83								1		S	4							E, H,A	H, A



APPENDIX 5

Seven Part Tests under the Environmental Planning and Assessment Act 1979

Appendix 5 – Seven Part Tests Under the Environmental Planning and Assessment act 1979

A Test for Ecological Significance is provided below for those threatened species, endangered populations and EECs considered (within **Appendix 1)** to have the potential to be impacted by the Project. The following species, endangered populations and EECs are assessed:

Grouping	Common Name	Scientific Name	TSC Act Status
Threatened Flora Species			
Terrestrial shrubs	Small-flower grevillea	*Grevillea parviflora* susbp. *parviflora*	V
	Netted bottle brush	*Callistemon linearifolius*	V
Terrestrial orchids	Variable midge orchid	*Genoplesium insignis*	CE
	Thick-lipped spider orchid	*Caladenia tessellata*	E
		Corunastylis sp. Charmhaven	CE
	Leafless tongue orchid	*Cryptostylis hunteriana*	V
	Wyong sun orchid	*Thelymitra* sp. *Adorata*	CE
Swamp Dependent Flora		*Maundia triglochinoides*	V
	Biconvex paperbark	*Melaleuca biconvexa*	V
Terrestrial Forbs	Heath wrinklewort	*Rutidosis heterogama*	V
Endangered Flora Populations			
		Eucalyptus parramattensis subsp. *parramattensis*	EP
Threatened Ecological Communities			
Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner Bioregions			EEC
River Flat Eucalypt Forest on Coastal Floodplains			EEC
Threatened Fauna			
Amphibians	Wallum froglet	*Crinia tinnula*	V
Wetland Birds	Black bittern	*Ixobrychus flavicollis*	V
	Australasian bittern	*Botaurus poiciloptilus*	E
Diurnal Birds of Prey	Little eagle	*Hieraaetus morphnoides*	V
	Black falcon	*Falco subniger*	V
Cockatoos and lorikeets	Glossy Black Cockatoo	*Calyptorhynchus lathami*	V
	Little lorikeet	*Glossopsitta pusilla*	V
Small Woodland Birds	Varied sittella	*Daphoenositta chrysoptera*	V
	Scarlet robin	*Petroica boodang*	V
	Flame robin	*Petroica phoenicea*	V

Grouping	Common Name	Scientific Name	TSC Act Status
Winter Migrants	Swift Parrot	*Lathamus discolor*	E
	Regent honeyeater	*Anthochaera phrygia*	CE
Owls	Powerful owl	*Ninox strenua*	V
	Masked Owl	*Tyto novaehollandiae*	V
	Barking owl	*Ninox connivens*	V
	Koala	*Phascolarctos cinereus*	V
	Grey-headed flying fox	*Pteropus poliocephalus*	V
	Squirrel glider	*Petaurus norfolcensis*	V
	Eastern pygmy possum	*Cercarteus nanus*	V
Predominantly cave roosting micro-bats	Little bentwing-bat	*Miniopterus australis*	V
	Eastern bentwing-bat	*Miniopterus schreibersii oceanensis*	V
	Eastern cave bat	*Vespadelus troughtoni*	V
Predominantly hollow-roosting micro-bats	Yellow-bellied sheath tailed bat	*Saccolaimus flaviventris*	V
	Eastern freetail-bat	*Mormopterus norfolkensis*	V
	Eastern false pipistrelle	*Falsistrellus tasmaniensis*	V
	Southern myotis	*Myotis macropus*	V
	Greater broad-nosed bat	*Scoteanax rueppellii*	V
Rodents	Eastern chestnut mouse	*Pseudomys gracilicaudatus*	V

Threatened Flora Species

Terrestrial Shrubs

Small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) is listed as a vulnerable species under the TSC Act. This species grows in sandy or light clay soils usually over thin shales and occurs in a range of vegetation types from heath and shrubby woodland to open forest and a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. It often occurs in open, slightly disturbed sites such as along tracks (OEH 2016b). This species is distributed throughout the Sydney Basin mainly occurring around Picton, Appin, Bargo and possibly Moss Vale, as well as in the north from Putty to Wyong, Lake Macquarie, Cessnock and Kurri Kurri in the lower Hunter. This species is not known to be reserved in the region. There are approximately 130 known records of this species within 10km of the Study Area (BioNet 2016). Including a cluster of records less than 1.5km from the Study Area in lands zoned for Environmental Conservation.

Netted bottle brush (*Callistemon linearifolius*) is listed as a vulnerable species under the TSC Act. This species typically grows in dry sclerophyll forest on the coast and adjacent ranges. There are ten records of this species within 10km of the Study Area (BioNet 2016). It is not known whether the nearest record (more than 2km from the Study Area) comprises an extant population as it was documented in 2002.

Neither of these species has been identified within the Study Area. In the event that these species were to occur it would likely only be in low densities as the habitats of the Study Area sub-optimal habitat for these species due to grazing and weed infestation. The Study Area contains 20.6 hectares of potential habitat for these species. If either of these species were to occur they would not be at the limits of their known distributions.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

These species have not been identified in the Study Area part of current or previous surveys. As such no known records of these species will be impacted by the Project. Consequently the Project is unlikely to disrupt the life cycle of this species such that a local viable population will be placed at risk of extinction.

b) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The project may lead to the removal of 20.6 hectares of potential habitat for these species.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will result in the fragmentation of two currently connected areas of habitat; however as these species are not known to occur in the Study Area the Project will not cause isolation of any known currently connected areas of habitat.

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

The Study Area comprises 20.6 hectares of potential sub-optimal habitat for these species in an area surrounded by vegetation of the same type and of a similar quality (providing known and likely habitats for this species). The removal of 20.6 hectares of potential habitat within an area surrounded by vegetation of the same type and of a similar quality is not likely to be important to the long term survival of these species.

c) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Study Area does not support any critical habitat for these species or any other species.

d) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

As part of the Saving Our Species program for these species currently listed on the OEH website (OEH 2016b), protection of known occurrences and habitat are recommended management actions. However, the extent of potential moderate quality habitat to be removed (approximately 20.6 hectares) will not significantly contravene these objectives.

No threat abatement plans are pertinent to these threatened species.

e) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There is one KTP most relevant to these species, being Clearing of Native Vegetation.

However given that the extent of vegetation that will be cleared will be of sub-optimal quality and is not known to contain records of these species the implications of this KTP are not considered significant.

Conclusion

The project is unlikely to have a significant impact on small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) or netted bottle brush (*Callistemon linearifolius*).

Terrestrial Orchids

The variable midge orchid (*Genoplesium insignis*) is listed as critically endangered.This species grows in patches of kangaroo grass (*Themeda australis*) amongst shrubs and sedges in heathland and forest. It is recorded from four localities between Chain Valley Bay and Wyong in Wyong LGA. Locally there are approximately 20 records of these species within 10km of the Study Area (BioNet 2016); however the nearest record is more than 5km to the north-east.

The thick-lipped spider orchid (*Caladenia tessellata*) is listed as endangered. This species is generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. It is known to occur in the Sydney area (albeit from old records), Wyong, Ulladulla and Braidwood in NSW. It was also recorded in the Huskisson area in the 1930s. The species occurs on the coast in Victoria from east of Melbourne to almost the NSW border.

There are four known records of this species within 10km of the Study Area (BioNet 2016); however the nearest known records are over 4km from the Study Area.

Corunastylis sp. Charmhaven is listed as a critically endangered species under the TSC Act. This species is known from only a few locations within Wyong Shire where it is restricted to a few locations in the Charmhaven, Warnervale and Tooheys Road (Bushells Ridge) areas. It grows in low woodland to heathland with a shrubby understorey and ground layer typically in association with black she-oak (*Allocasuarina littoralis*), prickly tea-tree (*Leptospermum juniperinum*), prickly leaved paperbark (*Melaleuca nodosa*), narrow-leaved bottlebrush (*Callistemon linearis*) and bog rush (*Schoenus brevifolius*).

The leafless tongue-orchid (*Cryptostylis hunteriana*) is listed as a vulnerable species under the TSC Act. This species may favour moist soils on the flat coastal plains. However, there are few records on the Central Coast and at least one of these is on a broad crest in dry woodland, whilst others are from dry sclerophyll forests/woodlands in the north of Wyong LGA. Occupies swamp heath, but also in sclerophyll forest and woodland, often on sandy soils. Typically found in communities containing *Eucalyptus haemastoma, E. capitellata* and *Corymbia gummifera*. The nearest record of this species to the Study Area is a recent record of three individuals of 'probable' *Cryptostylis hunteriana* in a property adjoining the north east corner of the Study Area.

Thelymitra sp. Adorata is listed as a critically endangered species under the TSC Act. This species is highly restricted in distribution and is currently known from several occurrences bounded by Warnervale, Wyong and Wyongah and is restricted to NSW (NSW Scientific Committee 2008e). It is known to occur in areas with an altitude between 10 and 40 metres above sea level, usually in areas of woodland with a grassy understorey. It is found on well-drained clay-loam or shale derived soils. Most of the identified populations have been identified growing in Dooralong Spotted Gum - Ironbark Forest (NSW Scientific Committee 2008c). Local records of this species exist from less than 400m to the north of the Study Area.

None of these threatened orchids listed under the TSC have been identified within the Study Area. In the event that these species were to occur it would likely only be in low densities as the habitats of the Study Area provide sub-optimal habitat for these species due to grazing and weed infestation. The Study Area provides 18.6 hectares of potential habitat for these species.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

These species have not been recorded within the Study Area, however are considered to have potential to occur. If these species were to occur in the Study Area, it would likely be in low numbers.

Potential habitats for this species will be impacted by the Project; however no known records of these species will be impacted.

It is unlikely that a viable local population of these species would be significantly impacted by the Project.

b) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The project may lead to the removal of 18.6 hectares of potential habitat for these species.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will result in the fragmentation of two currently connected areas of habitat; however as these species are not known to occur the Project will not cause isolation of any known currently connected areas of habitat.

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

The Study Area comprises 18.6 hectares of potential sub-optimal habitat for these species in an area surrounded by vegetation of the same type and of a similar quality (providing known and likely habitats for this species). The removal of 18.6 hectares of potential habitat within an area surrounded by vegetation of the same type and of a similar quality is not likely to be important to the long term survival of these species.

c) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Study Area does not support any critical habitat for these species or any other species.

d) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

As part of the Saving Our Species program for these species currently listed on the OEH website (OEH 2016b), protection of known occurrences and habitat are recommended management actions. However the extent of potential sub-optimal quality habitats to be removed (approximately 18.6 hectares) will not contravene these objectives.

No threat abatement plans are pertinent to this threatened species.

e) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There is one KTP most relevant to these species, being Clearing of Native Vegetation.

However given that the extent of vegetation that will be cleared will be of sub-optimal quality and is not known to contain records of these species the implications of this KTP are not considered significant.

Conclusion

Given the small-scale nature and extent of the proposed activity, it is considered unlikely to significantly impact the variable midge orchid (*Genoplesium insignis*), leafless tongue orchid (*Cryptostylis hunteriana*), *Corunastylis* sp. *Charmhaven*, thick-lip spider orchid (*Caladenia tessellata*) or *Thelymitra* sp. *Adorata*.

Swamp Dependent Flora

Maundia triglochinoides is listed as vulnerable under the TSC Act. This species grows in swamps, creeks or shallow freshwater 30 to 60 centimetres deep on heavy clays that are low in nutrients. It is typically associated with wetland species such as water ribbons (*Triglochin procerum*), and flowers between November and January. This species is restricted to coastal NSW and extends into southern Queensland. The current southern limit is Wyong; former known locations around Sydney are now considered to be extinct. 19 records of this species exist within 10km of the Study Area (Bionet 2016), including known records from nearby Porters Creek Wetland which are zoned for conservation.

Biconvex paperbark (*Melaleuca biconvexa*) is also listed as a vulnerable species under the TSC Act. This species is generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Its distribution consists of scattered and dispersed populations in the Karuah Manning and Wyong sub-regions of the Hunter/Central Rivers Catchment. Locally, there are over 400 records of this species within 10km of the Study Area (Bionet 2016), including records from lands zoned for environmental conservation.

The potential presence of *Maundia triglochinoides* or biconvex paperbark (*Melaleuca biconvexa*) in the Study Area would not be at their known geographic distributional limit.

In the event that these species were to occur it would likely only be in low densities as the habitats of the Study Area provide sub-optimal habitat for these species due to grazing and weed infestation. The Study Area provides 2.0 hectares of potential habitat for these species.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

These species have not been identified in the Study Area as part of current or previous surveys; however have been recorded to the west in Porters Creek Wetland. As such no known records of these species will be impacted by the Project. Consequently there is little potential for the life cycle of this species to be disrupted such that a local viable population of this species will be placed at risk of extinction.

b) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The project may lead to the removal of 2.0 hectares of potential habitat for these species.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will result in the fragmentation of two currently connected areas of habitat; however as these species are not known to occur the Project will not cause isolation of any known currently connected areas of habitat. Additionally two currently connected areas of swamp habitat will not be fragmented by the Project.

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

The Study Area comprises 2.0 hectares of potential sub-optimal habitat for these species in an area surrounded by vegetation of the same type and of a similar quality (providing known and likely habitats for these species). The removal of 2.0 hectares of potential habitat is not likely to be important to the long term survival of these species.

c) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Study Area does not support any critical habitat for these species or any other species.

d) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

As part of the Saving Our Species program for these species currently listed on the OEH website (OEH 2016b), protection of known occurrences and habitat are recommended management actions. However, the extent of potential occurrences to be removed (approximately 2.0 hectares) is not expected to significantly contravene these objectives.

No threat abatement plans are pertinent to this threatened species.

e) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There is one KTP most relevant to these species, being Clearing of Native Vegetation.

However given that the extent of vegetation that will be cleared will be of sub-optimal quality and is not known to contain records of these species the implications of this KTP are not considered significant.

Conclusion

The Project is unlikely to have a significant impact on *Maundia triglochinoides* or biconvex paperbark (*Melaleuca biconvexa*), given that the areas of known occurrence will not be impacted and that the potential habitats available are sub-optimal for these species.

Heath wrinklewort (*Rutidosis heterogama*)

This species is listed as vulnerable under the TSC Act and occurs mostly in open grassy sites (typically *Themeda* dominated), often along disturbed roadsides, and also in open forest, primarily in coastal districts. It occurs in coastal districts from Maclean to the Central Coast and inland to Torrington. It has been recorded at Cooranbong and Warnervale on the Central Coast and extensively around the Cessnock district.

Although this species was previously identified within the northern habitats of the Study Area, it was not identified during current surveys. This occurrence is considered to no longer be extant as a result of grazing practices and weed infestation.

There are numerous extant local records of this species in the local area (over 150 from Bionet 2016), including within a dedicated Heath Wrinklewort Reserve approximately 1km to the north.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

There is potential that this occurs within the Study Area in low numbers; however no known records of this species will be impacted by the Project. Consequently there is little potential for the life cycle of this species to be disrupted such that a local viable population of this species will be placed at risk of extinction.

b) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The project may lead to the removal of 20.6 hectares of potential habitat for this species.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will result in the fragmentation of two currently connected areas of habitat; however as this species is not known to occur the Project will not cause isolation of any known currently connected areas of habitat.

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

The Study Area comprises 20.6 hectares of potential sub-optimal habitat for this species in an area surrounded by vegetation of the same type and of a similar quality (providing known and likely habitats for this species). The removal of 20.6 hectares of potential habitat is not likely to be important to the long term survival of this species.

c) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Study Area does not support any critical habitat for this species or any other species.

d) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

As part of the Saving Our Species program for this species currently listed on the OEH website (OEH 2016b), protection of known occurrences and habitat are recommended management actions. However, the extent of potential occurrences to be removed (approximately 20.6 hectares) is not expected to significantly contravene these objectives.

e) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There is one KTP most relevant to this species, being Clearing of Native Vegetation.

However given that the extent of vegetation that will be cleared will be of sub-optimal quality and is not known to contain records of this species the implications of this KTP are not considered significant.

Conclusion

The Project is unlikely to have a significant impact on heath wrinklewort (*Rutidosis heterogama*) given that it is no longer known to occur in the Study Area and due to its known occurrence and conservation in the local area.

Endangered Flora Populations

Eucalyptus parramattensis subsp. *parramattensis* in the Wyong and Lake Macquarie Local Government Areas is listed as an endangered population under the TSC Act.

This population is associated with low moist areas alongside drainage lines and adjacent to wetlands. It is often found in woodland on sandy soils. The endangered population occurs on sandy alluvium within a floodplain community which also supports *Eucalyptus robusta* (Swamp mahogany), *E*. *tereticornis* (Forest Red Gum), *E*. *gummifera* (Sydney Bloodwood) as well as *Melaleuca* spp. (paperbark) (BioNet 2016b).

In the local area, there are over 100 known records of this species (Bionet 2016), some within areas zoned for environmental conservation. Although appropriate habitat is present for this endangered population in the Study Area, no occurrences have been identified during previous or current surveys.

If this endangered population were to occur it would be in very low numbers and would not be at the limit of its known geographic distribution.

a) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

The Project will remove 20.6 hectares of sub-optimal potential habitat for this species from the Impact Area, however it was not observed there. If this species was present in the 20.6 hectares of vegetation to be disturbed it would be expected to occur in low numbers.

It is unlikely that the removal of any potentially occurring individuals in an area surrounded by known areas of habitat (some in areas zoned for environmental conservation) for this endangered population will have an adverse effect on the life cycle of this species such that a viable local population 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 action proposed:

i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or

Not applicable.

ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

c) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The Project may lead to the removal of 20.6 hectares of potential habitat for this species.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will not cause isolation of any currently connected areas of known to provide habitat for this species.

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

The Study Area comprises a small amount of potential habitat for this endangered population in an area surrounded by vegetation of the same type and of a similar quality (providing known habitat and potential habitat for this species). The removal of 20.6 hectares of potential sub-optimal habitat from the Impact Area is not likely to be important to the long term survival of this endangered population.

d) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Study Area does not support any critical habitat for this endangered population or any other species.

e) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

As part of the Saving Our Species program for the *Eucalyptus parramattensis* subsp*. parramattensis* currently listed on the OEH website (OEH 2016b), protection of known occurrences and habitat are recommended management actions. However, the extent of potential habitat to be removed (approximately 20.6 hectares) will not significantly contravene these objectives.

No threat abatement plans are pertinent to this threatened species.

f) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are two KTPs most relevant to the Project, being:

- Clearing of native vegetation; and
- Loss of hollow-bearing trees.

However given that the extent of potential habitat for this endangered population that will be cleared will be minor and of a moderate quality, the implications of these KTPs are not considered significant.

Conclusion

The Project is considered unlikely to have a significant impact on the endangered population of *Eucalyptus parramattensis* subsp. *parramattensis* given no known occurrences will be removed and the extent of local conservation of this species.

Threatened Ecological Communities

River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions– Endangered Ecological Community TSC Act

This community occurs on with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. It generally occurs below 50 metres elevation, but may occur on localised river flats up to 250 metres above sea level. The composition of this EEC is highly variable, although typical species include forest red gum (*Eucalyptus tereticornis*), cabbage gum (*E. amplifolia*), rough-barked apple (*Angophora floribunda*) and broad-leaved apple (*A. subvelutina*).

This vegetation community occurs in the Study Area (0.7 hectares) in a highly modified form and consists of a canopy layer of forest red gum (*Eucalyptus tereticornis*) accompanied by a highly modified and grazed groundcover that is dominated by introduced species. The occurrence of this EEC in the Study Area is not at the limit of its known geographic distribution which is known from the local government areas of Port Stephens, Maitland, Singleton, Cessnock, Lake Macquarie, Wyong, Gosford, Hawkesbury, Baulkham Hills, Blacktown, Parramatta, Penrith, Blue Mountains, Fairfield, Holroyd, Liverpool, Bankstown, Wollondilly, Camden, Campbelltown, Sutherland, Wollongong, Shellharbour, Kiama, Shoalhaven, Palerang, Eurobodalla and Bega Valley.

Within the local area, this EEC is known to occur (Umwelt 2013), some occurrences of which are in areas zoned for environmental conservation.

a) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or

The Project will include the removal of 0.7 hectares of this highly modified EEC (in an area in which other occurrences are known), that is not considered significant for the local survival of this community. It is unlikely that this will have a significant adverse effect on the extent of this community such that its local occurrence is likely to be placed at risk of extinction.

ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

The diversity of species in this EEC as it occurs in the Study Area is low. It is unlikely that the removal of 0.7 hectares of this EEC will substantially and adversely modify the composition of the EEC such that a local occurrence is likely to be placed at risk of extinction.

b) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The project may lead to the removal of 0.7 hectares of a modified form of this EEC.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will not cause the fragmentation of two areas of this vegetation community.

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

The Study Area comprises a small extent (0.7 hectares) of a modified extent of this EEC in an area with other known occurrences of this community. The removal of approximately 0.7 hectares of modified EEC habitat is not likely to be important to the long term survival of this community.

c) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Study Area does not support any critical habitat for this EEC.

d) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

As part of the Saving Our Species program for the River-flat Eucalypt Forest EEC listed on the OEH website (OEH 2016b), protection of known occurrences and areas of high priority value are recommended management actions. However, the extent of modified occurrences to be removed (approximately 0.7 hectares) is unlikely to significantly contravene these objectives as it is not likely this vegetation would be considered of high conservation value.

No threat abatement plans are pertinent to this EEC.

e) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are two KTPs most relevant to the Project, being:

- Clearing of native vegetation; and
- Loss of hollow-bearing trees.

However given that the extent of vegetation that will be cleared will be minor and of a modified quality, the implications of these KTPs are not considered significant.

Conclusion

Given the small extent of this EEC that will be cleared and its highly modified state, the Project is not expected to have a significant impact on the overall recovery of River-flat Eucalypt Forest EEC.

Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions – Endangered Ecological Community TSC Act

Five closely related vegetation communities, which occur on the majority of the coastal floodplain in the Warnervale area, form part of the *complex of forested and treeless wetland communities found throughout the coastal floodplains of NSW* (NSW Scientific Committee 2008b). These communities conform to the EEC Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (Swamp Sclerophyll Forest EEC) (NSW Scientific Committee 2008a).

This vegetation community occurs in the Study Area (2.0ha) in a highly modified form and consists of an emergent sparse layer of forest red gum (*Eucalyptus tereticornis*) accompanied by a dense sub-canopy of Melaleuca species and a highly modified and grazed groundcover with high densities of introduced species. The occurrence of this EEC in the Study Area is not at the limit of its known geographic distribution which is known 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.

Within the local area, this EEC has been recorded in areas zoned for environmental conservation (Umwelt 2013).

a) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or

The Project will include the removal of 2.0 hectares of this modified EEC (in an area in which other occurrences are known), that is not considered significant for the local survival of this community. It is unlikely that this will have a significant adverse effect on the extent of this community such that its local occurrence is likely to be placed at risk of extinction.

ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

The diversity of species in this EEC as it occurs in the Study Area is low. It is unlikely that the removal of 2.0 hectares of this EEC will substantially and adversely modify the composition of the EEC such that a local occurrence is likely to be placed at risk of extinction.

b) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The project may lead to the removal of 2.0 hectares of a modified form of this EEC.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will not cause the fragmentation of two areas of this vegetation community.

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

The Study Area comprises a small extent (2.0 hectares) of a modified extent of this EEC in an area surrounded by vegetation of the same type and of a higher quality (some of which is zoned for environmental conservation). The removal of approximately 2.0 hectares of modified EEC habitat is not likely to be important to the long term survival of this community.

c) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Study Area does not support any critical habitat for this EEC.

d) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

As part of the Saving Our Species program for the Swamp Sclerophyll Forest EEC listed on the OEH website (OEH 2016b), protection of known occurrences and areas of high priority value are recommended management actions. However, the extent of modified occurrences to be removed (approximately 2.0 hectares) is unlikely to significantly contravene these objectives as it is not likely this vegetation would be considered of high conservation value.

No threat abatement plans are pertinent to this EEC.

e) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are two KTPs most relevant to the Project, being:

- Clearing of native vegetation; and
- Loss of hollow-bearing trees.

However given that the extent of vegetation that will be cleared will be minor and of a modified quality, the implications of these KTPs are not considered significant.

Conclusion

Given the extent of the modified vegetation that will be removed, the Project is not expected to have a significant impact on the overall recovery of Swamp Sclerophyll Forest on the Coastal Floodplains of the NSW North Coast, Sydney Basin and the NSW North Coast Bioregions EEC.

Threatened Fauna Species

Wallum froglet (*Crinia tinnula*)

The wallum froglet (*Crinia tinnula*) is listed as a vulnerable species under the TSC Act and is found in acid paperbark swamps and sedge swamps of the coastal 'wallum' country. It is known to occur in the Hunter, Manning, Wyong and Macleay Hastings sub-regions of the Hunter/Central Rivers Catchment. This species is known to occur in Wyrrabalong National Park and Munmorah State Conservation Area in the region.

This species has been identified during previous surveys undertaken within the Study Area; however was not identified during the current surveys. If this species was present it would only be during periods in which this swamp area was subject to inundation. It is unlikely that if this species was present that it would exclusively utilise the habitats present in the Study Area. This species would not be at the limit of its known geographic distribution if it were to occur here.

There are approximately 130 known records of this species within 10km of the Study Area (BioNet 2016), including a large cluster of records less than 2km to the west near Warnervale airport.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Although this species was not recorded by Umwelt during surveys it has been recorded occurring within the Study Are in the past (from OEH Atlas records). There is a low potential for this species to be present in the Study Area as part of a wider locally viable resident population on an intermittent basis.

If this species is present in the Study Area, it is likely that suitable habitat would be restricted to vegetation communities that are likely to conform to the Alluvial Melaleuca Sedge Forest (2.0 ha) during periods of inundation. As these areas are not permanent water resources and are currently subject to grazing, it is unlikely that this species would be exclusively reliant on the habitats of the Study Area. Larger areas containing permanent water resources are present to the west of the Study Area in Porters Creek Wetland.

As such it is unlikely that the life cycle of this species will be disrupted by the Project such that a locally viable population of this species is likely to be placed at risk of extinction.

b) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The Project will lead to the removal of 2.0 hectares of potential habitat for this species. It is unlikely that the removal of this extent of habitat within an area surrounded by vegetation of the same type and of a similar quality would be significant to a local population of this species.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will not result in the fragmentation of two currently connected areas of appropriate habitat for this species.

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

The Study Area comprises 2.0 hectares of potential sub-optimal habitat for this species in an area adjacent (to the east) to vegetation of the same type and of a similar quality, as well as areas within 2km known to support populations. The removal of 2.0 hectares of potential sub-optimal habitat is not likely to be important to the long term survival of this species.

c) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Study Area does not support any critical habitat for this species or any other species.

d) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

As part of the Saving Our Species program for this species currently listed on the OEH website (OEH 2016b), protection of known occurrences and habitat are recommended management actions. However, the extent of potential occurrences to be removed (approximately 2.0 hectares) is unlikely to significantly contravene these objectives.

No threat abatement plans are pertinent to this threatened species.

e) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There is one KTP most relevant to this species, being Clearing of Native Vegetation.

However given that the extent of vegetation that will be cleared will be of sub-optimal quality for this species and is not known to contain extant records of this species the implications of this KTP are not considered significant.

Conclusion

The Project is unlikely to have significant impact on the wallum froglet (*Crinia tinnula*).

Wetland Birds

The black bittern (*Ixobrychus flavicollis*) is listed as a vulnerable species under the TSC Act, and the Australasian bittern (*Botaurus poiciloptilus*) is listed as an endangered species under the TSC Act.

The black bittern (*Ixobrychus flavicollis*) 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. Records of the species are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland. This species has not been recorded within the Study Area, despite multiple surveys as part of the current Project and past studies. There are 30 records of this species within a 10km radius of the Study Area (BioNet 2016), the nearest record is from approximately 2km to the south.

The Australasian bittern (*Botaurus poiciloptilus*) favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.). This species may be

found over most of the state except for the far north-west. Seven records of this species exist within 10km of the Study Area (BioNet 2016) from wetland areas.

Neither of these species has been identified in the Study Area, however each has potential to occur in the swamp areas comprising 2.1 hectares of the Study Area. If either of these species were to occur it is likely that they would comprise part of viable local populations; however would not be exclusively restricted to the habitats of the Study Area.

If any of these species were to occur in the Study Area they would not be at the limit of their known geographical distributions.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

If these species were present in the Study Area, it is likely that suitable habitat would be restricted to vegetation communities that are likely to conform to the Alluvial Melaleuca Sedge Forest (2.1 ha) during periods of inundation as well as dams. As these areas are not permanent water resources and are currently subject to grazing, it is unlikely that this species would be exclusively reliant on the habitats of the Study Area. Larger areas containing permanent water resources are present to the west of the Study Area in Porters Creek Wetland.

As such it is unlikely that the life cycle of these species will be disrupted by the Project such that any locally viable populations of these species are likely to be placed at risk of extinction.

b) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The Project will lead to the removal of 2.1 hectares of potential habitat for these species.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will not result in the fragmentation of two currently connected areas of appropriate habitat for these species.

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

The Study Area comprises 2.1 hectares of potential sub-optimal habitat for these species in an area adjacent (to the east) by vegetation of the same type and of a similar or higher quality for these species. The removal of 2.1 hectares of potential sub-optimal habitat is not likely to be important to the long term survival of these species.

c) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Study Area does not support any critical habitat for these species or any other species.

d) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

As part of the Saving Our Species program for these species currently listed on the OEH website (OEH 2016b), protection of known occurrences and habitat are recommended management actions. However, the extent of potential occurrences to be removed (approximately 2.1 hectares) in an area adjacent to large tract of vegetation of a higher quality (Porters Creek Wetland) will not significantly contravene these objectives.

e) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There is one KTP most relevant to these species, being Clearing of Native Vegetation.

However given that the extent of vegetation that will be cleared will be of sub-optimal quality for these species and no known records of these species are present the implications of this KTP are not considered significant.

Conclusion

Given the sub-optimal habitats for the black bittern (*Ixobrychus flavicollis*) and Australasian bittern (*Botaurus poiciloptilus*) that will be removed by the Project and given that the Study Area is not known to contain records of these species, it is considered unlikely that the Project will result in a significant impact on these species.

Diurnal Birds of Prey

The black falcon (*Falco subniger*) and little eagle (*Hieraaetus morphnoides*) are both listed as vulnerable under the TSC Act.

The little eagle (*Hieraaetus morphnoides*) is typically identified in open eucalypt forests, woodlands and open woodlands, and other areas where prey are plentiful. The nest in tall living trees within remnant patches. This species is distributed throughout mainland Australia except for the most densely forested parts of the Great Dividing Range escarpment. There are eight records of this species within 10km of the Study Area (BioNet 2016).

The black falcon (*Falco subniger*) is widely but sparsely distributed throughout NSW with all individuals assumed to be part of the same population (BioNet 2016b). There is one other record of this species within 10km of the Study Area (Bionet 2016).

Both of these species have been either currently or previously identified within the Study Area and likely comprise local breeding populations. It is unlikely that either of these species would be utilising the habitats of the Study Area exclusively, and it is more likely that they would be present as part of a broader territory.

No nests were identified for either of these species and it is likely that utilisation of the Study Ares is limited to foraging.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Both species are likely to forage in the open woodland and grassland habitats of the Study Area as part of wider territories. No nests for these species were identified. As such it is unlikely that the life cycle of these species will be disrupted by the Project such that any locally viable populations of these species is likely to be placed at risk of extinction.

b) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The project may lead to the removal of 50.2 hectares of foraging habitat for these species.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will result in the fragmentation of two currently connected areas of habitat; however as these species are highly mobile it is unlikely that the extent of fragmentation that would occur would impede movements of these species.

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

The Study Area comprises 50.2 hectares of foraging habitat for these species in an area surrounded by vegetation of the same type and of a similar quality. The removal of 49.2 hectares of habitat likely being utilised as part of much larger territories is not likely to be important to the long term survival of these species.

c) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Study Area does not support any critical habitat for these species.

d) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

As part of the Saving Our Species program for these species currently listed on the OEH website (OEH 2016b), protection of known occurrences and habitat are recommended management actions. However, the extent of habitat to be removed (approximately 50.2 hectares) is unlikely to significantly contravene these objectives.

e) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There is one KTP most relevant to this species, being Clearing of Native Vegetation. However given that the extent of vegetation that will be cleared will be of sub-optimal and only provides foraging habitat for these species the implications of this KTP are not considered significant.

Conclusion

Given that these species have not been identified nesting in the Study Area and have large territories, the Project is unlikely to have a significant impact on the black falcon (*Falco subniger*) or little eagle (*Hieraaetus morphnoides*).

Small Woodland Birds

The varied sittella (*Daphoenositta chrysoptera*), scarlet robin (*Petroica boodang*) and flame robin (*Petroica phoenicea*) are each listed as vulnerable under the TSC Act.

The varied sittella (*Daphoenositta chrysoptera*) inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. This species inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. There are over 50 records of this species within 10km of the Study Area, mostly from areas (Bionet 2016).

The scarlet robin (*Petroica boodang*) can be found in woodlands and open forests from the coast through to inland slopes. The birds can sometimes be found on the eastern fringe of the inland plains in the colder months of the year. Woody debris and logs are both important structural elements of its habitat. It forages from low perches on invertebrates either on the ground or in woody debris or tree trunks. There are only two known records of this species within 10km of the Study Area (Bionet 2016), each one more than 6km from the Study Area and within well connected areas of habitat.

The flame robin (*Petroica phoenicea*) species is known to breed in moist eucalypt forests and woodlands. It can usually be seen on ridges and slopes in areas where there is an open understorey layer. This species migrates during the winter to more lowland areas such as grasslands where there are scattered trees, as well as open woodland of the inland slopes and plains. There is only one known record of this species within 10km of the Study Area (Bionet 2016). This record is approximately 5km to the south-east in a well-connected area of vegetation adjacent to Ourimbah State Forest.

None of these species has been identified in the Study Area; however each has a low potential to occur in the areas of woodland habitat comprising 23.5 hectares of the Study Area, 20.6 hectares of which are located within the Impact Area. If any of these species were to occur it is likely that they would comprise viable local populations.

If any of these species were to occur in the Study Area they would not be at the limit of their known geographical distributions.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

If these species were to occur in the Study Area it would likely be in the connected habitats in the north; however as these species have not been recorded and as the Study Area provides sub-optimal habitats for these species and are currently subject to grazing, it is considered unlikely that these habitats are important to these species.

It is unlikely that the life cycle of these species will be disrupted by the Project such that a locally viable population of this species is likely to be placed at risk of extinction.

b) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The project may lead to the removal of 20.6 hectares of potential habitat for these species from the Impact Area.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will result in the fragmentation of two currently connected areas of habitat; however as these species are not known to occur the Project will not cause isolation of any known currently connected areas of habitat.

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

The Study Area comprises 23.5 hectares of potential sub-optimal foraging habitat for this species in an area surrounded by vegetation of the same type and of a similar quality. The removal of 20.6 hectares of potential habitat within the Impact Area is not likely to be important to the long term survival of these species.

c) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Study Area does not support any critical habitat for these species or any other species.

d) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

As part of the Saving Our Species program for these species currently listed on the OEH website (OEH 2016b), protection of known occurrences and habitat are recommended management actions. However, the extent of potential sub-optimal habitat to be removed (approximately 20.6 hectares) will not significantly contravene these objectives.

No threat abatement plans are pertinent to these threatened species.

e) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are two KTPs most relevant to these species, being Clearing of Native Vegetation and removal of Hollow-bearing trees.

However given that the extent of vegetation that will be cleared will be of sub-optimal quality and is not known to contain records of these species the implications of these KTPs are not considered significant.

Conclusion

The Project is unlikely to have a significant impact on the varied sittella (*Daphoenositta chrysoptera*), scarlet robin (*Petroica boodang*) or flame robin (*Petroica phoenicea*).

Cockatoos and Lorikeets

The glossy black cockatoo (*Calyptorhynchus lathami*) and little lorikeet (*Glossopsitta pusilla*) are both listed as vulnerable under the TSC Act.

Habitat for the glossy black cockatoo (*Calyptorhynchus lathami*) includes forests on low-nutrient soils, specifically those containing key Allocasuarina feed species. It will also eat seeds from eucalypts, angophoras, acacias, cypress pine and hakeas, as well as eating insect larvae. Breeding occurs in autumn and winter, with large hollows required. The glossy black-cockatoo (*Calyptorhynchus lathami*) has a sparse distribution along the east coast and adjacent inland areas from western Victoria to Rockhampton in Queensland. In NSW, it has been recorded as far inland as Cobar and Griffith. Over 80 records of this species are known within 10 kilometres of the Study Area (Bionet 2016), these records are mostly from areas of large contiguous tracts of vegetation. The nearest record is from Woongarrah from 2013 and Wadalba from 2015, each approximately 1.5 kilometres from the Study Area.

The little lorikeet (*Glossopsitta pusilla*) can be found in dry-open eucalypt forests and woodlands, and has been identified in remnant vegetation, old growth vegetation, logged forests, and roadside vegetation. This species usually forages in small flocks, not always with birds of their own species. They nest in hollows, mostly in living smooth-barked apples (*Angophora costata*). There are 50 records of this species known within 10 kilometres of the Study Area (Bionet 2016), as well as records from habitats directly adjacent to the Study Area.

Although neither species has been identified in the Study Area, appropriate foraging and nesting habitat (hollow-bearing trees) are both available within the Study Area. The presence of these species in the Study Area would not place these species at the limits of their known geographic distribution.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

If these species were to occur in the Study Area it would likely be in the eucalypt dominant forested habitats; however as these species have not been recorded and as the Study Area provides sub-optimal habitats for these species, it is considered unlikely that these habitats are important to these species.

It is unlikely that the life cycle of these species will be disrupted by the Project such that a locally viable population of this species is likely to be placed at risk of extinction.

b) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The Project may lead to the removal of 20.6 hectares of potential habitat for these species from the Impact Area.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will result in the fragmentation of two currently connected areas of habitat; however as these species are not known to occur the Project will not cause isolation of any known currently connected areas of habitat. These species are highly mobile and it is unlikely that the extent of fragmentation that would occur would impede movements of these species.

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

The Study Area comprises 23.5 hectares of potential sub-optimal habitat for this species in an area surrounded by vegetation of the same type and of a similar quality. The removal of 20.6 hectares of potential habitat within the Impact Area is not likely to be important to the long term survival of these species.

c) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Study Area does not support any critical habitat for these species or any other species.

d) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

As part of the Saving Our Species program for these species currently listed on the OEH website (OEH 2016b), protection of known occurrences and habitat (particularly hollow-bearing trees) are recommended management actions. However, the extent of habitat to be removed (approximately 20.4 hectares) will not significantly contravene these objectives.

e) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are two KTPs most relevant to these species, being Clearing of Native Vegetation and removal of Hollow-bearing trees. However given that the extent of vegetation that will be cleared will be of sub-optimal quality and is not known to contain records of these species, the implications of this KTP are not considered significant.

Conclusion

Given that they are not known to occur within the Study Area, and that the habitat provided are sub-optimal in quality, it is unlikely that the Project will result in a significant impact on the glossy black-cockatoo (*Calyptorhynchus lathami*) or little lorikeet (*Glossopsitta pusilla*).

Winter Migrants

The swift parrot (*Lathamus discolor*) is listed as endangered under the TSC Act and the regent honeyeater (*Anthochaera phrygia*) is listed as critically endangered under the TSC Act.

The swift parrot (*Lathamus discolor*) often visits box-ironbark forests, feeding on nectar and lerps. In NSW, typical tree species in which it forages include mugga ironbark, grey box, swamp mahogany, spotted gum, red bloodwood, narrow-leaved red ironbark, forest red gum and yellow box. This bird is a migratory species that breeds in Tasmania during the spring and summer, and migrates to the mainland during the cooler months of the year. In NSW this species has been recorded from the western slopes region along the inland slopes of the Great Dividing Range, as well as forests along the coastal plains from southern to northern NSW. The Study Area is within the known distribution of this species. There are over 100 records of this specie s within 10km of the Study Area (Bionet 2016).

The regent honeyeater (*Anthochaera phrygia*) generally occurs in temperate eucalypt woodlands and open forests of south eastern Australia. It is commonly recorded from box-ironbark eucalypt associations; wet lowland coastal forests dominated by swamp mahogany (*Eucalyptus robusta*), spotted gum (*Corymbia maculata*) and riverine casuarina woodlands. An apparent preference exists for the wettest, most fertile

sites within these associations, such as creek flats, river valleys and foothills. There are 26 records of this species within 10km of the Study Area (Bionet 2016).

23.5 hectares of sub-optimal foraging habitats for both of these species are present in the Study Area, although neither has previously been identified.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

These species have not been identified in the Study Area; however appropriate habitat is present for them to be foraging, particularly during mass eucalypt flowering events. The swift parrot (*Lathamus discolor*) does not breed on mainland Australia and the nearest known breeding area for the regent honeyeater (*Anthochaera phrygia*) is the Hunter Valley. If these species were to occur in the Study Area it would be irregularly and they would only be utilising the moderate quality habitat present as part of a much larger foraging range.

It is unlikely that the removal of this potential foraging habitat in an area adjacent to similar quality contiguous habitat would have an adverse effect on the life cycle of this species such that a viable local population would be likely to be placed at risk of extinction.

b) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The Project may lead to the removal of 20.6 hectares of potential foraging habitat for these species from the Impact Area. No breeding habitats will be removed.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will result in the fragmentation of two currently connected areas of habitat; however as these species are not known to occur the Project will not cause isolation of any known currently connected areas of habitat. These species are highly mobile and it is unlikely that the extent of fragmentation that would occur would impede movements of these species.

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

The Study Area comprises 23.5 hectares of potential sub-optimal foraging habitat for these species in an area surrounded by vegetation of the same type and of a similar quality. The removal of 20.6 hectares of potential habitat from the Impact Area is not likely to be important to the long term survival of these species.

c) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Study Area does not support any critical habitat for these species or any other species.

d) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

As part of the Saving Our Species program for these species currently listed on the OEH website (OEH 2016b), protection of known habitat for these species is a recommended action. However, the extent of potential foraging habitat to be removed (less than 20.6 hectares) is not likely to significantly contravene these objectives.

No recovery plans have been prepared for the swift parrot (*Lathamus discolor*) at the State level. However a National Recovery Plan for the Swift Parrot has been prepared. The Project is likely to contravene the recovery plan by removing potential foraging habitat for the species, however the extent of this is not considered significant in a local context.

The Regent Honeyeater Recovery Plan 1993 – 2003 (Menkhorst, Schedvin and Geering 1999) is pertinent to the regent honeyeater (*Anthochaera phrygia*) however due to the small extent of only moderate quality foraging habitat present for this species, the Project will not significantly contravene this recovery plan.

e) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There is one KTP most relevant to these species, being Clearing of Native Vegetation.

However given that the extent of vegetation that will be cleared will be of sub-optimal quality and is not known to contain records of these species the implications of this KTP are not considered significant.

Conclusion

The Project will remove approximately 20.6 hectares of potential sub-optimal foraging habitat for the swift parrot (*Lathamus discolor*) and regent honeyeater (*Anthochaera phrygia*) from the Impact Area, this is not likely to have a significant impact on the overall recovery of these species.

Owls

The powerful owl (*Ninox strenua*), masked owl (*Tyto novaehollandiae*) and barking owl (*Ninox connivens*) are each listed as vulnerable species under the TSC Act.

The powerful owl (*Ninox strenua*) inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. It generally requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation. This species occurs in eastern Australia, mostly on the coastal side of the Great Dividing Range, from south-western Victoria to Bowen in Queensland. The powerful owl (*Ninox strenua*) has not been identified within the Study Area, however has been identified in habitats adjacent to the Study Area. There is appropriate roosting habitat and prey species diversity for a breeding pair to be present in the Study Area, although none were identified during surveys. There are approximately 100 records of this species within 10km of the Study Area (BioNet 2016), including records from areas zoned for environmental conservation. Recent records exist from habitats immediately to the north (AEP 2016) and it is likely that the Study Area comprises part of the territory of a local breeding pair. A roost site is known to occur within the Wadalba Wildlife Corridor (Bionet 2016) as well as in near Wallarah (Birding NSW pers.comm in AEP 2016)

The masked owl (*Tyto novaehollandiae*) is generally recorded from open forest habitat with sparse mid-storey but patches of dense, low ground cover. It is also recorded from ecotones between wet and dry

eucalypt forest, along minor drainage lines and near boundaries between forest and cleared land. This species occurs sparsely throughout the continent and nearby islands, including Tasmania and New Guinea. This species has not been identified in the Study Area; however appropriate roosting habitat and prey species diversity are present for a breeding pair to be present. There are approximately 40 known records of this species within 10km of the Study Area (Bionet 2016), including a known roost site near to the Sparks Road – M1 intersection (BioNet 2016). There is potential that a local population would use the habitats of the Study Area as part of foraging within their broader territory.

The barking owl (*Ninox connivens*) occurs in dry forests and woodlands, often in association with hydrological features such as rivers and swamps. This species has been identified utilising the habitats of the Study Area and there are potential roost trees and prey species diversity for a local breeding pair to be present. Four known records of this species exist within 10km of the Study Area including foraging records at Wadalba and a known roost from Porters Creek Wetland (Bionet 2016). The occurrence of a known roost within Porters Creek wetland may reduce the likelihood of onsite hollows being utilised by this species as it is likely within the same territory (the territory size of this species can be more than 100 hectares (NSW Scientific Committee 1998)).

Usage of hollow-bearing trees in the Study Area by these species was not observed during targeted hollow surveys as part of the current study.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Project will remove up to 32 potentially appropriate roosting hollows for these species from the Impact Area. No roosting of these species was observed in the Study Area, and it is likely that the habitats present comprise 50.2 hectares of foraging habitat as part of wider territories of local populations of these species rather than breeding habitats.

As such it is unlikely that the Project will have an adverse effect on the life cycle of these species such that viable local populations have potential to be placed at risk of extinction.

b) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The Project may lead to the removal of 50.2 hectares of potential foraging habitat for these species and up to 32 potentially appropriate hollows from the Impact Area.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will result in the fragmentation of two currently connected areas of habitat; however the level of fragmentation that will occur is not likely to be significant to these highly mobile species.

However the existing fragmentation of vegetation within the Study Area is likely to be a barrier to movements of prey species which may limit its value for foraging purposes.

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

The Study Area comprises 50.2 hectares of potential foraging habitat and 32 potentially appropriate hollows for these species. As known roost sites for each of these species occur within a distance of the Study Area such that they could be within the territories of local breeding pairs there is only a low potential that these habitats are important to the long-term survival of these species in the locality.

c) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Study Area does not support any critical habitat for these species or any other species.

d) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

As part of the Saving Our Species program for this species currently listed on the OEH website (OEH 2016b), protection of known occurrences and habitat (particularly hollow-bearing trees) are recommended management actions. There is potential that the project contradicts these objectives, however no known roosts occur in the Study Area.

e) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are two KTPs most relevant to the Project, being:

- Clearing of native vegetation and
- Loss of hollow-bearing trees.

The impacts to local occurrences of hollow-bearing trees will be increases within this highly urbanised landscape as part of the Project.

Conclusion

There is a low potential that the Project could impact on locally viable populations of the powerful owl (*Ninox strenua*), masked owl (*Tyto novaehollandiae*) and barking owl (*Ninox connivens*), however is not likely to substantially interfere with the overall recovery of these species.

Koala (*Phascolarctos cinereus*) – Vulnerable TSC Act

The koala (*Phascolarctos cinereus*) inhabits eucalypt forest and woodland, with suitability influenced by tree species and age, soil fertility, climate, rainfall and fragmentation patterns. The species is known to feed on a large number of eucalypt and non-eucalypt species; however it tends to specialise on a small number in different areas. Preferred eucalypt species include *Eucalyptus tereticornis, E. punctata, E. cypellocarpa, E. viminalis, E. microcorys, E. robusta, E. albens, E. camaldulensis* and *E. populnea*. The koala has a fragmented distribution throughout eastern Australia, with the majority of records from NSW occurring on the central and north coasts, as well as some areas further west. It is known to occur along inland rivers on the western side of the Great Dividing Range. There are over 20 records of this species within 10km of the Study Area (OEH 2016a), including records within areas zoned for environmental conservation within to the west of the rail line.

This species has not been identified in the Study Area; however appropriate habitat is present in the 0.7 hectares of Alluvial Red Gum Forest habitats for this species to be foraging as part of a wider range.

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

If this species were to occur in the Study Area it would likely be in the Alluvial Red Gum Forest; however as this species has not been recorded and as the Study Area provides sub-optimal habitats for this species, it is considered unlikely that these habitats are important.

It is unlikely that the life cycle of this species will be disrupted by the Project such that a locally viable population of this species is likely to be placed at risk of extinction.

b) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The Project may lead to the removal of 0.7 hectares of potential habitat for this species.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will result in the fragmentation of two currently connected areas of habitat; however as these species are not known to occur the Project will not cause isolation of any known currently connected areas of habitat.

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

The Study Area comprises 0.7 hectares of potential sub-optimal habitat for this species in an area surrounded by vegetation of the same type and of a similar quality. The removal of 0.7 hectares of potential habitat is not likely to be important to the long term survival of these species.

c) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Study Area does not support any critical habitat for this species or any other species.

d) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

The 'Recovery plan for the koala (*Phascolarctos cinereus*)' (DECC 2008b) is relevant to this species. This plan identified habitat loss and fragmentation as one of the current threats to koalas (*Phascolarctos cinereus*). However the loss of 0.7 hectares of moderate quality forging habitat for this species in an area surrounded by vegetation of the same quality is not likely to significantly contravene objectives of this plan. No fragmentation to habitats for this species will occur as a result of this Project.

No threat abatement plans are pertinent to this threatened species.

e) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There is one KTP most relevant to this species, being Clearing of Native Vegetation.

However given that the extent of vegetation that will be cleared will be of sub-optimal quality and is not known to contain records of these species the implications of this KTP are not considered significant.

Conclusion

The Project will involve the removal of 0.7 hectares of potential sub-optimal foraging habitat for this species. The Project is unlikely to result in a significant impact on this species.

Eastern pygmy possum (*Cercartetus nanus*)

This species is listed as vulnerable under the TSC Act and is 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. There are only four records of this species within 10km of the Study Area (OEH 2016a).

This species has not been identified in the Study Area. The habitats provided for this species by the Study Area are sub-optimal for this species due to their highly modified nature and the extent of cattle grazing occurring.

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

If this species were to occur in the Study Area it would likely be in the eucalypt dominant forested habitats; however as this species has not been recorded and as the Study Area provides sub-optimal habitats for this species, it is considered unlikely that these habitats are important.

It is unlikely that the life cycle of these species will be disrupted by the Project such that a locally viable population of this species is likely to be placed at risk of extinction.

b) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The Project may lead to the removal of 20.6 hectares of potential habitat for these species from the Impact Area. It is unlikely that the removal of this extent of potential habitat for these species would be significant to any local populations.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will result in the fragmentation of two currently connected areas of habitat; however as these species are not known to occur the Project will not cause isolation of any known currently connected areas of habitat.

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

The Study Area comprises 23.5 hectares of potential sub-optimal habitat for this species in an area surrounded by vegetation of the same type and of a similar quality. The removal of 20.6 hectares of this habitat is located within the Impact Area; however this potential habitat is not likely to be important to the long term survival of these species.

c) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Study Area does not support any critical habitat for this species or any other species.

d) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

As part of the Saving Our Species program for this species currently listed on the OEH website (OEH 2016b), protection of known occurrences and habitat are recommended management actions. However, the extent of potential sub-optimal habitat to be removed (approximately 20.6 hectares) is not expected to significantly contravene these objectives.

No threat abatement plans are pertinent to this threatened species.

e) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are two KTPs most relevant to the Project, being:

- Clearing of native vegetation and
- Loss of hollow-bearing trees.

The impacts to local occurrence of hollow-bearing trees have potential to be significant in this highly urbanised landscape. The extent of removal of potential habitat for this species is not likely to be significant.

Conclusion

There is potential for the eastern pygmy possum (*Cercartetus nanus*) to occur in the Study Area; however these habitats are considered to be sub-optimal in quality for this species. It is considered unlikely that the Project would result in a significant impact to this species.

Squirrel glider (*Petaurus norfolcensis*)

The squirrel glider (*Petaurus norfolcensis*) is listed as a vulnerable species under the TSC Act and inhabits a variety of mature or old growth habitats, including box, box-ironbark woodlands, river red gum forest, and blackbutt-bloodwood forest with heath understorey. It prefers mixed species stands with a shrub or acacia mid-storey, and requires abundant tree hollows for refuge and nest sites. The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria.

In the local area, over 150 records are present within 10km of the Study Area (Bionet 2016), including records from within the Wadalba Wildlife Corridor.

The squirrel glider (*Petaurus norfolcensis*) population is considered to be more abundant in Wyong Shire than in any other areas of Australia (Smith 2002a). The largest known population of squirrel gliders occurs in Wyong Shire, this population is considered to comprise approximately 5000 individuals.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

This species have previously been identified within the habitats of the Study Area and one unconfirmed *Petaurus* sp. record was made during surveys undertaken by Umwelt during 2016 (which may have been a sugar glider (*Petaurus breviceps*)). There is potential that this species is utilising the habitats of the Study Area for foraging and for breeding in the 45 appropriate hollows identified in the Study Area (only 37 of which are proposed for removal), however no evidence of this has been recorded.

Without mitigation, there is potential that the Project may have a significant impact on a viable local population of squirrel glider (*Petaurus norfolcensis*). This would be a result of habitat loss (foraging habitat and hollows) and fragmentation of the northern remnant within the Study Area. To address this, the project has included a number of mitigation measures on top of those required within the CMP (Umwelt 2013) for the Precinct 7a project. In considering the mitigation measures known to benefit this species, and committed to as part of the project, it is not likely that the project will result in a significant impact on this species.

b) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The project may lead to the removal of 20.6 hectares of foraging habitat and up to 37 appropriate hollows for this species from the Impact Area.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will result in the fragmentation of two currently connected areas of habitat which will potentially create a dispersal barrier for this species.

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

The Study Area comprises 23.5 hectares of foraging habitat and 45 appropriate denning trees for this species. Of this, 20.6 hectares of foraging habitat and 37 appropriate denning trees have been identified within the Impact Area. There is potential that the removal of these habitats is important to the long term survival of this species in the locality.

c) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Study Area does not support any critical habitat for this species or any other species.

d) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

As part of the Saving Our Species program for this species currently listed on the OEH website (OEH 2016b), protection of known occurrences and habitat are recommended management actions. There is potential that the removal of 37 appropriate hollow-bearing trees for this species will be in contravention of these objectives. However the mitigation measures committed to as part of this project will assist in reducing this impact.

No threat abatement plans are pertinent to this threatened species.

e) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are two KTPs most relevant to the Project, being:

- Clearing of native vegetation; and
- Loss of hollow-bearing trees.

There is potential that the removal of these trees will be important in a local context for this species.

Conclusion

There is a low potential that the Project could have a significant impact on the squirrel glider (*Petaurus norfolcensis*). However this would be unlikely to impact the overall local recovery of this species.

Grey-headed flying-fox (*Pteropus poliocephalus*)

The grey-headed flying-fox (*Pteropus poliocephalus*) is listed as vulnerable under the TSC Act and 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 kilometres of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. This species is found within 200 kilometres of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria.

There are over 90 records of this species within 10km of the Study Area (Bionet 2016).

There are three local camps known of this species (one from Watanobbi, Toukley and Jilliby)(Bionet 2016) are known of this species and no individual records of this species have been identified in the Study Area.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The grey-headed flying-fox (*Pteropus poliocephalus*) has not been recorded in the Study Area; however the majority of the vegetation provides potential foraging habitat for this species. This species forms roosting/breeding colonies which are readily identifiable due to their large size, noise and odours. No such colonies have been recorded within the Study Area, and it is highly unlikely that one occurs there at this time.

It is unlikely that the life cycle of this species will be disrupted by the Project such that a locally viable population of this species is likely to be placed at risk of extinction.

b) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The Project may lead to the removal of 20.6 hectares of potential foraging habitat for this species from the Impact Area.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will result in the fragmentation of two currently connected areas of habitat; however as these species are not known to occur the Project will not cause isolation of any known currently connected areas of habitat. These species are highly mobile and it is unlikely that the extent of fragmentation that would occur would impede movements of these species.

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

The Study Area comprises 23.5 hectares of potential sub-optimal habitat for this species, of this, 20.6 hectares are located within the Impact Area. The removal of 20.6 hectares of potential habitat is not likely to be important to the long term survival of this species.

c) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Study Area does not support any critical habitat for this species or any other species.

d) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

As part of the Saving Our Species program for the grey-headed flying-fox (*Pteropus poliocephalus*) currently listed on the OEH website (OEH 2016b), protection of known foraging habitat and camp sites for this species are recommended action. However, the extent of potential foraging habitat to be removed (approximately 20.6 hectares) is not expected to significantly contravene these objectives. No camp sites are present or likely to occur.

e) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There is one KTP most relevant to this species, being Clearing of Native. However given that the extent of vegetation that will be cleared will be of sub-optimal quality and is not known to contain records of this species, the implications of this KTP are not considered significant.

Conclusion

The Project would be unlikely to have a significant impact on the grey-headed flying-fox (*Pteropus poliocephalus*).

Predominantly Hollow-dependent Micro-bats

The yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*), eastern freetail-bat (*Mormopterus norfolkensis*), eastern false pipistrelle (*Falsistrellus tasmaniensis*), southern myotis (*Myotis macropus*) and greater broad-nosed bat (*Scoteanax rueppellii*) are each listed as vulnerable species under the TSC Act.

The yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*) forages in most habitats across its very wide range, with and without trees; and appears to defend an aerial territory. It roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to use mammal burrows. Within 10km of the Study Area there are seven records (Bionet 2016), none of these records comprise known roosts.

The eastern freetail-bat (*Mormopterus norfolkensis*) occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. It roosts mainly in tree hollows but will also roost under bark or in man-made structures. It is found along the east coast from south Queensland to southern NSW. Within 10km of the Study Area there are 84 records (Bionet 2016), none of these records comprise known roosts.

Habitat for the eastern false pipistrelle (*Falsistrellus tasmaniensis*), includes sclerophyll forest. It prefers wet habitats, with trees over 20 metres high, and generally roosts in tree hollows or trunks. This species has a range from south eastern Queensland, through NSW, Victoria and into Tasmania, and occurs from the Great Dividing Range to the coast. Within 10km of the Study Area there are 44 records that are relatively evenly distributed throughout (Bionet 2016), none of these records comprise known roosts.

The southern myotis (*Myotis macropus*) generally roosts in groups of 10-15 close to water in caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage. It forages over streams and pools catching insects and small fish by raking its feet across the water surface. In NSW it generally occurs east of the Great Dividing Range, with scattered inland records in the south-west of the state. Within 10km of the Study Area there are 69 records (Bionet 2016), none of these records comprise known roosts..

The greater broad-nosed bat (*Scoteanax rueppellii*) prefers moist environments such as moist gullies in coastal forests, or rainforest. They have also been found in gullies associated with wet and dry sclerophyll forests and open woodland. It roosts in hollows in tree trunks and branches and has also been found to roost in the roofs of old buildings. The species is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. Within 10km of the Study Area there are 84 records (Bionet 2016), this included one assumed roost site from Tuggerah.

Each of these species have been identified utilising the habitats present in the Study Area either during previous or current surveys and due to the presence of potentially appropriate roost trees, they cannot be excluded as having potential to roost here.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

These species have been recorded using the habitats of the Study Area and have potential to be roosting on site. The Study Area contains foraging and potential roosting habitats (although none was identified) for these species (in the form of hollow-bearing trees and loose bark).

There is potential that removal of these hollow bearing trees may impact viable local populations of these species; however unlikely that this would be to the extent that it would affect the life cycle of these species such that viable local populations are likely to be placed at risk of extinction.

b) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The project may lead to the removal of 20.7 hectares of foraging habitat and up to 90 appropriate roost hollows for these species from the Impact Area.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will result in the fragmentation of two currently connected areas of habitat; however this level of fragmentation is unlikely to be significant for these highly mobile species.

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

The Study Area comprises 23.5 hectares of foraging habitat and 86 potentially appropriate hollows for these species (although none were identified), of this 20.7 hectares of foraging habitat is located within the Impact Area. There is a low potential that the removal of these habitats is important to the long term survival of these species in the locality. However, it is unlikely that they would be important to the long term survival of these species given the known occurrence in other areas in the locality of higher quality habitat.

c) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Study Area does not support any critical habitat for these species or any other species.

d) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

As part of the Saving Our Species program for these species currently listed on the OEH website (OEH 2016b), protection of known occurrences and habitat (particularly hollow-bearing trees) are recommended management actions. Given that these species have not been recorded in the 90 appropriate hollows in the Study Area, there is only a low potential that their removal will contravene these objectives.

e) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are two KTPs most relevant to the Project, being:

- Clearing of native vegetation and
- Loss of hollow-bearing trees.

Given that none of these micro-bats have been identified utilising the hollows on site there is only a low potential that impacts of the Project on these KTPs will be of significance.

Conclusion

Loss of habitats of these species is unlikely to have locally adverse impacts on local populations of these species.

Predominantly Cave-Roosting Micro-bats

The eastern cave bat (*Vespadelus troughtoni*), little bentwing-bat (*Miniopterus australis*) and eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) are each listed as vulnerable species under the TSC Act.

The eastern cave bat (*Vespadelus troughtoni*) is a cave-roosting (and disused mine dwelling) species that is usually located in dry-open forest and woodland in close proximity to cliffs and rocky over-hangs. Colonies of this species can be up to 500 individuals in size. The eastern cave bat (*Vespadelus troughtoni*) is occasionally located in wet eucalypt forest and rainforests along cliff-lines. This species 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. There is only one Bionet record of this species within 10km of the Study Area (Bionet 2016).)

The little bentwing-bat (*Miniopterus australis*) prefers moist eucalypt forest, rainforest or dense coastal banksia scrub. This species 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. In NSW it mostly occurs along the coast from the Queensland border to Sydney at its south-most, and to the west. There are approximately 100 known records of this species within 10km of the Study Area (Bionet 2016a).

The eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) forages in forested areas and uses caves as the primary roosting habitat, but also uses derelict mines, storm-water tunnels, buildings and other man-made structures. In NSW, this species is found both east and west of the Great Dividing Range, but typically no further than 300 kilometres from the coast. There are 130 known records of this species within 10km of the Study Area (Bionet 2016a).

Each of these species has been identified in the Study Area either during current or previous surveys (or both). These species are highly mobile and it is likely that they are only utilising the habitats present as part of much larger foraging range.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

These species are likely to forage over the forested habitats of the Study Area. However the Study Area is unlikely to provide suitable breeding habitat for these species. The habitats of the Study Area are likely to form part of a larger home range in the local area.

As such it is unlikely that the life cycle of these species will be disrupted by the Project such that any locally viable populations of these species is likely to be placed at risk of extinction.

b) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The project may lead to the removal of 20.7 hectares of potential foraging habitat for these species.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will result in the fragmentation of two currently connected areas of habitat; however as these species are highly mobile it is unlikely that the extent of fragmentation that would occur would impede movements of these species.

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

The Study Area comprises 23.5 hectares of foraging habitats for these species in an area surrounded by vegetation of the same type and of a similar quality, of this, 20.7 hectares of foraging habitat is located within the Impact Area. The removal of 20.7 hectares of foraging habitat is not likely to be important to the long term survival of these species.

c) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Study Area does not support any critical habitat for these species or any other species.

d) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

As part of the Saving Our Species program for these species currently listed on the OEH website (OEH 2016b), protection of known occurrences and habitat are recommended management actions. However, the extent of foraging habitat to be removed (20.7 hectares) is not expected to significantly contravene these objectives.

No threat abatement plans are pertinent to these threatened species.

e) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There is one KTP most relevant to these species, being Clearing of Native Vegetation. However given that the extent of vegetation that will be cleared will be of sub-optimal quality and likely to only provide foraging habitats as part of a wider range the implications of this KTP are not considered significant.

Conclusion

Although use or potential use of the habitats of the Study Area have been documented by each of these species. There are no potential cave-roosting habitats available to these species and it is considered that they would only likely be utilising the habitats for foraging as part of a wider range. As such it is unlikely that the Project will have a significant impact on the eastern cave bat (*Vespadelus troughtoni*), little bentwing-bat (*Miniopterus australis*) and eastern bentwing-bat (*Miniopterus schreibersii oceanensis*).

Eastern chestnut mouse (*Pseudomys gracilicaudatus*)

The eastern chestnut mouse (*Pseudomys gracilicaudatus*) is listed as a vulnerable species under the TSC Act. In NSW this species is mostly found, in low numbers, in heathland and is most common in dense, wet heath and swamps. The eastern chestnut mouse is scattered along the east coast from Townsville to Brisbane Water NP; in the south-east region it is found at Jervis Bay. The nearest know record of this species to the Study Area occurs approximately 15km south near Holgate.

This species has not been identified in the Study Area; however 23.5 hectares of potentially appropriate habitat was present, with 20.6 hectares of this being located within the Impact Area. The presence of this species in the Study Area would not place it at the limit of its known geographic distribution.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

This species has not been identified in the Study Areas part of current or previous surveys. As such no known records of these species will be impacted by the Project. Consequently there is little potential for the life cycle of this species to be disrupted such that a local viable population of this species will be placed at risk of extinction.

b) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The project may lead to the removal of 20.6 hectares of potential habitat for this species.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The Project will result in the fragmentation of two currently connected areas of habitat; however as this species is not known to occur the Project will not cause isolation of any known currently connected areas of habitat.

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

The Study Area comprises 23.5 hectares of potential sub-optimal habitat for this species in an area surrounded by vegetation of the same type and of a similar quality, of this, 20.6 hectares is located within the Impact Area. The removal of 20.6 hectares of potential habitat is not likely to be important to the long term survival of this species.

c) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Study Area does not support any critical habitat for this species or any other species.

d) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

As part of the Saving Our Species program for this species currently listed on the OEH website (OEH 2016b), protection of known occurrences and habitat are recommended management actions. However, the extent of potential occurrences to be removed from the Impact Area (approximately 20.6 hectares) is not expected to significantly contravene these objectives.

No threat abatement plans are pertinent to this threatened species.

e) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are two KTPs most relevant to these species, being Clearing of Native Vegetation and removal of Hollow-bearing trees.

However given that the extent of vegetation that will be cleared will be of sub-optimal quality and is not known to contain records of this species the implications of this KTP are not considered significant.

Conclusion

Based on the information provided above, and taking into consideration of the application of the precautionary principle, the Project is unlikely to result in a significant impact on the eastern chestnut mouse (*Pseudomys gracilicaudatus*).

APPENDIX 6

Assessment of Significance under the EPBC Act

Appendix 6 – Assessment of Significance under the EPBC Act

A 10 kilometre radius search of the Department of the Environment (DotE) Protected Matters Database identified threatened and migratory species listed under the EPBC Act known to occur or considered likely to occur in the Study Area. On the basis of habitat modelling, and based on local knowledge, the following threatened and migratory species were assessed as having potential to be impacted by the Project.

The following species have been assessed under the EPBC Act:

Common Name	Scientific Name	EPBC Act Status
Critically Endangered Species		
Variable midge orchid	*Genoplesium insignis*	CE
	Corunastylis sp. Charmhaven	CE
Wyong sun orchid	*Thelymitra* sp. *Adorata*	CE
Regent honeyeater	*Anthochaera phrygia*	CE
Endangered Species		
Australasian bittern	*Botaurus poiciloptilus*	E
Swift Parrot	*Lathamus discolor*	E
Vulnerable Species		
Leafless tongue orchid	*Cryptostylis hunteriana*	V
Small-flower grevillea	*Grevillea parviflora* susbp. *parviflora*	V
Thick-lipped spider orchid	*Caladenia tessellata*	V
Biconvex paperbark	*Melaleuca biconvexa*	V
Heath wrinklewort	*Rutidosis heterogama*	V
Koala	*Phascolarctos cinereus*	V
Grey-headed flying fox	*Pteropus poliocephalus*	V
Migratory Species		
Cattle egret	*Ardea ibis*	MIG
Fork-tailed swift	*Apus pacificus*	MIG
Oriental cuckoo	*Cuculus optatus*	MIG
White-throated needletail	*Hirundapus caudatus*	MIG
Great egret	*Ardea alba*	MIG
Japanese snipe	*Galliango hardwickii*	MIG
Osprey	*Pandion haliaetus*	MIG
Black-faced monarch	*Monarcha melanopsis*	MIG
Spectacled monarch	*Monarcha trivirgata*	MIG
Satin flycatcher	*Myagria cyanoleuca*	MIG
Rufous fantail	*Rhipidura albifrons*	MIG

No EPBC Act listed threatened ecological communities (TECs) are known or have potential to occur within Study Area.

Endangered and Critically Endangered Species

The following species have been considered in this assessment:

- Variable midge orchid (*Genoplesium insignis*)
- *Corunastylis* s. Charmhaven
- Wyong sun orchid (*Thelymitra* sp. Adorata)
- Regent honeyeater (*Anthochaera phrygia*)
- Australasian bittern (*Botaurus poiciloptilus*); and
- Swift parrot (*Lathamus discolour*).

In this case, a 'population of a species' is defined as an occurrence of the species in a particular area. Occurrences include but are not limited to:

- **a geographically distinct regional population, or collection of local populations, or**
- **a population, or collection of local populations, that occurs within a particular bioregion.**

None of the above species have been documented within the Study Area. The Study Area provides 21.1 hectares of potential sub-optimal habitat for the variable midge orchid (*Genoplesium insignis*), *Corunastylis* s. Charmhaven and Wyong sun orchid (*Thelymitra* sp. *Adorata*). Of this, 18.4 hectares of potential habitat is located within the Impact Area. If these species were to occur it is anticipated that it would be in very low numbers and would not comprise distinct populations.

Although they have not been recorded, the vegetation of the Study Area provides some potential foraging habitat (23.5 hectares) for the swift parrot (*Lathamus discolor*) and regent honeyeater (*Anthochaera phrygia*). 20.6 hectares of this potential foraging habitat has been identified within the Impact Area. If these species were to occur it would not be utilising these habitats exclusively and would likely be in passing to areas of higher quality habitat.

An occurrence of the swift parrot (*Lathamus discolor*) within the local area is not likely to be a distinct *population* (or *sub-population*) of this species on mainland Australia. Records of this species on the coast and coastal slopes of the Great Dividing Range are widespread, and its distribution can vary seasonally in response to mass flowering of key eucalypt species.

A record of the regent honeyeater (*Anthochaera phrygia*) within the local area is not likely to comprise a distinct *population* (or *sub-population*) of this species within Australia. Records of the distribution of this species are widespread, with occurrences occurring on both sides of the Great Dividing Range, and its distribution can vary seasonally in response to mass flowering of key eucalypt species.

The Australasian bittern (*Botaurus poiciloptilus*) has not been recorded previously in the Study Area (although there are local historical records); however could occur in the Alluvial Melaleuca Sedge Forest (2.0 hectares) during periods of inundation. If this species were present it would not be exclusively reliant on the habitats available and would be utilising the areas as part of a wider habitat range. It is unlikely that

an extant population of this species persists in the Study Area and if present would not comprise a population.

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:

- **lead to a long-term decrease in the size of a population, or;**

No populations of any of these species have been identified or are likely to occur within the Study Area. However the Project will involve the removal of

- 18.6 hectares of potentially appropriate sub-optimal habitat for the variable midge orchid (*Genoplesium insignis*), *Corunastylis* sp. *Charmhaven* and Wyong sun orchid (*Thelymitra* sp. *Adorata*).
- 20.6 hectares of potentially appropriate sub-optimal foraging habitat for the regent honeyeater (*Anthochaera phrygia*) and swift parrot (*Lathamus discolor*); and
- 2.0 hectares of potentially appropriate sub-optimal habitat for the Australasian bittern (*Botaurus poiciloptilus*).

The Study Area is not known as a historical or important site for these species. It is unlikely that the Project will lead to a decrease in the size of a population (as defined above) of any of these species.

- **reduce the area of occupancy of the species, or;**

No records of any of these species have been recorded within the Study Area. However each is considered to have potential to occur in the habitats present. The Project will reduce the potential available habitats for each species by up to 20.6 hectares within the Impact Area; however this is unlikely to substantially reduce the area of known occupancy of these species.

- **fragment an existing population into two or more populations, or;**

No records of variable midge orchid (*Genoplesium insignis*), *Corunastylis* s. Charmhaven, Wyong sun orchid (*Thelymitra* sp. Adorata) or Australasian bittern (*Botaurus poiciloptilus*) are known to occur within the Study Area. In the unlikely event that these species were to occur they would be in very low numbers and would be unlikely to comprise populations which would be confined to the Study Area. It is unlikely that any populations of this species would be fragmented by the Project.

No records of regent honeyeater (*Anthochaera phrygia*) or swift parrot (*Lathamus discolor*) have been recorded within the Study Area. Each of these species is either highly mobile with a large territory or highly dispersive and it is unlikely that the Project will create a significant change to the species' dispersal capacity or create a significant barrier the movement of these species.

It is unlikely that the Project will result in the fragmentation of an existing population of any of these species into two or more populations.

- **adversely affect habitat critical to the survival of a species, or;**

No habitats critical for the survival of any of these species were identified in the Study Area. The loss of up to 20.6 hectares of potential habitat within the Impact Area is unlikely to affect habitat that is critical to the survival of any of these species.

- **disrupt the breeding cycle of a population, or;**

No records of variable midge orchid (*Genoplesium insignis*), *Corunastylis* s. Charmhaven, Wyong sun orchid (*Thelymitra* sp. Adorata) or Australasian bittern (*Botaurus poiciloptilus*) are known to occur within the Study Area.

The regent honeyeater (*Anthochaera phrygia*) mainly breeds in three key sites from the Bundarra-Barraba area NSW, the Capertee Valley in NSW, and north-eastern Victoria. Breeding has also been recorded within the Hunter Valley, with the species recorded breeding in open forest close to Kurri Kurri in the Lower Hunter region in 2007. Nests have also been recorded at Quorrobolong, north of the Watagan range in the Lower Hunter region, in lowland forest habitat. Low-lying forests and woodlands are important habitat for the species being used as winter foraging habitat and potential breeding sites. The regent honeyeater (*Anthochaera phrygia*) has not been previously recorded in the Study Area.

The regent honeyeater population is considered to be in decline based on historic declines throughout much of the species' range, a range contraction, a decline in reporting frequency and the reduced size and occurrence of flocks (Garnett *et al*. 2011).

Currently, breeding season survey data suggest that the population of the swift parrot (*Lathamus discolor*) is at best stable, with an estimated 2000 breeding birds, or 1000 pairs (Garnett & Crowley 2000). The swift parrot (*Lathamus discolor*) breeds and nests exclusively in Tasmania and migrates to mainland Australia during the non-breeding season. There is no potential for breeding habitat to occur in the Study Area.

The Project is not expected to disrupt the breeding cycle of any of these endangered or critically endangered species.

- **modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline; or**

The Project will involve the removal of up to 20.6 hectares of vegetation from the Impact Area that provides potential habitat for these species. The locality supports other areas of habitat that contain higher quality vegetation that would also provide potential habitat for these species. It is considered unlikely that the Project will modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that these species would be likely to decline.

- **result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species habitat, or;**

The Project is not likely to result in invasive species that are harmful to the variable midge orchid (*Genoplesium insignis*), *Corunastylis* s. Charmhaven, Wyong sun orchid (*Thelymitra* sp. Adorata) or Australasian bittern (*Botaurus poiciloptilus*), swift parrot (*Lathamus discolor*) or regent honeyeater (*Anthochaera phrygia*) becoming established in their habitat.

- **introduce disease that may cause the species to decline; or**

The variable midge orchid (*Genoplesium insignis*), *Corunastylis* s. Charmhaven and Wyong sun orchid (*Thelymitra* sp. Adorata) and Australasian bittern (*Botaurus poiciloptilus*) are not known to be affected by specific diseases that are causing the species to decline. The Project will not introduce disease that may cause these species to decline.

Psittacine beak and feather disease (BFD) is a common and potentially deadly disease of parrots caused by a circovirus named beak and feather disease virus. The disease appears to have originated in Australia and is widespread and continuously present in wild populations of Australian parrots. BFD affecting endangered

psittacine species (parrots and related species) was listed in April 2001 as a key threatening process under the EPBC Act.

It is considered unlikely that the Project will introduce BFD or any other disease that may cause the swift parrot (*Lathamus discolor*) or regent honeyeater (*Anthochaera phrygia*) to decline.

- **interfere with the recovery of the species.**

The Project is unlikely to interfere substantially with the recovery of any of these endangered or critically endangered species.

Conclusion

The Project is unlikely to result in a significant impact on a *population* of

- Variable midge orchid (*Genoplesium insignis*)
- *Corunastylis* s. Charmhaven
- Wyong sun orchid (*Thelymitra* sp. Adorata)
- Regent honeyeater (*Anthochaera phrygia*)
- Australasian bittern (*Botaurus poiciloptilus*); or
- Swift parrot (*Lathamus discolour*).

Vulnerable Species

The following species have been considered in this assessment:

- Leafless tongue-orchid (*Cryptostylis hunteriana*)
- Small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*)
- Thick-lipped spider orchid (*Caladenia tesselata*)
- Biconvex paperbark (*Melaleuca biconvexa*)
- Heath wrinklewort (*Rutidosis heterogama*)
- Grey-headed flying-fox (*Pteropus poliocephalus*); and
- Koala (*Phascolarctos cinereus*).

Of these species, only heath wrinklewort (*Rutidosis heterogama*) has been previously recorded within the Study Area; however these individuals could not be relocated as part of the current survey.

None of the other species have been identified within the Study Area, and if present they would likely that would only occur in very low numbers as the habitats present are sub-optimal in quality.

With the exception of the koala (*Phascolarctos cinereus*) each of these species has been assessed conjointly.

In this case, an important population is a population that is necessary for a species' long-term survival and recovery. This may include populations that are:

- **key source populations either for breeding or dispersal; or**
- **populations that are necessary for maintaining genetic diversity, and/or**
- **populations that are near the limit of the species range.**

None of these species that have potential to occur fulfil the criteria specified above for important populations.

An action has, will have, or is likely to have a significant impact on threatened species if it does, will, or is likely to:

- **lead to a long-term decrease in the size of an important population of a species;**

The Study Area is not considered to provide *important habitat* for any of these potentially occurring species. If any of the above species were to occur in the Study Area it would likely only be in low numbers. Habitats of similar quality and higher quality habitat occur in adjacent vegetation that provides likely and known habitats for these species. It is considered unlikely that the Project will lead to a long-term decrease in the size of an *important population* of any of these species.

- **reduce the area of occupancy of an important population, or;**

The Study Area does not contain an *important population* of any of these species and therefore will not reduce the area of occupancy of an *important population* of these species.

- **fragment an existing important population into two or more populations, or;**

The Project will cause the fragmentation of two currently connected areas of appropriate habitat for these species.

However as the Study Area does not contain an *important population* of any of these species it is unlikely the Project will fragment any existing *important population* into two or more populations.

- **adversely affect habitat critical to the survival of a species, or;**

The Study Area is not considered to provide habitat that is critical to the survival of any of these potentially occurring species.

- **disrupt the breeding cycle of an *important population*, or;**

The Project is not considered likely to disrupt the breeding cycle of an *important population* of any of these species given that if present they are only likely to occur in low numbers and would not constitute the definition 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, or;**

The Project is unlikely to modify, destroy, remove, isolate, or decrease the availability or quality of habitat for any of these potentially occurring species to the extent that the species are likely to decline.

- **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat, or;**

The Project is unlikely to result in an invasive species that is harmful to these species becoming established in their habitats.

- **interferes substantially with the recovery of the species.**

The occurrence/potential occurrence of any of these species in the Study Area would be as part of a wider range in which more appropriate less disturbed habitat is present in surrounding vegetation. It is considered unlikely that the Project would interfere substantially with the recovery of these species.

Conclusion

The Project is unlikely to result in a significant impact on an *important population* of

- Leafless tongue-orchid (*Cryptostylis hunteriana*)
- Small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*)
- Thick-lipped spider orchid (*Caladenia tesselata*)
- Biconvex paperbark (*Melaleuca biconvexa*)
- Heath wrinklewort (*Rutidosis heterogama*); or
- Grey-headed flying-fox (*Pteropus poliocephalus*).

Koala (*Phascolarctos cinereus*)

The Assessment of Significance for the koala (*Phascolarctos cinereus*) has been prepared with consideration of the EPBC Act Referral Guidelines for the Vulnerable Koala (DoE 2014).

The Referral Guidelines advise that the assessment of significant impacts on the koala (*Phascolarctos cinereus*) is undertaken primarily through the assessment of habitat critical to the survival of the koala (*Phascolarctos cinereus*) and actions that interfere substantially with the recovery of the koala (*Phascolarctos cinereus*). This approach aims to avoid and address habitat loss as well as promote a streamlined assessment and approval process.

In accordance with the Referral Guidelines, the habitat assessment tool was applied to determine the extent of vegetation that contains at least one known koala (*Phascolarctos cinereus*) food tree within the Hunter-Central Rivers Koala Management Area. In accordance with these guidelines the Alluvial Red Gum Forest vegetation (0.7 hectares) of the Study Area is dominated by primary food tree species forest red gum (*Eucalyptus tereticornis*).

Table A6.1 below applies the Koala Habitat Assessment Tool as outlined in Table 3 of the Referral Guidelines.

Table A6.1 Assessment of Koala Habitats

Koala Habitat Assessment Tool (Table 3 from DoE 2014)			Study Area Assessment	
Attribute	**Score**	**Coastal**	**Allocated Score**	**Score Justification**
Koala occurrence	+2 (high)	Evidence of one or more koalas within the last 2 years.	**+1**	Although not identified in the Study Area, BioNet records indicate presence within 2km of the Study Area
	+1 (medium)	Evidence of one or more koalas within 2 km of the edge of the Impact Area within the last 5 years.		
	0 (low)	None of the above.		
Vegetation composition	+2 (high)	Has forest or woodland with 2 or more known koala food tree species, OR 1 food tree species that alone accounts for >50% of the vegetation in the relevant strata.	**+2**	Forest red gum (*Eucalyptus tereticornis*) accounts for >50% of canopy species in the Alluvial Red Gum Forest
	+1 (medium)	Has forest or woodland with only 1 species of known koala food tree present.		
	0 (low)	None of the above.		
Habitat connectivity	+2 (high)	Area is part of a contiguous landscape ≥ 500 ha.	**+1**	The Study Area has moderate connectivity, however not with large tracts of preferred koala habitat
	+1 (medium)	Area is part of a contiguous landscape < 500 ha, but ≥ 300 ha.		
	0 (low)	None of the above.		
Key existing threats	+2 (low)	Little or no evidence of koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence.	**0**	Database searches identify several mortalities from dog or road strike. Study Area is in an urban/agricultural interface. The Study Area surrounded by heavily used roads and residential dwellings where pet ownership is regular.
	+1 (medium)	Evidence of infrequent or irregular koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence, OR areas which score 0 for koala occurrence are likely to have some degree of dog or vehicle threat present.		
	0 (high)	Evidence of frequent or regular koala mortality from vehicle strike or dog attack in the Study Area at present, OR areas which score 0 for koala occurrence and have a significant dog or vehicle threat present.		

Koala Habitat Assessment Tool (Table 3 from DoE 2014)			Study Area Assessment	
Attribute	**Score**	**Coastal**	**Allocated Score**	**Score Justification**
Recovery value	+2 (high)	Habitat is likely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.	0	Table 1 of the Draft Referral Guidelines (DoE 2014) prescribes, that for coastal areas, the interim recovery objective(s) are to: *"Protect and conserve large, connected areas of koala habitat, particularly large, connected areas that support koalas that are of sufficient size to be genetically robust/operate as a viable sub-population OR free of disease or have a low incidence of disease OR breeding and to maintain corridors and connective habitat that allow movement of koalas between large areas of habitat."* The habitat present for the koala in the Study Area is not consistent with this description.
	+1 (medium)	Uncertainty exists as to whether the habitat is important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.		
	0 (low)	Habitat is unlikely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.		
TOTAL SCORE			**4**	**≥ 5 indicates habitat critical for the survival of the koala.**

As the habitats identified in the Study Area scored 4 using the Referral Guidelines habitat assessment tool, the Study Area is not considered to contain habitat critical to the survival of the koala (DoE 2014). As such the Project is unlikely to significantly affect habitats crucial to the survival of this species and Referral is not recommended.

Further consideration of the impacts of the project is detailed in the Assessment of Significance below.

In this case, an *important population* is a population that is necessary for a species' long-term survival and recovery. This may include populations that are:

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

The koala is known to occur in eucalypt woodlands and forests from north-eastern Queensland, along the eastern coast of NSW, to the south-east corner of South Australia. The vulnerable listing (under the EPBC Act) for the koala extends from north-eastern Queensland to the Victoria border.

The Impact Area (approximately 0.7 hectares of potential foraging habitat) does not contain sufficient habitat to provide a key source population for breeding or dispersal; nor does it provide a population necessary for maintaining genetic biodiversity; or is it at the limit of the species range.

An action has, will have, or is likely to have a significant impact on threatened species if it does, will, or is likely to:

- **lead to a long-term decrease in the size of an important population of a species;**

The Project will result in the loss of 0.7 hectares of potential foraging habitat for this species in an area where occupation is known. As the Study Area contains only a small amount of habitat for this species in an area surrounded by similar and higher quality vegetation, it is unlikely that any locally occurring koalas (*Phascolarctos cinereus*) would be exclusively utilising the habitats of the Study Area. The Project is not expected to lead to a long-term decrease in the size of an important population of the species.

- **reduce the area of occupancy of an important population, or;**

The works will result in the loss of 0.7 hectares of potential foraging habitat for this species in an area in which koalas (*Phascolarctos cinereus*) are likely to occur as part of a wider foraging range. It is likely that this area would be used primarily whilst moving between areas of higher quality habitat. There is insufficient habitat present in the Study Area for a resident population of this species to be present exclusively in these areas proposed for disturbance. The Project is not expected to reduce the area of occupancy of an important population of the species.

- **fragment an existing important population into two or more populations, or;**

The Project will cause fragmentation of two currently connected areas of habitat; however as the Study Area does not comprise an *important population* of this species, the project will not fragment an existing important population into two or more populations.

- **adversely affect habitat critical to the survival of a species, or;**

In accordance with the Referral guidelines, the Project will result in the loss of 0.7 hectares of potential non-critical foraging habitat for the survival of this species. As such the adverse effects from this habitat removal are not expected to be significant.

- **disrupt the breeding cycle of an important population, or;**

Evidence of koalas (*Phascolarctos cinereus*) has not been recorded in the Study Area, and there is no evidence of breeding or territorial behaviour to indicate the Study Area is important for the breeding cycle of an important population of the koala (*Phascolarctos cinereus*). Locally occurring records of this species are primarily present in the habitats present in surrounding areas of higher quality vegetation. The project will not substantially alter habitat available for this species and is subsequently unlikely to disrupt the breeding cycle of an important population of the species.

- **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or;**

The Project will result in the loss of 0.7 hectares of potential koala (*Phascolarctos cinereus*)) foraging habitat. The koala (*Phascolarctos cinereus*) would be expected to occur in low densities passing through the Study Area to areas of higher quality habitat and subsequently the project are considered 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;**

No invasive species are likely to become established as a result of the project that may impact upon any habitat relevant to the koala (*Phascolarctos cinereus*).

- **introduce disease that may cause the species to decline; or**

The koala (*Phascolarctos cinereus*) is known to contract strains of *Chlamydia* and the koala retrovirus. Chlamydia infections are known to cause reduced female fertility and are expected to reduce the reproductive potential of koala (*Phascolarctos cinereus*) populations. There is potential that at least some of the Hunter-Central Rivers population is infected with Chlamydia. The koala retrovirus can cause a range of conditions including leukaemia and immunodeficiency syndrome. It is estimated that up to 100 per cent of koala (*Phascolarctos cinereus*) populations in Queensland and New South Wales have the koala retrovirus (TSSC 2012).

The project will not involve any processes that are likely to introduce a disease on site for the koala or that may cause this species to decline.

- **interfere substantially with the recovery of the species.**

The Approved Recovery Plan for the Koala (DECC 2008) contains specific recovery objectives and performance criteria including maintaining existing populations, improving the extent and quality of priority habitat areas, increasing numbers of breeding females, increasing the health of individuals in the wild, expanding the distribution of the species and increasing community reports of sightings.

The project will only result in the loss of 0.7 hectares of potential foraging habitat for the koala (*Phascolarctos cinereus*) in an otherwise connected area of larger less disturbed habitat for this species, this is not anticipated to have a significant effect on the recovery of the koala (*Phascolarctos cinereus*).

Conclusion

Although the Project will impact on 0.7 hectares of potential non-critical foraging habitat for this species as described in the Referral Guidelines (DoE 2014), the Project is unlikely to result in a significant impact on an important population of koala (*Phascolarctos cinereus*) due to the small scale of cleaning of sub-optimal habitats as well as surrounding areas of known habitat for this species.

Migratory Species

The following EPBC Act listed migratory species are considered in this assessment:

- Cattle egret (*Ardea ibis*)
- Fork-tailed swift (*Apus pacificus)*
- Oriental cuckoo (*Cuculus optatus)*
- White-throated needletail (*Hirundapus caudatus)*
- Great egret (*Ardea alba)*
- Japanese snipe (*Galliango hardwickii)*
- Osprey (*Pandion haliaetus)*
- Black-faced monarch (*Monarcha melanopsis)*

- Spectacled monarch (*Monarcha trivirgata)*
- Satin flycatcher (*Myagria cyanoleuca)*
- Rufous fantail (*Rhipidura albifrons)*

Of the above, only the cattle egret (*Ardea ibis*) has been identified utilising the habitats of the Study Area, however the other species have potential to occur based on the presence of appropriate habitat.

An assessment in accordance with the DoE significant impact guidelines is provided below for these species.

An area of important habitat is:

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

The Study Area is not regarded to comprise *important habitat* or an ecologically significant proportion of a population for any of the occurring and potentially-occurring listed migratory species, based on the criteria described above.

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

- **substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles of altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species**

The Study Area is not regarded to comprise important habitat for any of the occurring and potentially-occurring listed migratory species, based on the criteria described above. As such, no further assessment is required.

- **Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species**

The Study Area is not regarded to comprise important habitat for any of the occurring and potentially-occurring listed migratory species, based on the criteria described above. As such, no further assessment is required.

- **Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species**

The Study Area is not regarded to comprise an ecologically significant proportion of the population for any of the occurring and potentially-occurring listed migratory species. As such, no further assessment is required for any EPBC Act listed migratory species.

Conclusion

From the Assessment of Significance, it is concluded that the Project is not likely to pose a significant impact on matters of national environmental significance as listed under the Schedules of the EPBC Act. The proposal is not believed likely to comprise a controlled action, and will not require referral to the Minister for determination.

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