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RIFLE RANGE
DEFENCE HOUSING PROJECT

Ecological Assessment Report

FINAL

May 2018

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DEFENCE HOUSING PROJECT

Ecological Assessment Report

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Defence Housing Australia

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Report No.	3764/R02/Final
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This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	**Date**	**Name**	**Date**
Final	Rebecca Vere	29/05/2018	Rebecca Vere	29/05/2018

Executive Summary

Umwelt (Australia) Pty Limited (Umwelt) has been commissioned by Defence Housing Australia (DHA) to prepare an Ecological Assessment for a rezoning application for the land known as the Rifle Range, the boundary of which is Lot 5 DP233358 (the Study Area) in Fern Bay, NSW. It is proposed to rezone the Study Area from the current Environmental Conservation (E2) to Low Density Residential (R2) and National Parks and Reserve (E1) under the Port Stephens Local Environmental Plan (LEP) 2013 to allow for a residential subdivision and conservation.

DHA has an ongoing requirement for additional housing in the Newcastle area to cater for Newcastle-based Defence members and their families and to replace existing DHA dwellings that do not meet current standards. In response to this, DHA have recently purchased two sites: Fort Wallace, Stockton, NSW and the Rifle Range, Fern Bay, NSW. DHA intends to obtain the necessary planning approvals to develop these sites for residential use with a mix of housing suitable for both Australian Defence Force (ADF) personnel and the private market.

The proposed Master Plan for the Rifle Range site includes a mix of residential typologies including townhouses, coastal cluster houses, courtyard homes, dune apartments and single eco-homes primarily placed within the former Rifle Range footprint. The Master Plan has sought to focus development within the previously disturbed areas of the site.

This Ecological Assessment was prepared to be appended to the Planning Proposal to rezone the Rifle Range site.

The Rifle Range site contains five native vegetation communities including Frontal Dune Blackbutt-Apple Forest, Mahogany-Baloskion Swamp Forest, Coastal Tea-tree – Banksia Scrub, Foredune Spinifex and Beach Wetlands. A wide range of flora and fauna species have been recorded within and surrounding the Study Area as part of previous ecological surveys.

Five threatened species and one community listed under the TSC Act and/or EPBC Act have been recorded being likely *Sydney Freshwater Wetlands in the Sydney Basin Bioregion EEC*, potential Earp's gum (*Eucalyptus parramattensis* subsp. *decadens*), grey-headed flying-fox (*Pteropus poliocephalus*), little bentwing-bat (*Miniopterus australis*), eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) and east coast freetail-bat (*Mormopterus norfolkensis*). Additionally, preferred and supplementary koala habitat occurs on the site, however the koala has not been recorded.

As the proposed rezoning has focused on the retention of as much intact vegetation as possible, the impacts to local biodiversity and threatened species are minimal. Based on the current Master Plan, it is considered unlikely that the potential redevelopment of the site for residential uses would result in a significant impact on threatened species and communities occurring or with the potential to occur on the site.

A range of mitigation and management measures are proposed to minimise the adverse impacts of the rezoning on local biodiversity. The rezoning aims to protect approximately 80 hectares of the site, via a proposed rezoning to National Parks and Reserves (E1) under the Port Stephens LEP or to be secured under a Biodiversity Stewardship Site.

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List of Abbreviations and Acronyms

Abbreviation/ Acronym	Definition
ADF	Australian Defence Force
APZ	Asset Protection Zone
BC Act	*Biodiversity Conservation Act 2016*
BVT	Biometric Vegetation Type
CKPoM	Comprehensive Koala Plan of Management
DHA	Defence Housing Australia
DoEE	Commonwealth Department of the Environment and Energy (formerly DoE)
EEC	Endangered Ecological Community
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FM Act	*Fisheries Management Act 1994*
IBRA	Interim Biogeographic Regionalisation for Australia
KPoM	Koala Plan of Management
LEP	Local Environmental Plan
LGA	Local Government Area
NPWS	National Parks and Wildlife Service
MNES	Matters of National Environmental Significance
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
RAAF	Royal Australian Air Force
SAT	Spot Assessment Technique
SEPP	State Environmental Planning Policy
TEC	Threatened Ecological Community
TSC Act	*Threatened Species Conservation Act 1995*
VIS	Vegetation Information System

1.0 Introduction

Umwelt (Australia) Pty Limited (Umwelt) has been commissioned by Defence Housing Australia (DHA)) to prepare an Ecological Assessment for a rezoning application for the land known as the Rifle Range, the boundary of which is Lot 5 DP233358 (the Study Area) in Fern Bay, NSW (refer to **Figure 1.1**). It is proposed to rezone the Study Area from the current Environmental Conservation (E2) to Low Density Residential (R2) and National Parks and Reserve (E1) under the Port Stephens Local Environmental Plan (LEP) 2013 to allow for a residential subdivision and conservation.

The Study Area has been subject to ongoing investigations (including ecological survey) as a potential development site since 2008. The ecological features identified as part of such investigations (including current and previous field survey) have been used to guide the design of an appropriate Master Plan that informs the planning proposal, with the aim of providing a development approach which balances the economic potential of the study area with appropriate biodiversity conservation outcomes for the broader Stockton area.

1.1 Project Description

DHA has an ongoing requirement for additional housing in the Newcastle area to cater for Newcastle-based Defence members and their families and to replace existing DHA dwellings that do not meet current standards. In response to this, DHA have recently purchased two sites: Fort Wallace, Stockton, NSW and the Rifle Range, Fern Bay, NSW. DHA intends to obtain the necessary planning approvals to develop these sites for residential use with a mix of housing suitable for both Australian Defence Force (ADF) personnel and the private market.

The two sites are located close to the Royal Australian Air Force (RAAF) Base Williamtown which lies 11 to 12 kilometres to the north of the sites. The Newcastle central business district lies a few kilometres to the south across the Hunter River.

1.1.1 Proposed Master Plan – Rifle Range

The proposed Master Plan for the Rifle Range site includes a mix of residential typologies primarily placed within the former Rifle Range footprint (refer to **Figure 1.2**). The Master Plan has sought to retain the Rifle Range landscape and focus development within the previously disturbed areas of the site. The residential typologies for the Rifle Range include the following:

- ***Townhouses*** – up to 68 attached 1-3 storey dwellings with a lightweight design that facilitates layouts that are responsive to site features and context.
- ***Coastal cluster houses*** – up to 120 townhouse style dwellings set within natural landscape areas. Private open space is limited to decks and immediate terrace areas attached to each dwelling.
- ***Courtyard homes*** – up to 48 large courtyard family homes including 4 bedrooms, 3 bathrooms, open plan living space, single garage and an ample rear garden.
- ***Single eco-homes*** – up to 16 lightweight, climate responsive individual homes set within generous lots.
- ***Dune apartments*** – up to 66 small scale apartments with 1-3 bedrooms each, in blocks up to four stories.

Image Source: Nearmap (May2016)
Data Source: LPI NSW (2009)

0 1.0 2.0 2.5km
1:50 000

Legend

- Site Boundary
- National Park
- State Conservation Area
- Regional Park
- Hunter Estuary Wetlands Ramsar Site

FIGURE 1.1

Locality Map

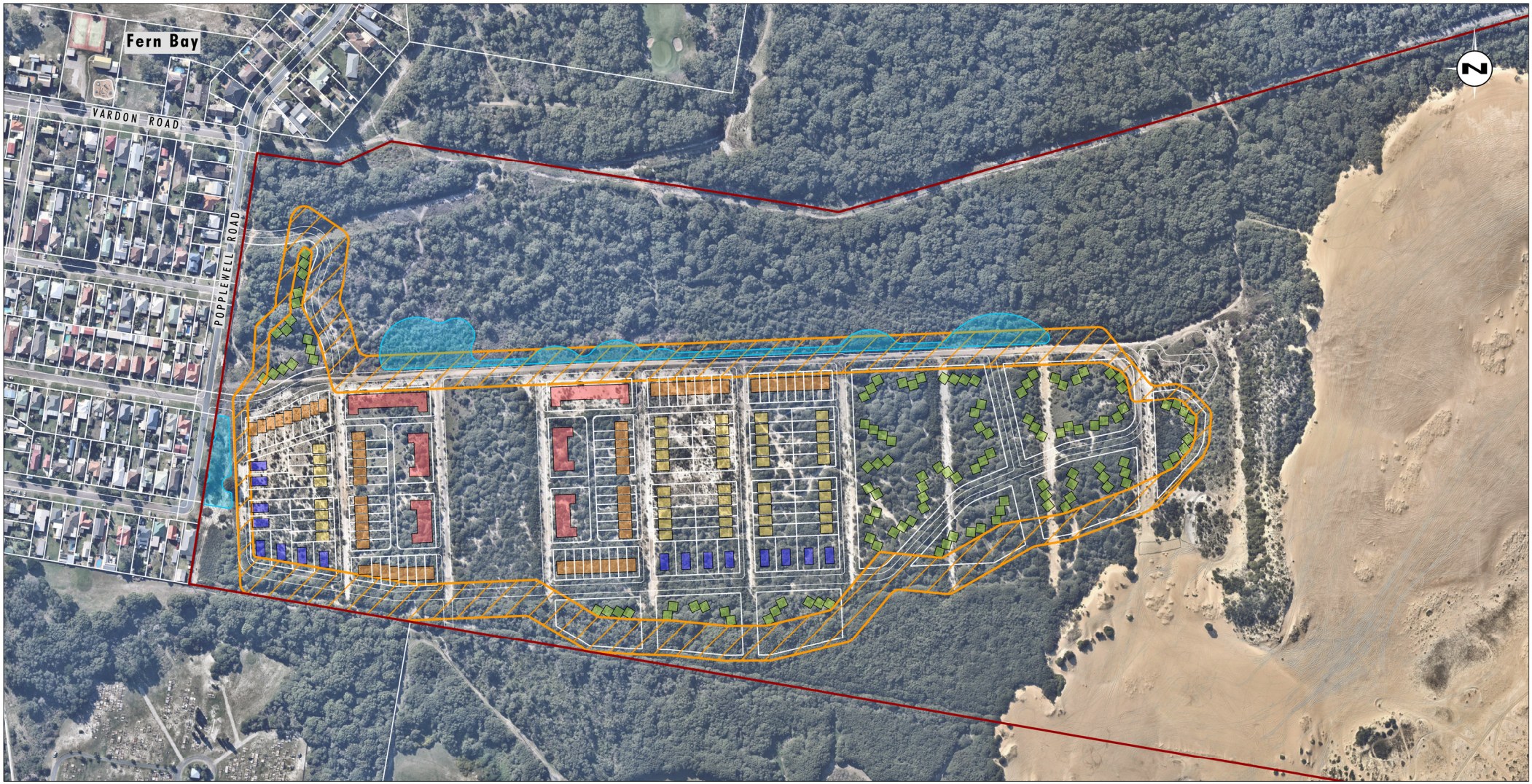

Image Source: Nearmap (Apr 2018)
Data Source: LPI NSW (2009), Architectus (2018)

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Legend

- Site Boundary
- Asset Protection Zone
- Stormwater Detention Basin (Subject to design resolution)
- Dune Apartment
- Townhouse
- Courtyard Home
- Cluster Home
- Single Eco Home

FIGURE 1.2

Proposed Master Plan

File Name (A4): R02/3764_002.dgn
20180524 16.08

1.1.2 Guiding Principles

It is envisaged that a residential development at the Rifle Range would develop the site and the areas of Stockton and Fern Bay as unique coastal communities with strong links to Newcastle and the growing Hunter region. The Master Plan aims to provide residential housing while balancing the natural coastal environment and cultural heritage assets of the site.

Guiding principles for the rezoning of the Rifle Range, which have shaped the design considerations of the Master Plan, include the following:

- ***Touch lightly on the land*** – raised building (no slabs), working with the existing natural topography to minimise earthworks.
- ***Embrace the coastal ecology*** – minimisation of private open space and boundary fencing, native endemic planting only, maximise views to the ocean, dunes, river and bushland.
- ***Celebrate history and cultural heritage*** – retain heritage structures, connect with the Worimi reserve.
- ***Create a diverse community*** – mix of building typologies for defence, private and affordable housing needs, recreational opportunities for visitors.
- ***Open the gates to the public*** – provide public access via the local road, pedestrian and cycle networks, controlled access to the beach and dunes.
- ***Utilise interesting architectural forms*** – staggered building heights, natural materials and finishes, varied street setbacks.

1.2 Approval Pathway

This Ecological Assessment is part of a suite of specialist assessments of the site that have informed consideration of the site's potential for redevelopment. These assessments have been used as the basis of master plan options and the development of a recommended Master Plan, which has subsequently informed proposed revised planning controls for the site with respect to land use, height of buildings, and heritage.

It is intended that a Planning Proposal will be lodged with Port Stephens Council, seeking support of the strategic merit of the proposal to proceed to a Gateway Determination by the Department of Planning and Environment (DPE). It is intended that the Planning Proposal, if supported by both Council and DPE, would then proceed to public exhibition and finalisation through an amendment to the LEP. Key outcomes of the Master Plan may be established in a site specific Development Control Plan or Stage 1 Development Application. Appropriate approvals will then be sought for the subdivision and development of the site under the amended planning controls.

The Master Plan has been used as a demonstration of how the site could appropriately accommodate residential uses in response to best practice urban design and planning principles. Where appropriate, this report has considered the likely impacts of the Master Plan on the ecology of the site to enable as detailed an assessment as possible. However, it is acknowledged that further detailed work will be undertaken and consideration given to potential ecological impacts at the subdivision and detailed design stage.

1.3 Objectives of the Ecological Assessment

This Ecological Assessment will be appended to the Planning Proposal to rezone the Rifle Range. Specifically, the objectives of the Ecological Assessment are to:

- describe the flora and fauna species and other significant ecological features recorded within the Study Area and locality from previous studies on the site, local studies and ecological database searches
- identify any threatened species, endangered populations, threatened ecological communities (TECs), or their habitats listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act), NSW *Fisheries Management Act 1994* (FM Act), and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), that may be adversely affected as a result of the proposal
- assess the potential impact of the proposal in relation to identified and potential significant ecological features, according to the requirements of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the EPBC Act and
- develop impact mitigation measures (including consideration of offsetting opportunities) to avoid or reduce any potential significant impacts of the proposal on the significant ecological values of the Study Area.

The *Biodiversity Conservation Act 2016* was implemented on 25 August 2017, repealing the TSC Act. It should be noted that this Ecological Assessment was prepared and submitted to Council prior to the repeal of the TSC Act (February 2017). This report (Version 6) has been updated to reflect the changes requested following Council's review of the Planning Proposal in relation to housing densities.

The assessments in this report have not been updated to reflect the minor changes in relation to the replacement of the TSC Act by the BC Act. It is understood that threatened entities previously listed under the TSC Act were automatically transferred to be listed under the BC Act and the amended Assessment of Significance Test (now outlined in Section 7.3 of the BC Act) does not materially change the assessment outcome. Consideration of the BC Act and its implications on the Project will be addressed at the DA phase of the project, as required.

1.4 Document Outline

The Ecological Assessment includes the following sections:

- Section 1 – provides the introduction to the report
- Section 2 – outlines the methods used in the ecological assessment
- Section 3 - describes the ecological features of the Study Area
- Section 4 – assesses the likely impacts on significant ecological features
- Section 5 – describes impact avoidance, mitigation and offsetting opportunities
- Section 6 – outlines recommendations for additional ecological investigations during the development application phase of the project
- Section 7 - provides a list of references used throughout the report and analysis.

2.0 Methods

The methods employed as part of the desktop and field components of the Ecological Assessment are discussed in the following sections, including those of the current and previous surveys within the Study Area.

2.1 Literature Review

A review of all relevant and available literature was undertaken in order to gain a holistic understanding of the ecological values of the Study Area. Documents reviewed included regional vegetation mapping reports, site-specific monitoring surveys, ecological surveys undertaken in the vicinity of the Study Area and also relevant ecological database searches.

The following key documents were reviewed during the preparation of this Ecological Assessment:

- Ecological Constraints Assessment – Rifle Range, Stockton Peninsula (Kleinfelder 2015)
- Ecological Constraints Report, Stockton Rifle Range, Stockton, NSW (SMEC 2008)
- Vegetation of the Worimi Conservation Lands Port Stephens, NSW: Worimi NP, Worimi SCA and Worimi RP (Bell and Driscoll 2010)
- Fern Bay Seaside Village Ecology Assessment Report (ERM 2009)
- Worimi Regional Park Vegetation Management Plan (ERM 2009)
- Worimi Conservation Lands Plan of Management (OEH 2015)
- Port Stephens Council Comprehensive Koala Plan of Management (PSC 2002)
- Port Stephens Council Koala Habitat Planning Map (PSC 2007)
- Greater Hunter Native Vegetation Mapping (Sivertsen *et al.* 2011).

2.2 Database Searches

In order to identify threatened species, endangered populations and TECs with the potential to occur in the Study Area, a review of relevant ecological databases was completed. These database sources comprised:

- Office of Environment and Heritage (OEH) Threatened Species Profile Database for known/predicted threatened species and TECs in the Karuah-Manning Interim Biogeographic Regionalisation for Australia (IBRA) subregion, accessed September 2016
- OEH BioNet Atlas of NSW Wildlife database and mapping tool (OEH 2016), accessed in September 2016
- PlantNET (Royal Botanic Gardens Sydney) database search for Rare or Threatened Australian Plant species within the Port Stephens LGA, accessed September 2016
- Department of Environment and Energy (DoEE) Protected Matters Search Tool for known/predicted EPBC Act-listed TECs, accessed September 2016
- VIS Classification Database (OEH 2016), accessed September 2016.

2.3 Field Surveys

2.3.1 Previous Field Surveys

Ecological field surveys have been carried out in the Study Area over many years and seasons including in December 2002 (Ecotone 2003), April 2007 (SMEC 2008) and October 2015 (Kleinfelder 2015). Throughout these surveys, the following has been undertaken:

- Flora surveys including four 20m x 20m quadrats
- Diurnal fauna observations including signs of presence surveys and targeted bird surveys
- Habitat assessments
- Nocturnal spotlighting, call playback and Anabat surveys and
- Reconnaissance vegetation mapping and weed mapping.

The results of these surveys have been reviewed as part of the literature review outlined in **Section 2.1**.

2.3.2 Ecological Site Inspection

A site inspection was undertaken by Umwelt ecologists on 25 May 2016 in order to complete ground-truthing of previous surveys and identification of any important ecological features. This included:

- Rapid vegetation mapping reconnaissance
- Recording dominant weed species and infestations
- Habitat assessments for threatened species
- Diurnal bird surveys
- Spot Assessment Technique (SAT) surveys for koala (*Phascolarctos cinereus*) as per Phillips and Callaghan (1995)
- Call playback for masked owl (*Tyto novaehollandiae*), powerful owl (*Ninox s*trenua), squirrel glider (*Petaurus norfolcensis*) and koala
- Spotlighting searches for nocturnal threatened fauna
- Two remote camera survey locations over seven nights targeting ground-dwelling threatened mammal species
- One Anabat survey location over seven nights targeted threatened micro-bat species and
- Opportunistic observations throughout the site inspection.

Remote cameras and the Anabat were set up on 25 May 2016 and collected after seven nights on 1 June 2016.

2.3.3 Targeted Orchid Surveys

Site walkovers of the Study Area were undertaken by two Umwelt ecologists on 8 September 2016 to determine the presence or otherwise of sand doubletail (*Diuris arenaria*) and rough doubletail (*Diuris praecox*) within suitable habitats within the Study Area. Both species are known to occur along the Tomaree Peninsula in sandy soils in associated with sclerophyll forest and disturbed habitat margins.

The timing of these surveys was dependent on the known flowering times of these species within the Port Stephens area. Furthermore, known records of the threatened orchids (control sites) were visited prior to the surveys to confirm the flowering of the species in the local area. Survey was undertaken in early September 2016 to cover the beginning of the sand doubletail flowering period and the end of the rough doubletail flowering period as per the flowering times outlined in **Table 2.1**.

Table 2.1 Threatened Orchid Species Known Flowering Period in Port Stephens

Targeted Orchid Species	Flowering Period
sand doubletail (*Diuris arenaria*)	August to September
rough doubletail (*Diuris praecox*)	July to September

2.3.4 Habitat Tree Survey and Biometric Plots and Transects

Hollow-bearing tree surveys, koala feed tree surveys and biometric plots and transects were undertaken by two Umwelt ecologists on 1 November 2016 to provide further information on the following features of the Study Area:

- Presence or otherwise of Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions endangered ecological community (EEC)
- Distribution and size of hollow-bearing trees
- Distribution and identification of preferred koala feed tree species and
- Floristic composition of the vegetation communities across the site for potential future assessment pathways.

2.3.4.1 Habitat Tree Survey

Hollow-bearing trees and preferred koala feed trees were surveyed across the Study Area by undertaking walking transects and marking suitable features as a GPS waypoint. Hollow-bearing trees were recorded with information on tree species, hollow size, number and tree diameter at breast height (DBH). Preferred koala feed trees (as per the Port Stephens Comprehensive Koala Plan of Management (CKPoM)) were recorded including information on species and general description.

2.3.4.2 Plot and Transect Surveys

A total of five systematic plots/transect surveys were conducted across the Study Area during the surveys undertaken for this assessment. At each plot/transect data was recorded according to Section 5 of the BBAM (OEH 2014). This involved setting out 20 x 50 metre and 20 x 20 metre plots and a 50 metre transect.

The location of each quadrat was recorded using a hand-held GPS with accuracy of ± 5 metres. The Map Grid of Australia (MGA) coordinate system was used.

At each plot/transect, roughly 45 to 60 minutes was spent searching for all vascular flora species present within the 20 x 20 metre plot. Searches of each 20 x 20 metre plot were generally undertaken through parallel transects from one side of the plot to another. Most effort was spent on examining the groundcover, which usually supported well over half of the species present, however the composition of the shrub, mid-storey, canopy and emergent layers were also thoroughly examined. Effort was made to search the tree canopy and tree trunks for mistletoes, vines and epiphytes.

For each flora species recorded in the plot, the following data was collected in accordance with Table 1 of the BBAM (OEH 2014):

- stratum/layer in which the species occurs
- growth form
- scientific name and common name
- cover
- abundance.

At each standard flora plot, 10 points along a 50 metre transect were assessed for:

- percentage native overstorey cover
- percentage native mid-storey cover.

In addition, 50 points along a 50 metre transect were assessed for:

- percentage native groundcover (grass)
- percentage native groundcover (shrubs)
- percentage native ground cover (other)
- percentage exotic plant cover.

Additional details were recorded in each quadrat, including soil texture, drainage and depth; site disturbances; physiography (position in the landscape); and vegetation structure (strata percentage covers, heights and dominant species). Photographic records were also taken at each site.

Meandering transects were also undertaken through vegetation units across the Study Area to enable floristic sampling across a much larger area than systematic plots, allowing the survey to achieve a combination of detailed observation and broader appreciation. Records along transects supplemented floristic sampling carried out as part of plot survey.

3.0 Results

3.1 Ecological Local Context

The Rifle Range (Study Area) is situated on a sand peninsula that occurs between the Hunter River and Stockton Beach, north of Newcastle, NSW. The Study Area is located within the Port Stephens Council Local Government Area (LGA) and in the NSW North Coast Bioregion and the Karuah Manning subregion.

Table 3.1 Study Area Location in the Landscape

Rifle Range	
IBRA (V7) Bioregion	NSW North Coast
IBRA (V7) Subregion	Karuah Manning
Major Catchment Area	Hunter/Central Rivers
Mitchell Landscape	Sydney – Newcastle Barriers and Beaches
LGA	Port Stephens Council
Lot and DP	Lot 5 DP233358

The Study Area is approximately 112 hectares in size and is broadly located between Popplewell Road, Fern Bay, and the high water mark at Stockton Beach. The land is currently zoned as E2 Environmental Conservation under the Port Stephens Council Local Environmental Plan (LEP) 2013.

The Study Area is surrounded by residential development and conservation lands including housing to the west of Popplewell Road, coastal dunes to the east and the Worimi Regional Park adjoining the northern portion of the site. The Worimi Regional Park constitutes part of the wider Worimi Conservation Lands that provide an important habitat link within a broader wildlife corridor from the Hunter Wetlands National Park in the northwest, Tomaree National Park and Tilligerry State Conservation Area in the north. The majority of the Worimi Conservation Lands are dominated by blackbutt (*Eucalyptus pilularis*) and smooth-barked apple (*Angophora costata*) forests (OEH 2015). Connectivity from the Worimi Conservation Lands to the south of the Study Area is currently severed by urban development and historic disturbances.

Vegetation in the Study Area has been subjected to several human disturbances including activities during the active use of the Rifle Range, vehicle recreation and illicit dumping. These disturbances have led to a reduction in vegetation condition, particularly within the former firing mounds. Retained vegetation in the northern portion of the Study Area adjoins the Worimi Regional Park and represents the highest quality vegetation and habitats on the site. Fauna habitats in the locality include forests, coastal sand scrub and sand dunes.

3.2 Flora and Native Vegetation

A total of 89 flora species have been recorded in the Study Area following floristic surveys undertaken by SMEC (2008), Kleinfelder (2015) and Umwelt. A full list of the flora species recorded during surveys of the Study Area is presented in **Appendix A**.

Five native vegetation community types have been mapped within the Study Area, being:

- Frontal Dune Blackbutt-Apple Forest
- Mahogany-Baloskion Swamp Forest
- Coastal Tea-tree – Banksia Scrub
- Foredune Spinifex
- Beach Wetlands.

These communities have been aligned with the Vegetation of the Worimi Conservation Lands (Bell and Driscoll 2010) and assigned (where possible) to Plant Community Types (PCTs) and Biometric Vegetation Types (BVTs) as per the Vegetation Information System (VIS).

Table 3.2 outlines the native vegetation community types within the Study Area. **Figure 3.1** shows vegetation mapping of the Study Area.

Table 3.2 Vegetation Communities in the Study Area

Vegetation Community (Bell and Driscoll 2010)	Likely Associated PCT/BVT	Area within the Study Area (ha)
Frontal Dune Blackbutt-Apple Forest	PCT1646/HU860 – Smooth-barked Apple – Blackbutt – Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	17.5
Mahogany-Baloskion Swamp Forest	PCT1725/HU939 - Swamp Mahogany - Broad-leaved Paperbark - Swamp Water Fern - Plume Rush swamp forest on coastal lowlands of the Central Coast and Lower North Coast	2.3
Coastal Tea-tree – Banksia Scrub	PCT1646/HU860 – Smooth-barked Apple – Blackbutt – Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	20.5
Foredune Spinifex	PCT1204/(no equivalent BVT) – Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion	1.4
Beach Wetlands	No equivalent PCT or BVT	3.2
Cleared land/sand dunes	No equivalent PCT or BVT	66.7
Total		**111.6**

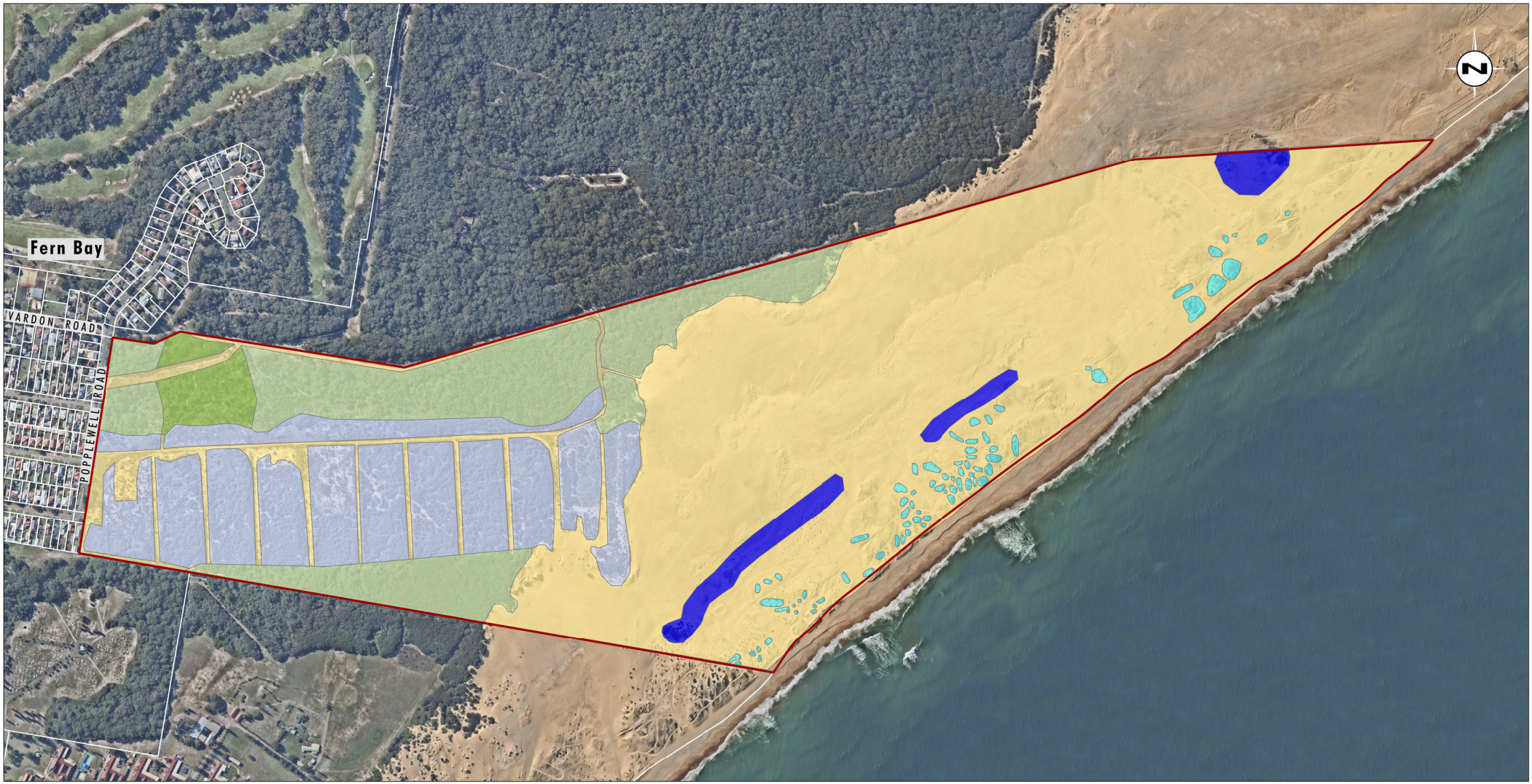

Image Source: Nearmap (Apr 2018)
Data Source: LPI NSW (2009)

0 100 250 500m
1:10 000

Legend

- Site Boundary
- Frontal Dune Blackbutt-Apple Forest
- Mahogany-Baloskion Swamp Forest
- Coastal Tea-tree-Banksia Scrub
- Beach Wetlands
- Foredune Spinifex
- Cleared Land/Sand Dunes

FIGURE 3.1

Preliminary Vegetation Community Mapping

File Name (A4): R02/3764_001.dgn
20180524 16.13

3.2.1 Vegetation Community Descriptions

Tables 3.3 to **3.7** below describe the vegetation communities occurring in the Study Area.

Table 3.3 Frontal Dune Blackbutt-Apple Forest

Community Name	Frontal Dune Blackbutt-Apple Forest	
Likely Plant Community Type (PCT)	PCT1646/HU860 – Smooth-barked Apple – Blackbutt – Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	
Vegetation Formation	Dry Sclerophyll Forests (Shrubby sub-formation)	
Vegetation Class	Coastal Dune Dry Sclerophyll Forests	
Total Area in Study Area (ha)	17.5	
General Description	This vegetation community occurs on the Holocene sands along the Port Stephens coastline where there is protection from direct coastal winds. This vegetation community condition class is located primarily to the north of the Study Area adjoining the habitats of Worimi Regional Park. This community also occurs in a smaller patch to the south of the Study Area.	
Floristic Description	This community is a moderately open forest with a shrubby understorey. The canopy is dominated by smooth-barked apple (*Angophora costata*) and blackbutt (*Eucalyptus pilularis*). The midstorey was dominated by old man banksia (*Banksia serrata*), Sydney golden wattle (*Acacia longifolia*) and coastal tea-tree (*Leptospermum laevigatum*), with occasional coast banksia (*B. integrifolia*). The ground cover consisted primarily of bracken fern (*Pteridium esculentum*) with spiny-headed mat-rush (*Lomandra longifolia*), raspwort (*Gonocarpus teucrioides*), blue flax lily (*Dianella caerulea*), blady grass (*Imperata cylindrica*) and kangaroo grass (*Themeda triandra*) also present. The exotic bitou bush (*Chrysanthemoides monilifera*) and lantana (*Lantana camara*) also occur in this community.	
TSC Act Status	This vegetation community does not conform to a TEC listed under the TSC Act.	
EPBC Act Status	This vegetation community does not conform to a TEC listed under the EPBC Act.	

Table 3.4 Mahogany-Baloskion Swamp Forest

Community Name	Mahogany-Baloskion Swamp Forest	
Likely Plant Community Type (PCT)	PCT1725/HU939 - Swamp Mahogany - Broad-leaved Paperbark - Swamp Water Fern - Plume Rush swamp forest on coastal lowlands of the Central Coast and Lower North Coast	
Vegetation Formation	Forested Wetlands	
Vegetation Class	Coastal Swamp Forests	
Total Area in Study Area (ha)	2.3	
General Description	This vegetation community occurs on a low lying area in the west of the Study Area and is located either side of the Frontal Dune Blackbutt-Apple Forest resulting in ecotonal influences.	
Floristic Description	This community is characterised by a canopy of swamp mahogany (*Eucalyptus robusta*) with occurrences of likely hybrids of swamp mahogany and Earp's gum (*Eucalyptus parramattensis* subsp. *decadens* x *robusta*). Common midstorey species include coast teatree (*Leptospermum laevigatum*), tantoon (*Leptospermum polygalifolium*), tree broom-heath (*Monotoca elliptica*) and common fringe-myrtle (*Calytrix tetragona*). The native groundcover is dominated by pomax (*Pomax umbellata*), spiny-headed mat-rush (*Lomandra longifolia*), blue flax-lily (*Dianella caerulea*) and bracken fern (*Pteridium esculentum*).	
TSC Act Status	This vegetation community does not conform to a TEC listed under the TSC Act due to the low number of characteristic flora species and lack of association with an alluvial floodplain (refer to **Section 3.4.1.4**).	
EPBC Act Status	This vegetation community does not conform to a TEC listed under the EPBC Act.	

Table 3.5 Coastal Tea-tree – Banksia Scrub

Community Name	Coastal Tea-tree – Banksia Scrub	
Likely Plant Community Type (PCT)	PCT1646/HU860 – Smooth-barked Apple – Blackbutt – Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	
Vegetation Formation	Dry Sclerophyll Forests (Shrubby sub-formation)	
Vegetation Class	Coastal Dune Dry Sclerophyll Forests	
Total Area in Study Area (ha)	20.5	
General Description	This vegetation community occurs on the Holocene sands along the Port Stephens coastline where there is protection from direct coastal winds. This vegetation community condition class is likely to be derived from the Frontal Dune Blackbutt-Apple Forest occurring in the north and south of the Study Area. Historical disturbances from the former use of the Rifle Range have modified this community with groundcovers and shrubs now dominating. This community is likely to have previously conformed to the Frontal Dune Blackbutt-Apple Forest. This community occurs in the central portion of the Study Area associated with the Rifle Range footprint.	
Floristic Description	This community occurs as a shrubland and is primarily dominated by coastal tea-tree (*Leptospermum laevigatum*) with occurrences of coastal wattle (*Acacia longifolia* subsp. *sophorae*), tree broom-heath (*Monotoca elliptica*) and coast banksia (*Banksia integrifolia*). The native groundcover consisted primarily of pig face (*Carpobrotus glaucescens*), spiny-headed mat-rush (*Lomandra longifolia*), *Hibbertia* sp. and kidney weed (*Dichondra repens*). The exotic bitou bush (*Chrysanthemoides monilifera*) and lantana (*Lantana camara*) also occur in this community. Disturbance of this community is varied with some areas recently cleared with sparse vegetation cover and other areas presenting dense coastal tea-tree stands. This community also extends to the dune margins to the east of the Study Area where it is dominated by bitou bush (*Chrysanthemoides monilifera*) with occurrences of pig face (*Carpobrotus glaucescens*). Other exotic vegetation on the dune margins includes prickly pear (*Opuntia stricta*), African love grass (*Eragrostis curvula*) and buffalo grass (*Stenotaphrum secundatum*).	
TSC Act Status	This vegetation community does not conform to a TEC listed under the TSC Act.	
EPBC Act Status	This vegetation community does not conform to a TEC listed under the EPBC Act.	

Table 3.6 Foredune Spinifex

Community Name	Foredune Spinifex	
Likely Plant Community Type (PCT)	PCT1204/(no equivalent BVT) – Spinifex beach strand grassland, Sydney Basin Bioregion and South East Corner Bioregion	
Vegetation Formation	Grasslands	
Vegetation Class	Maritime Grasslands	
Total Area in Study Area (ha)	1.4	
General Description	This vegetation community occurs on the incipient foredunes on the far eastern sections of the Study Area. This community occurs sporadically along the mobile sands of Stockton Bight, and is characterised by the colonising, sand-stabilising grass *Spinifex sericeus*. These are often temporary communities found growing on mobile sand deposits such as beach foredunes and dune blowouts. Beach spinifex grassland is found across beach strands in New South Wales.	
Floristic Description	The dominant species in this community is hairy spinifex (*Spinifex sericeus*) with patches of bitou bush (*Chrysanthemoides monilifera*). In some areas, bitou bush appears to be dominant and threatening the persistence of the spinifex community.	
TSC Act Status	This vegetation community does not conform to a TEC listed under the TSC Act.	
EPBC Act Status	This vegetation community does not conform to a TEC listed under the EPBC Act.	

Table 3.7 Beach Wetlands

Community Name	Beach Wetlands	
Likely Plant Community Type (PCT)	No equivalent PCT	
Vegetation Formation	N/A	
Vegetation Class	N/A	
Total Area in Study Area (ha)	3.2	
General Description	This community occurs within depressions along the dune system. Beach wetlands form where fresh groundwater meets the surface, typically at the foot of larger sand dunes, and allows simple ecosystems of perennial and ephemeral wetland species to survive. A range of floristic variations of this community are known to occur along Stockton Beach. Two of these variants, *Carex* meadows and *Ficinia* reedlands, occur to the east of the Study Area on the dunes.	
Floristic Description	This vegetation community occurs as two variants within the Study Area, the first being *Carex pumila* meadows, which is dominated by *Carex pumila*, occasional *Ficinia nodosa* and the exotic *Hydrocotyle bonariensis*. The second variant includes *Ficinia* reedlands, dominated by *Ficinia nodosa*, *Juncus pallidus*, *Hydrocotyle bonariensis* with wetland margins containing coast banksia (*Banksia integrifolia*) and bitou bush (*Chrysanthemoides monilifera*). At the time of survey these areas did not contain standing water and it is likely that these wetlands are dynamic in response to wet periods.	
TSC Act Status	This vegetation community is likely to conform to Sydney Freshwater Wetlands in the Sydney Basin Bioregion EEC (refer to **Section 3.4.1.4**).	
EPBC Act Status	This vegetation community does not conform to a TEC listed under the EPBC Act.	

3.3 Fauna and Fauna Habitats

3.3.1 Fauna Species

A wide range of fauna species have been recorded within and surrounding the Study Area as part of previous ecological surveys.

Thirty seven bird, ten mammal, two reptile and two amphibian species have been previously recorded in the Study Area utilising a wide range of habitats. Of these, four threatened species listed under the TSC Act and/or EPBC Act have been recorded. These are further discussed in **Section 3.4**.

Commonly recorded species observed in the forest and shrubland habitats include laughing kookaburra (*Dacelo novaeguineae*), grey butcherbird (*Cracticus torquatus*), red-browed finch (*Neochmia temporalis*), red wattlebird (*Anthochaera carunculata*) and swamp wallaby (*Wallabia bicolor*). Introduced fauna species observed within the Study Area include feral cat (*Felix catus*), red fox (*Vulpes vulpes*) and the European rabbit (*Oryctolagus cuniculus*). A full fauna list for the Study Area is included in **Appendix B**.

3.3.2 Fauna Habitats

Several general fauna habitat types occur in the Study Area. Each of these broad habitat types has a range of characteristics which influence the habitat value, and the range of fauna species that are likely to be identified within each type. The broad habitat types recorded within the Study Area consist of forest, shrubland and dune spinifex/wetland habitat.

Forested habitats of the Study Area are dominated by eucalypts species which are likely to provide a seasonally prolific nectar resource for birds such as honeyeaters and lorikeets. The forested habitats of the Study Area contain limited hollow resources due a general lack of mature and old growth trees. The forest understorey provides potential foraging habitat for micro-bats, macropods, birds and some limited nesting potential in protected areas for small woodland birds. The ground cover is dense with several fallen hollow branches and trees providing foraging and refuge resources for reptiles and small terrestrial mammals. Water resources are limited within this habitat type.

The shrubland habitat in the central portion of the Study Area may provide habitat resources for a wide range of nectarivorous species. This habitat is considered to be derived from the surrounding forest habitat, with the community likely a result of ground disturbance in this area. Small birds such as the brown quail (*Coturnix ypsilophora*), superb fairy wren (*Malurus cyaneus*) and red-browed finch (*Neochmia temporalis*), and reptiles such as the eastern striped skink (*Ctenotus robustus*) are provided foraging habitat as well as refuge habitat within the dense shrub layers.

The dune spinifex and wetland habitat in the Study Area is subject to coastal winds with minimal vegetation and no fauna species were recorded at the time of the surveys. Despite this, it is likely that sea birds such as gulls and terns would occasionally utilise these areas for foraging or roosting. Common species such as silver gull (*Chroicocephalus novaehollandiae*), crested tern (*Thalasseus bergii*) and red-capped plovers (*Charadrius ruficapillus*) are likely to occur in these habitats. There is potential for migratory wader birds to forage along the tideline or nest on sandflats between the dunes immediately behind the beach.

3.3.2.1 Hollow-bearing Trees

Seventeen hollow bearing trees were identified within the Study Area, primarily in the northern extent of remnant vegetation. The locations of these trees were recorded using a handheld GPS. A total of 7 tiny hollows (<25mm diameter), 14 small hollows (26-50mm diameter), and 5 medium hollows (51 – 100mm diameter) were identified (refer to **Table 3.8**). These results demonstrate a low number of habitat trees with predominantly smaller sized hollows. These were typically formed at the end of spouts while a small number were found within trunks of stags or trees with a substantial amount of dieback. These observations were not unexpected given hollows associated with viable habitat are characteristic of older, mature to over-mature trees, which do not occur within the Study Area.

Table 3.8 Hollow-bearing Trees within the Study Area

Tree Species	DBH (mm)	Number of Hollows				
		Tiny <25mm	Small 26-50mm	Medium 51-100mm	Large 100-300mm	Extra Large 301+
blackbutt *Eucalyptus pilularis*	500	3	-	-	-	-
blackbutt *Eucalyptus pilularis*	400	-	2	-	-	-
blackbutt *Eucalyptus pilularis*	500	-	1	-	-	-
smooth-barked apple *Angophora costata*	800	-	1	-	-	-
blackbutt *Eucalyptus pilularis*	800	-	1	-	-	-
blackbutt *Eucalyptus pilularis*	600	-	2	1	-	-
unknown (substantial dieback)	400	-	-	1	-	-
stag (dead tree)	300	1	1	-	-	-
stag	300	1	-	-	-	-
stag	300	2	-	-	-	-
blackbutt *Eucalyptus pilularis*	400	-	1	-	-	-
smooth-barked apple *Angophora costata*	300	-	1	-	-	-

Tree Species	DBH (mm)	Number of Hollows				
		Tiny <25mm	Small 26-50mm	Medium 51-100mm	Large 100-300mm	Extra Large 301+
smooth-barked apple *Angophora costata*	600	-	-	1	-	-
blackbutt *Eucalyptus pilularis*	800	-	-	1	-	-
blackbutt *Eucalyptus pilularis*	300	-	-	1	-	-
blackbutt *Eucalyptus pilularis*	400	-	1	-	-	-
blackbutt *Eucalyptus pilularis*	500	-	3	-	-	-
Total		**7**	**14**	**5**	**0**	**0**

3.3.2.2 Koala Habitat

Koalas feed on the foliage of eucalypt tree species and in some areas exhibit extremely strong preferences for particular eucalypt species. State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44) (currently under review) lists preferred koala feed trees as does the Comprehensive Koala Plan of Management (CKPoM) (PSC 2002) and the Approved Recovery Plan for the Koala (DECC 2008). One of these feed species, swamp mahogany (*Eucalyptus robusta*), is known to occur in the Study Area. Furthermore, an additional hybrid species being *Eucalyptus parramattensis* subsp. *decadens* x *robusta*, was likely recorded within the Study Area. These species are outlined in **Table 3.9** below as well as counts of preferred feed tree species in the Study Area as a result of the koala habitat tree survey.

Table 3.9 Preferred/Primary Koala Feed Trees

Preferred/Primary Koala Feed Tree Species	SEPP 44	Port Stephens Comprehensive Koala Plan of Management	Approved Recovery Plan for the Koala^	Number Recorded in the Study Area
swamp mahogany *Eucalyptus robusta*	✓	✓	✓	148
Parramatta red gum *Eucalyptus parramattensis*	-	✓	✓	2 (likely hybrid with *E. robusta*)
forest red gum *Eucalyptus tereticornis*	✓	✓	✓	-

Preferred/Primary Koala Feed Tree Species	SEPP 44	Port Stephens Comprehensive Koala Plan of Management	Approved Recovery Plan for the Koala^	Number Recorded in the Study Area
tallowwood *Eucalyptus microcorys*	✓	-	✓	-
grey gum *Eucalyptus punctata*	✓	-	-	-
ribbon or manna gum *Eucalyptus viminalis*	✓	-	-	-
river red gum *Eucalyptus camaldulensis*	✓	-	-	-
broad-leaved scribbly gum *Eucalyptus haemastoma*	✓	-	-	-
scribbly gum *Eucalyptus signata*	✓	-	-	-
white box *Eucalyptus albens*	✓	-	-	-
bimble box or poplar box *Eucalyptus populnea*	✓	-	-	-
cabbage gum *Eucalyptus amplifolia*	-	-	✓	-
			Total	**150**

^Appendix 2 – North Coast Koala Management Area

Koala habitat in the Port Stephens LGA has been mapped and presented in the Port Stephens Council Koala Plan of Management (PSC 2002). Koala habitat identification was undertaken by Lunney *et al.* (1998) and incorporated into the CKPoM which identified the following habitat types for koalas in the Port Stephens area:

- Preferred koala habitat
- Supplementary koala habitat
- Marginal koala habitat
- Habitat buffers
- Habitat linking areas.

Preferred habitat on the coastal strip of Port Stephens generally occurs in the intact Swamp Sclerophyll Forest community and supplementary habitat includes areas where the Swamp Sclerophyll Forest intergrades with the Smooth-barked Apple Blackbutt Forest vegetation community. The Port Stephens Koala Habitat Planning Map (PSC 2007) maps the Study Area as 'mainly cleared' with edges of 'supplementary habitat' occurring to the north of the site in association with the Frontal Dune Blackbutt-Apple Forest and the Worimi Conservation Lands.

However, based on the habitat categories by Lunney *et al.* (1998), it is likely that the Mahogany-Baloskion Swamp Forest would meet the definition of Category B vegetation detailed by Lunney *et al.* (1998) and therefore would be considered preferred koala habitat in the Port Stephens LGA. The Frontal Dune Blackbutt-Apple Forest is likely to confirm to Category C vegetation and would be considered supplementary koala habitat. The remaining vegetation in the Study Area is classified as 'other vegetation'. Koala habitat within the Study Area, mapped by Umwelt in consideration of Lunney *et al.* (1998), is shown in **Figure 3.2**.

The koala was targeted during surveys undertaken in May 2016 including SAT, call playback and spotlighting surveys (refer to **Section 2.3.2**). No evidence (scats, scratches, etc) of koala occupation was recorded in the Study Area. While the koala has not been specifically recorded within the Study Area, the species has been recorded as recently as 2015 in habitats associated with Fern Bay approximately 1.5km north of the Study Area.

An assessment of the proposed rezoning under the performance criteria for rezoning proposals in accordance with Appendix 2 the CKPoM (PSC 2002) is provided in **Section 4.6**.

3.4 Important Ecological Features

3.4.1 Threatened Species, Populations and Communities

Threatened species relevant to the Study Area are discussed in the sections below and shown in **Figure 3.2**.

3.4.1.1 Threatened Flora Species

No threatened flora species listed under the TSC or EPBC Acts have been previously recorded within the Study Area.

A range of threatened flora species have been previously recorded in the wider locality in similar habitats. **Table 3.10** below outlines the threatened flora species that have been recorded in the Study Area or are likely to occur in the Study Area due to local records and the availability of suitable habitat. A full list and assessment of the threatened species previously recorded within 10km of the Study Area is provided in **Appendix C**.

Table 3.10 Threatened Flora Species Recorded or Likely to Occur in the Study Area

Species Name	TSC Act	EPBC Act	Records and Further Information
Earp's gum *Eucalyptus parramattensis* subsp. *decadens*	V	V	An atypical eucalypt was recorded within the Study Area that may be *Eucalyptus parramattensis* subsp. *decadens* x *robusta*. This species is known to hybridise with *Eucalyptus robusta* in the Worimi Regional Park just north of the Study Area (Bell and Driscoll 2010). The location of this individual is shown in **Figure 3.2**. Neither the OEH profile (OEH 2016) or the approved Commonwealth conservation advice (TSSC 2014) for this species discusses the inclusion of hybrids in the listed species. Most specimens present within Worimi (and surrounds) exhibit stronger characteristics of *Eucalyptus robusta* rather than *Eucalyptus parramattensis* subsp. *decadens* (Bell and Driscoll 2010). Samples of two potential Earps gum hybrids from the Study Area have been sent to the Royal Botanic Gardens in Sydney for formal identification.
sand doubletail *Diuris arenaria*	E	-	Not recorded within the Study Area. This species occurs in coastal heath and dry grassy eucalypt forest on sandy flats and has been recorded along the Tomaree Peninsula. This species was subject to targeted surveys on 8 September 2016 during the known flowering period for the species. It was not recorded within the Study Area, despite other known populations flowering in the locality.
rough doubletail *Diuris praecox*	V	V	Not recorded within the Study Area. Previously recorded in Fern Bay within 2km to the northeast of the Study Area in similar habitats. This species was subject to targeted surveys on 8 September 2016 during the known flowering period for the species. It was not recorded within the Study Area, despite other known populations flowering in the locality.
coast groundsel *Senecio spathulatus*	E	-	Not recorded within the Study Area. Has been previously recorded on the Stockton sand dunes approximately 10km northeast of the Study Area (Bell and Driscoll 2010). Likely to occur on the sand dunes in the east of the Study Area.

Notes:
V vulnerable
E endangered

Image Source: Nearmap (Apr 2018)
Data Source: LPI NSW (2009), Atlas (2016)

0 100 250 500m
1:10 000

Legend

- Site Boundary
- Hollow-bearing Trees

Koala Habitat Entities:

- Preferred Koala Habitat
- 50m Buffer around Preferred Koala Habitat
- Supplementary Koala Habitat
- Other Vegetation
- Mainly Cleared

Threatened Species:

- Sydney Freshwater Wetlands in the Sydney Basin Bioregion EEC
- Eastern Bentwing-bat
- Little Bentwing-bat
- Powerful Owl
- *Eucalyptus parramattensis* subsp. *decadens x robusta*

FIGURE 3.2

Significant Ecological Features of the Study Area

File Name (A4): R02/3764_003.dgn
20180524 16.22

3.4.1.2 Threatened Fauna Species

Four threatened fauna species listed under the TSC or EPBC Acts have been previously recorded within the Study Area being:

- grey-headed flying-fox (*Pteropus poliocephalus*), listed as vulnerable under the TSC and EPBC Acts
- little bentwing-bat (*Miniopterus australis*), listed as vulnerable under the TSC Act
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*), listed as vulnerable under the TSC Act
- east coast freetail-bat (*Mormopterus norfolkensis*), listed as vulnerable under the TSC Act.

Table 3.11 below outlines the threatened fauna species that have been recorded in the Study Area or are likely to occur in the Study Area due to local records and the availability of suitable habitat. A full list and assessment of the threatened species previously recorded within 10km of the Study Area is provided in **Appendix C**.

Table 3.11 Threatened Fauna Species Recorded or Likely to Occur in the Study Area

Species Name	TSC Act	EPBC Act	Records and Further Information
Amphibians			
wallum froglet *Crinia tinnula*	V	-	Not recorded within the Study Area. This species has been recorded in adjacent habitat associated with Fern Bay and swamp forests. Usually associated with wallum heaths and wet soak habitat.
Birds			
little tern *Sternula albifrons*	E	-	Not recorded within the Study Area. Previously recorded nesting in mined dunes along the south-western edge of the Worimi Conservation Lands. Likely to utilise the sandy habitats of the Study Area for nesting.
powerful owl *Ninox strenua*	V	-	Not recorded within the Study Area. Previously recorded in Fern Bay and within the Worimi Regional Park. Hollow resources are limited in the Study Area. Likely to utilise the Study Area for foraging resources.
masked owl *Tyto novaehollandiae*	V	-	Not recorded within the Study Area. Previously recorded in Fern Bay and within the Worimi Regional Park. Hollow resources are limited in the Study Area. Likely to utilise the Study Area for foraging resources.

Species Name	TSC Act	EPBC Act	Records and Further Information
white-bellied sea eagle *Haliaeetus leucogaster*	V	-	**Recorded** within the Study Area during the surveys undertaken in September 2016. The Study Area is likely to provide suitable foraging habitat and potential nesting habitat for the species, however no nests have been recorded in the Study Area.
Mammals			
New Holland mouse *Pseudomys novaehollandiae*	-	V	Not recorded within the Study Area. Known to occur in the Worimi Conservation Lands in similar habitats to that of the Study Area. It is associated with heathlands and vegetation sand dunes and is found to peak in abundance 3 to 5 years following a fire. The last fire to impact the Study Area occurred in late 2006 and would have likely resulted in suitable habitat for the species.
koala *Phascolarctos cinereus*	V	V	Not recorded within the Study Area. The Study Area contains two preferred koala feed trees, being swamp mahogany (*Eucalyptus robusta*) and likely Earps gum hybrids (*Eucalyptus parramattensis* subsp. *decadens* x *robusta*) occurring in the northwest of the site in the Mahogany-Baloskion Swamp Forest. This species has been recorded in adjacent habitats associated with Fern Bay and the Worimi Regional Park. This species was targeted during surveys undertaken in May 2016 including SAT surveys, call playback and spotlighting (refer to **Section 2.3.2**). No evidence (scats, scratches, etc) of koala occupation was recorded in the Study Area. 150 preferred koala feed trees occur in the Study Area. The Study Area is unlikely to be core habitat for the Port Stephens koala population, however individuals may occur infrequently as they move through the landscape around Fern Bay.
squirrel glider *Petaurus norfolcensis*	V	-	Not recorded within the Study Area. This species has been recorded in adjacent similar habitat associated with Fern Bay. *Banksia serrata* in the forest understorey provides suitable foraging habitat for the species, however it is noted that hollow resources in the Study Area occur in low densities.

Species Name	TSC Act	EPBC Act	Records and Further Information
grey-headed flying-fox *Pteropus poliocephalus*	V	V	**Recorded** within the Study Area. Up to five individuals were observed foraging in the forested habitats of the Study Area in April 2007. No flying-fox camps have been recorded in the Study Area. The Study Area is likely to provide suitable foraging habitat for the species.
little bentwing-bat *Miniopterus australis*	V	-	**Recorded** within the Study Area. Detected on site using an Anabat detector in May 2016 in the forested habitats in the Study Area. The Study Area is likely to provide suitable foraging habitat for the species and potential hollow-bearing tree roosting habitat.
eastern bentwing-bat *Miniopterus schreibersii oceanensis*	V	-	**Recorded** within the Study Area. Detected on site using an Anabat detector in May 2016 in the forested habitats in the Study Area. The Study Area is likely to provide suitable foraging habitat for the species.
east coast freetail-bat *Mormopterus norfolkensis*	V	-	**Recorded** within the Study Area. Detected on site using an Anabat detector in April 2007 (SMEC 2008) in the forested habitats in the Study Area. The Study Area is likely to provide suitable foraging habitat for the species and potential hollow-bearing tree roosting habitat.
greater broad-nosed bat *Scoteanax rueppellii*	V	-	Not recorded within the Study Area. Previously recorded in Fern Bay within 2km to the northeast of the Study Area in similar habitats. The Study Area is likely to provide suitable foraging habitat for the species and potential hollow-bearing tree roosting habitat.

Notes:

V vulnerable
E endangered
CE critically endangered

3.4.1.3 Endangered Populations

No endangered populations listed under the TSC or EPBC Acts have been previously recorded within the Study Area.

One endangered population is known to occur within the Port Stephens LGA, being the Emu population (*Dromaius novaehollandiae*) in the NSW North Coast Bioregion and Port Stephens LGA. The population is of significant conservation value as the last known population in northern coastal NSW, however this species has not been recorded within the Study Area or the locality and it is unlikely to occur.

3.4.1.4 Threatened Ecological Communities

One likely threatened ecological community (TEC) was recorded within the Study Area, being *Sydney Freshwater Wetlands in the Sydney Basin Bioregion EEC* listed under the TSC Act associated with the beach wetlands occurring in the east of Study Area. While the Study Area is not within the Sydney Basin Bioregion according to the current Version 7 of the IBRA Bioregion mapping (DSEWPC 2012), the EEC was gazetted in 2000 (NSWSC 2000), and, as per advice from OEH, TECs determined prior to March 2013 are to use mapping from Version 4.0 of the IBRA Bioregion mapping (Thackway and Cresswell 1995). As such, for the purposes of determining the presence or otherwise of ecological communities in the Study Area, the beach wetlands within the Study Area occur within the Sydney Basin Bioregion (Version 4.0 IBRA mapping) and conform to *Sydney Freshwater Wetlands EEC*.

No other threatened ecological communities listed under the TSC or EPBC Acts have been recorded within the Study Area. Further investigations into the presence or otherwise of *Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions EEC* under the TSC Act have been undertaken and are detailed in **Appendix D**.

Table 3.12 below outlines the TECs that likely to occur in the Study Area due to local records and the availability of suitable habitat. A full list of the TECs previously recorded within 10km of the Study Area is provided in **Appendix C**.

Table 3.12 Threatened Ecological Communities Likely to Occur in the Study Area

Species Name	TSC Act	EPBC Act	Records and Further Information
Sydney Freshwater Wetlands in the Sydney Basin Bioregion	EEC	-	Beach wetlands within the Study Area are likely to conform to this EEC. While the Study Area is not within the Sydney Basin Bioregion according to the current Version 7 of the IBRA Bioregion mapping, the EEC was determined prior to March 2013 (NSWSC 2000).

Notes:
EEC endangered ecological community

3.4.2 Matters of National Environmental Significance

Under the Commonwealth EPBC Act, the approval of the Commonwealth Minister for DoEE 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 communities
- migratory species protected under international agreements
- Ramsar wetlands of international importance
- the Commonwealth marine environment
- the Great Barrier Reef Marine Park
- World Heritage properties
- National Heritage places
- nuclear actions
- a water resource, in relation to coal seam gas development and large coal mining development.

One MNES, and one potential MNES, have been recorded within the Study Area, being:

- grey-headed flying-fox (*Pteropus poliocephalus*), listed as vulnerable under the EPBC Act
- Earp's gum (*Eucalyptus parramattensis* subsp. *decadens*) (possible hybrid with *Eucalyptus robusta*), listed is vulnerable under the EPBC Act.

Grey-headed flying-fox was recorded in April 2007 feeding within the Frontal Dune Blackbutt-Apple Forest in the north of the Study Area. In accordance with the draft National Recovery Plan for the species (DECCW 2009), all foraging habitat has the potential to be productive during general food shortages and to therefore provide a resource critical to survival for the species.

Earp's gum (*Eucalyptus parramattensis* subsp. *decadens*) may occur on the site as a hybrid with *Eucalyptus robusta*. An atypical eucalypt was recorded within the Study Area that may be *Eucalyptus parramattensis* subsp. *decadens* x *robusta*. This species is known to hybridise with *Eucalyptus robusta* in the Worimi Regional Park just north of the Study Area (Bell and Driscoll 2010). The Commonwealth Approved Conservation Advice for the species (TSSC 2014) does not provide advice on the inclusion of hybrids in the listed species. Under the Precautionary Principle, it is appropriate to treat hybrids as the threatened species that forms part of the hybrid material. Further investigation into this specimen will be undertaken during the Development Application phase of the Project.

The following MNES are considered to have the potential to occur within the Study Area due to local records and the availability of suitable habitat:

- rough doubletail (*Diuris praecox*), listed as vulnerable under the EPBC Act
- swift parrot (*Lathamus discolor*), critically endangered under the EPBC Act
- regent honeyeater (*Anthochaera phrygia*) critically endangered under the EPBC Act

- koala (*Phascolarctos cinereus*), vulnerable under the EPBC Act
- New Holland mouse (*Pseudomys novaehollandiae*), vulnerable under the EPBC Act
- spotted-tailed quoll (*Dasyurus maculatus*), endangered under the EPBC Act
- long-nosed potoroo (*Potorous tridactylus*), vulnerable under the EPBC Act
- little tern (*Sternula albifrons*), migratory under the Bonn Convention, China –Australia Migratory Bird Agreement (CAMBA), Japan- Australia Migratory Bird Agreement (JAMBA) and Republic of Korea – Australia Migratory Bird Agreement (ROKAMBA)
- crested tern (*Thalasseus bergii*), migratory under JAMBA
- white-throated needletail (*Hirundapus caudacutus*), migratory under the CAMBA, JAMBA and ROKAMBA
- fork-tailed swift (*Apus pacificus*), migratory under the CAMBA, JAMBA and ROKAMBA
- eastern osprey (*Pandion cristatus*), migratory under the Bonn Convention.

A wide range of threatened and migratory shorebird species, listed under the EPBC Act, are known to occupy the Stockton Sandspit located approximately 1km to the southwest of the Study Area. The Stockton Sandspit foreshore is one of the most important high tide roosts for shorebirds in the Hunter Estuary (Herbert 2007) containing saltmarsh, mudflats and lagoon areas suitable as foraging and roosting habitat. Species such as black-tailed godwit (*Limosa limosa*), eastern curlew (*Numenius madagascariensis*), marsh sandpiper (*Tringa stagnatilis*), great knot (*Calidris tenuirostris*), sharp-tailed sandpiper (*Calidris acuminata*) and curlew sandpiper (*Calidris ferruginea*) are regularly recorded in the summer months.

Furthermore, the Hunter Estuary Wetlands Ramsar Wetland of International Importance occurs within 250m to the west of the Study Area, mapped along the edges of the northern arm of the Hunter River. The Hunter Estuary Wetlands are listed internationally under the Ramsar Convention due to their unique mix of wetland types, importance for maintaining biological diversity and conservation of migratory shorebirds, including regularly supporting between 2 per cent and 5 per cent of the East Asian–Australasian Flyway population of eastern curlew (*Numenius madagascariensis*) (Australian Wetlands Database 2016).

3.4.3 Corridors and Connectivity

The Study Area occurs on the southern edge of extensive areas of forested habitat within the Worimi Conservation Lands that provide connectivity and movement corridors for a wide range of flora and fauna species from Stockton in the south to Tomaree and Nelson Bay in the north. The Study Area contains intact vegetation primarily along its northern boundaries. While this allows some east to west fauna movement from the coastal dune area to the Hunter River estuary, the value of this is limited due to residential areas and Nelson Bay Road to the west of the Study Area. Connectivity from the south of the site to Stockton is currently highly fragmented as a result of previous residential and urban development.

Dune habitat along the eastern portion of the Study Area contains minimal and sparse vegetation, however is part of a large coastal dune system reaching from Stockton to Nelson Bay. Consequently the dune system provides an important corridor along the length of the Newcastle Bight.

The Study Area is also broadly part of the conceptual Lower Hunter Biodiversity Conservation Corridor (the 'Green Corridor') that connects remaining areas of vegetation from the Watagans National Park in the south through to Hexham Swamp and into Port Stephens in the north (DECCW 2009). Landscape connections are important to ensure the exchange of genetic material and ensure adequate feeding areas, breeding grounds and to allow for migration for species.

4.0 Assessment of Impacts

4.1 Avoidance Measures

DHA undertook a detailed constraints study to guide the design of the Master Plan. Through this process, different development concepts were considered and DHA has sought to minimise the biodiversity impacts associated with the proposed rezoning. Key factors in selecting the location of the disturbance footprints included the likely impacts on important ecological features, including threatened species, TECs and/or their habitats.

Ecological site inspections were undertaken in May 2016 within the Study Area to provide information on the early design phase of the Master Plan. The final layout of the Master Plan was determined in consideration of the biodiversity values of the Study Area. It was found that the area north of the Study Area contained higher value vegetation and fauna habitat in structured woodland areas than the lower quality scattered woodland trees and exotic groundcovers dominating the central portion of the Study Area and therefore the disturbance area for the development was focused in the areas of lower ecological value.

In addition to avoiding areas of high conservation value, the proposed rezoning includes provision for large lots with minimal building envelopes to retain as much vegetation surrounding and within the residential buildings as possible. This should allow continued connectivity in a north/south direction across the site following the completion of construction. This was considered to provide an important mechanism particularly for the movement of species such as the koala, which is known to occur to the north of the Study Area, and also allows for the targeted selected retention of important habitat features such as hollow-bearing trees.

4.2 Assessment of Master Plan

The proposed rezoning has been designed with the aim of providing a development approach which balances the economic potential of the Study Area with appropriate biodiversity conservation outcomes for the broader Stockton area. In order to achieve this outcome, focus has been paid to the retention of as much intact vegetation as practical as well as the retention and protection of identified important ecological features of the Study Area.

The current Master Plan indicates a maximum disturbance of an estimate 17.9 hectares of vegetation within the Study Area. It is notable that this is a maximum potential impact, and does not take into account the existing disturbed nature of a substantial part of the vegetation in the area to be developed, nor vegetation that will be able to be retained within the larger lots. Impacts are inclusive of Asset Protection Zones (APZs) that will require maintenance and thinning activities to provide suitable fire protection to residential buildings across the development.

The majority of the area to be impacted comprises the previously Coastal Tea-tree – Banksia Scrub, with some impacts to the lower quality (weed infested) forest condition of this community in the northwest of the Study Area.

Section 4.1.1 describes the likely direct impacts and **Section 4.1.2** describes the likely indirect impacts associated the proposed rezoning.

4.2.1 Direct Impacts

The construction and operation of the proposed rezoning may result in a range of direct impacts on biodiversity values within the Study Area. Direct impacts include the loss of native vegetation and fauna habitats as a result of direct vegetation clearance for the construction of residential buildings, roads, gardens and parklands. Key ecological impacts include:

- the loss of native vegetation communities and fauna habitats
- reduction in known threatened species habitat, including:
    - known foraging habitat for the grey-headed flying-fox (*Pteropus poliocephalus*)
    - likely foraging habitat for threatened micro-bat species
    - buffer habitat for the koala (*Phascolarctos cinereus*).
- impacts to likely Earp's gum (*Eucalyptus parramattensis* subsp. *decadens*) hybrids

Table 4.1 summarises the area of each vegetation community that may be impacted by the proposed rezoning and current Master Plan. It should be noted that the current Master Plan provides an indicative impact area and will likely be refined and finalised in the future development application.

A range of impact mitigation measures have been formulated to minimise the impact of vegetation loss, as discussed in **Section 5.0**.

Table 4.1 Vegetation Community Impacts as a Result of the Proposed rezoning

Vegetation Community	Area within the Study Area (ha)	Indicative Area to be Impacted by the current Master Plan (ha)^
Frontal Dune Blackbutt-Apple Forest	17.5	2.1
Mahogany-Baloskion Swamp Forest	2.3	0.0
Coastal Tea-tree – Banksia Scrub	20.5	15.9
Foredune Spinifex	1.4	0.0
Beach Wetlands	3.2	0.0
Cleared land/sand dunes	66.7	3.3
Total	**111.6**	**21.3**

^ to be refined and finalised for the development application

4.2.2 Indirect Impacts

The proposed rezoning is not expected to result in any substantial indirect impacts on the biodiversity values of surrounding lands during the construction or operational phases of the proposed rezoning. However, the following minor indirect impacts may occur during the construction and operational phases of the proposed rezoning:

- Edge effects resulting in increased weed species could invade naturally through removal of native vegetation.
- Increases in the occurrence of feral fauna species such as foxes, rabbits, pigs, dogs and cats resulting from disturbances.
- Noise impacts have the potential to adversely impact native species such as disturbing the roosting and foraging behaviour of fauna species and reducing the occupancy of areas of suitable habitat.
- Dust impacts have the potential to adversely impact native species during construction. Potential impacts include dust covering vegetation thereby reducing vegetation health and growth.
- Vehicle strike impacts on ground-dwelling fauna species with increased vehicle movements in the post-construction landscape.

Mitigation measures outlined in **Section 5.0** will minimise the potential for these indirect impacts occurring as a result of the proposed rezoning. The majority of impacts will be dealt with at the detailed Development Application stage.

4.3 Preliminary Seven Part Tests of Significance under the EP&A Act

The potential level of impact on threatened species listed under the TSC Act was assessed using a preliminary 'Seven Part Test of Significance' as detailed in Section 5A of the EP&A Act and the Threatened Species Assessment Guidelines (DECC 2007). As outlined in **Section 1.3**, the assessments in this report have not been updated to reflect the minor changes in relation to the replacement of the TSC Act by the BC Act. Threatened entities previously listed under the TSC Act were automatically transferred to be listed under the BC Act and the amended Assessment of Significance Test (now outlined in Section 7.3 of the BC Act) does not materially change the assessment outcome.

The Seven Part Tests of Significance were undertaken following an initial screening process to identify species that have a reasonable likelihood to be impacted by the proposed rezoning (refer to **Appendix C**). Preliminary assessments were undertaken for a range of species to determine the likelihood of significant impacts occurring on listed species and communities as a result of the rezoning proposal. It is expected that these assessments will be reviewed and revised following the finalisation of the Master Plan and impact boundaries as part of the future development application.

The Seven Part Tests of Significance do not take into account the full range of impact mitigation strategies and offsets proposed for the development, rather they consider the impacts of the proposed rezoning without any mitigation or offsetting, consistent with the requirements of the Threatened Species Assessment Guidelines (DECC 2007). Seven Part Tests of Significance were undertaken in consideration of the following threatened species and communities listed under the TSC Act:

Threatened Ecological Communities

- *Sydney Freshwater Wetlands in the Sydney Basin Bioregion EEC*

Threatened Flora Species

- Earp's gum (*Eucalyptus parramattensis* subsp. *decadens*)
- rough doubletail (*Diuris praecox*)
- sand doubletail (*Diuris arenaria*)
- coast groundsel (*Senecio spathulatus*).

Threatened Fauna Species

- wallum froglet (*Crinia tinnula*)
- little tern (*Sternula albifrons*)
- regent honeyeater (*Anthochaera phrygia*)
- swift parrot (*Lathamus discolor*)
- turquoise parrot (*Neophema pulchella*)
- dusky woodswallow (*Artamus cyanopterus cyanopterus*)
- white-bellied sea eagle (*Haliaeetus leucogaster*)
- eastern osprey (*Pandion cristatus*)
- powerful owl (*Ninox strenua*)
- masked owl (*Tyto novaehollandiae*)
- koala (*Phascolarctos cinereus*)
- squirrel glider (*Petaurus norfolcensis*)
- long-nosed potoroo (*Potorous tridactylus*)
- grey-headed flying-fox (*Pteropus poliocephalus*)
- eastern false pipistrelle (*Falsistrellus tasmaniensis*)
- little bentwing-bat (*Miniopterus australis*)
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*)
- east coast freetail-bat (*Mormopterus norfolkensis*)
- hoary wattled bat (*Chalinolobus nigrogriseus*)
- greater broad-nosed bat (*Scoteanax rueppellii*)
- yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*)
- southern myotis (*Myotis macropus*).

The Seven Part Tests of Significance concluded that, based on the current Master Plan, the proposed rezoning was unlikely to result in a significant impact on threatened species or communities occurring or potentially occurring in the Study Area. Further investigations into the likely Earp's gum hybrid occurring within the Study Area is required to determine the conservation status and importance of the Earp's gum hybrid population occurring within the Study Area.

Any changes to the Master Plan following this assessment, as part of a future development application, will require a revised Seven Part Test of Significance under the EP&A Act.

4.4 Preliminary Assessments of Significance under the EPBC Act

The potential level of impact on threatened species listed under the EPBC Act was assessed using the 'Assessments of Significance' as detailed in the Significant Impact Guidelines 1.1 (DoE 2013). The assessments of significance were undertaken following an initial screening process to identify species that have a reasonable likelihood to be impacted by the proposed rezoning (refer to **Appendix C**). Preliminary assessments were undertaken for a range of species to determine the likelihood of significant impacts occurring on listed species and communities as a result of the rezoning proposal. It is expected that these assessments will be reviewed and revised following the finalisation of the Master Plan and impact boundaries as part of the future development application.

As per the assessments under the EP&A Act (refer to **Section 4.3**), the assessments of significance do not take into account the full range of impact mitigation strategies and offsets proposed for the development, rather they consider the impacts of the proposed rezoning without any mitigation or offsetting.

Assessments of Significance were undertaken in consideration of the following threatened and migratory species listed under the EPBC Act:

Endangered and Critically Endangered Species

- swift parrot (*Lathamus discolor*)
- regent honeyeater (*Anthochaera phrygia*)
- spotted-tailed quoll (*Dasyurus maculatus maculatus*) SE mainland population.

Vulnerable Species

- Earp's gum (*Eucalyptus parramattensis* subsp. *decadens*)
- rough doubletail (*Diuris praecox*)
- long-nosed potoroo (*Potorous tridactylus*)
- koala (*Phascolarctos cinereus*) combined populations of Qld, NSW and the ACT
- New Holland mouse (*Pseudomys novaehollandiae*)
- grey-headed flying-fox (*Pteropus poliocephalus*).

Migratory Species under International Conventions

- little tern (*Sternula albifrons*)
- crested tern (*Thalasseus bergii*)
- white-throated needletail (*Hirundapus caudacutus*)
- fork-tailed swift (*Apus pacificus*)
- eastern osprey (*Pandion cristatus*).

The Assessments of Significance concluded that, based on the current Master Plan, the proposed rezoning was unlikely to result in a significant impact on MNES occurring or potentially occurring in the Study Area. Further investigations into the likely Earp's gum hybrid occurring within the Study Area is required to determine the conservation status and importance of the Earp's gum hybrid population occurring within the Study Area.

Due to the nature of the proposed rezoning and that no direct or indirect impacts are likely to occur on surrounding lands, it is unlikely that the proposed rezoning would impact the Hunter Estuary Wetlands Ramsar Site or Stockton Sandspit known to provide habitat for EPBC Act-listed threatened and migratory species.

Any changes to the Master Plan following this assessment, as part of a future development application, will require a revised Assessment of Significance under the EPBC Act.

4.5 Impacts on Adjacent Conservation Areas

The Project will not result in direct impacts to the adjacent Worimi Regional Park which occurs immediately to the north of the Study Area. The proposed rezoning will be managed appropriately in order to limit the potential for indirect impacts and potential management strategies will be discussed with the Worimi Local Aboriginal Land Council and National Parks and Wildlife Service.

The Master Plan has incorporated a minimum 20 metre buffer zone between the project components and Worimi Regional Park boundaries in order to minimise the potential for indirect impacts to the conservation value of the Worimi Regional Park. Broadly, the vegetation in the northern portion of the Study Area will be retained and provide a substantial buffer area between the development and the Worimi Regional Park.

4.6 Assessment of CKPoM Performance Criteria for Rezoning Proposals

Performance criteria for rezoning requests apply only to circumstances where a request is made of Council to rezone land in relation to impacts on the koala. Consideration is to be given to the matters outlined in **Table 4.4** (from Appendix 2 of the CKPoM (PSC 2002)) when assessing rezoning requests including any amendment to the Port Stephens LEP.

Table 4.2 Assessment of Performance Criteria from CKPoM

Performance Criteria from CKPoM (Appendix 2)	Assessment of the Proposed rezoning
Rezoning proposals should:	
a) *not result in development within areas of Preferred Koala Habitat or defined Habitat Buffers*	The areas subject to disturbance within the Study Area are currently mapped identified on the Koala Habitat Planning Map (PSC 2007) as being 'mainly cleared', however it is acknowledged that the Mahogany-Baloskion Swamp Forest occurring in the north eastern portion of the Study Area is likely to conform to 'preferred habitat' with the immediate surrounds including 'habitat buffers' as per Lunney *et al.* (1998). The current Master Plan shows some encroachment into 1.6 hectares of buffer habitat around preferred mainly associated with the asset protection zones of the cluster homes. No impacts are expected to occur within the preferred koala habitat. The proposed disturbance area in this habitat is highly disturbed due to weed infestations and previous clearance and occurs on the edge of existing residential areas. No evidence of koalas has been recorded in the Study Area.
b) *allow for only low impact development within areas of Supplementary Koala Habitat and Habitat Linking Areas*	The proposed rezoning seeks to minimise the impacts on important ecological features across the site and create a residential development that aims to balance the built environment with the natural environment. The current Master Plan shows minimal impacts, being 1.6 hectares, to the identified 'supplementary habitat' associated with the Frontal Dune Blackbutt-Apple Forest in the north and south of the Study Area.
c) *minimise the removal of any individuals of preferred koala food trees, where ever they occur on the site*	The Study Area is known to contain two preferred koala feed trees, being swamp mahogany (*Eucalyptus robusta*) and likely Earp's gum hybrid (*Eucalyptus parramattensis* subsp. *decadens x robusta*), which occur in the north eastern areas associated with the Mahogany-Baloskion Swamp Forest. 150 koala feed trees have been recorded in the Study Area. The proposed rezoning includes impacts into areas containing koala feed trees. This area includes cluster homes that will require some removal of these habitat trees and APZs subject to thinning and fire break management. The current Master Plan indicates potential disturbance to two koala feed trees. Where possible, koala feed trees will be selectively retained within the development footprint. Refer to the Preliminary Koala Plan of Management in **Appendix E** for details and koala feed tree mapping.

Performance Criteria from CKPoM (Appendix 2)	Assessment of the Proposed rezoning
Rezoning proposals should:	
d) *not result in development which would sever koala movement across the site. This should include consideration of the need for maximising tree retention on the site generally and for minimising the likelihood of impediments to safe/unrestricted koala movement*	The proposed rezoning is not expected to sever movement of the koala across the site. The Study Area occurs on the southern edge of extensive areas of forested habitat within the Worimi Conservation Lands that provide connectivity and movement corridors for koala from the Study Area in the south to Tomaree and Nelson Bay in the north. While the Study Area contains intact vegetation along its northern boundary, connectivity from the south of the site to Stockton is currently highly fragmented and limited as a result of previous residential and urban development. As the proposed rezoning has sought to avoid areas of higher habitat quality and focus building footprints in existing disturbed areas of the Study Area, it is unlikely that the proposed rezoning exacerbate the existing fragmentation across the site.

5.0 Mitigation, Management and Offsets

5.1 Mitigation Strategy

DHA has sought to avoid and minimise potential impacts on the ecological values of the Study Area throughout the design and planning process. This has included avoidance and minimisation of disturbance of key vegetation communities and fauna habitats. These avoidance measures are described in detail in **Section 4.1**.

DHA has committed to the design and implementation of a comprehensive strategy to mitigate the adverse impacts of the proposed rezoning. This section details the mitigation strategies that are designed to minimise impacts on important ecological features known to occur in the areas to be disturbed as part of any residential development that would result from the rezoning, subsequent to detailed planning and approval.

5.1.1 Pre-clearance Surveys and Clearance Supervision

A robust tree felling procedure will be implemented to minimise the potential for impacts on native fauna species (focusing on threatened species) as a result of the clearing of habitat trees. The tree felling procedure is designed to minimise impacts to hollow-dependent fauna, koala and hollow-dependent micro-bats.

5.1.1.1 Pre-clearance Surveys

Pre-clearance surveys will be required within areas of woody native vegetation that are to be cleared. Pre-clearance surveys will be undertaken by suitably qualified and experienced ecologist and involve the following:

- the demarcation of areas approved for clearing to reduce risk of accidental clearing
- habitat resources and habitat trees should be identified and marked (note: habitat trees are those containing hollows, cracks or fissures and spouts, active nests, dreys or other signs of recent fauna usage. Other habitat features to be identified include fallen timber/hollow logs, burrows and boulder piles)
- the potential presence of threatened flora and fauna species, endangered populations and TECs should be identified
- the identification of species or habitat features that are suitable for translocation or salvage
- the presence of weed species and vertebrate pest species should be assessed, if relevant and
- disturbance activities should be targeted for specific times of the year to minimise impacts to target species usage of habitat features for breeding and roosting, where practicable.

5.1.1.2 Clearance Supervision

Tree clearing will be completed as close to the completion of pre-clearance surveys as practicable to limit the potential for new issues to arise (such as new active nests being built). Tree felling supervision will be undertaken by an appropriately qualified and experienced ecologist after pre-clearance surveys have identified potential threatened species habitat. The supervising ecologist will be licensed by the relevant field survey and ethics authorities to allow for capture, housing, transport and possibly ethical euthanizing of injured fauna. The tree-felling procedure will include the following:

- Prior to clearing identified habitat trees, the felling of non-habitat trees will be completed as close to the felling of habitat trees as possible, with all surrounding habitat trees to be vigorously shaken with heavy machinery.
- On the day of habitat tree felling, the following is to be undertaken:
    - all habitat trees will be subject to a visual inspection to survey for threatened species
    - trees previously identified as containing fauna will be shaken and then felled, providing no threatened species are identified
    - all reasonable attempts will be made to reduce the impact of felling on all fauna species. This may include delaying felling trees with fauna present or felling in sections to reduce potential for injury
    - the lowering of hollow-bearing trees will be done as gently as possible with heavy machinery
    - if a threatened species is identified in a habitat tree on the day of felling, the supervising person is to advise the most appropriate method to minimise potential harm. This may include leaving the tree overnight, further shaking to encourage the animal to vacate the tree, gradual removal of branches to discourage ongoing use, soft-felling of the tree with the animal in the tree, or measures to capture and relocate the animal to secure habitats
    - uninjured animals should be released on the day of capture into nearby suitable secure habitat and should not be held for extended periods of time, and
    - injured animals will be taken to the nearest veterinary clinic or wildlife carer as soon as possible for assessment and treatment. If required, the supervising person may ethically euthanize fauna
- Following felling, habitat trees will be inspected for remaining or injured fauna species and to ensure that no hollows are blocked against the ground. This may require the tree to be rolled to ensure adequate access
- All felled habitat trees should remain in place for a least one night to allow any fauna still present to move on
- Habitat features identified for translocation or salvage operations should be extracted and stored appropriately, and
- Detailed records should be maintained regarding the type and number of habitat features cleared, the type and number of fauna encountered and their fate. This will assist in informing mitigation programs such as nest boxes and habitat augmentation programs.

5.1.2 Weed Control

Weed species could be inadvertently brought into the Study Area with imported materials, or could invade naturally through removal of native vegetation. The increased presence of weed species within the Study Area has the potential to decrease the value of extant vegetation to native species, particularly threatened species.

The following management measures will be undertaken to minimise the potential impacts and spread of weeds during the construction of the proposed rezoning:

- Any vehicles or equipment being brought onto the Study Area to be involved in ground disturbance activities and/or travelling around the site must be inspected and cleaned prior to commencing work to limit the spread of seeds and plant material between sites.
- The limits of ground disturbance will be clearly demarcated and no unnecessary disturbance will be undertaken outside of these areas.
- Regular inspections will be undertaken in the Study Area to monitor the spread of weed species.
- Training of environmental personnel on the identification of target weed species.

Any outbreak of noxious weeds will be controlled and eradicated as required under the *Noxious Weeds Act 1993*, and as required by the Local Land Services and other relevant authorities. Weed control and eradication techniques may include:

- spraying with herbicides
- physical removal e.g. chipping, or
- minimisation of area available for weed infestation, through prompt revegetation of bare areas.

5.1.3 Site Management for Flora and Fauna Protection

DHA has sought to avoid areas of higher quality fauna and flora habitat in the Study Area. The following management measures are proposed to minimise the impacts on the local flora and fauna as a result of the proposed rezoning:

- Traffic control measures including 40 km/h speed limits and speed bumps installed in suitable locations.
- Signage within the development to minimise fauna injury/road kills, as much as possible.
- Minimisation of fencing between properties to reduce impacts on wildlife movement through the development.
- Where fencing is required, fauna-friendly fencing is to be used to allow for dispersal and safe fauna movement throughout the Study Area.
- Dog and cat ownership policies, such as requiring on-lead dogs and inside cats.
- Restricted vehicle and controlled pedestrian access along frontal dune system.

5.1.4 Specific Management of Koalas

DHA has substantially reduced the proposed rezoning footprint, avoiding large areas of high quality koala habitat across the Study Area. A Preliminary Koala Plan of Management has been prepared (refer to **Appendix E**) to guide the implementation of impact mitigation and management measures specific to the koala. The following measures are proposed to minimise the impacts on the local koala population as a result of the re-zoning:

- Traffic control measures/20 km/h speed limits/signage within the site to minimise fauna injury/road kills, as much as possible.
- Fencing to be used along the perimeter of the site to restrict koala from developed areas of the site and funnel individuals to move through retained high quality koala habitat.
- Detailed pre-clearing surveys, including pre-clearing nocturnal spotlighting and call playback surveys to be completed to specifically assess potential presence of the koala at the site prior to clearing activities.
- Detailed tree-felling procedures, including the use of adequately qualified and experienced ecologists and on-call wildlife rescue group to assist with any injured koalas, to minimise potential impact on koalas.
- Dog management including provisions for suitability fenced yards, management of vegetation adjacent to fencing and dog ownership covenants.
- Targeted koala feed tree planting such as swamp mahogany (*Eucalyptus robusta*) and Earps red gum (*Eucalyptus parramattensis* subsp*. decadens*).

5.1.5 Conservation Area Protection Measures

The Study Area adjoins the Worimi Regional Park which is jointly managed by the Worimi LALC and NPWS. The '*Guidelines for developments on adjoining land and water managed by the Department of Climate Change and Water*' (DECCW 2010) has been prepared to help avoid and minimise any direct or indirect adverse impacts on the National Parks estate.

The following issues need to be considered for developments adjoining reserve land and, in particular, their impacts:

- erosion and sediment control
- stormwater runoff
- wastewater
- management implications relating to pests, weeds and edge effects
- fire and the location of asset protection zones
- boundary encroachments and access through OEH lands
- visual, odour, noise, vibration, air quality and amenity impacts
- threats to ecological connectivity and groundwater dependent ecosystems
- cultural heritage.

In order to address the issues that are relevant to the Project, a range of measures have been proposed including the:

- use of a minimum 20 metre buffer zone between Worimi Regional Park and the Study Area to minimise the potential for adverse impact to NPWS estate
- implementation of weed control protocols within the buffer zone to prevent weed species spreading into Worimi Regional Park
- implementation of appropriate sediment and erosion control measures to ensure that there are no off-site impacts associated with the proposed rezoning.

5.1.6 Vegetation and Dune Rehabilitation

The aim of the dune rehabilitation will be to remove current weed infestations to establish and improve native coastal vegetation communities and fauna habitats occurring in the Study Area. Rehabilitation biodiversity objectives will be used in future rehabilitation planning as appropriate according to coastal hazard recommendations and should:

- aim to create a sustainable and stabilising vegetation community on the fore dunes
- focus on the planting of endemic coastal flora species
- aim to provide fauna movement habitat between the northern and southern boundaries of the site
- encourage ecological stewardship by promoting community planting days and wildlife watching.

Dune rehabilitation should consist of stabilising and returning the fore dune landscape to a condition characteristic of the natural coastal environment. Dune rehabilitation and landscaping between the development footprints will be conducted progressively during the construction and establishment of the development to self-sustaining native and coastal vegetation communities in line with the proposed vision of the Master Plan. Rehabilitation works will use local provenance endemic species (for native communities), including the consideration of seed availability.

5.2 Biodiversity Offsets and Buffers

This report has identified the numerous measures that have been undertaken as part of the planning and design of the Master Plan to avoid, minimise and then mitigate/offset the potential impacts of the proposed rezoning on the ecologically significant features of the Study Area. The implementation of these measures has resulted in a Master Plan that is likely to result in minimal residual impact on important ecological features.

The Master Plan also indicates the retention and protection of approximately 80 hectares within the Study Area. It is proposed that this will be protected via a proposed rezoning to National Parks and Reserves (E1) under the Port Stephens LEP or through a Biodiversity Stewardship Site under the *Biodiversity Conservation Act 2016*. This vegetation comprises the highest quality habitats in the Study Area being Frontal Dune Blackbutt-Apple Forest in the north and south of the Study Area. This includes the protection of preferred and supplementary koala habitat, as well as providing buffer vegetation between impacted areas and adjacent conservation areas.

The merits of these approaches will be determined by DHA at the Development Application phase.

6.0 Recommendations

It is recommended that the following additional ecological investigations are undertaken for the future development application phase of the project:

- Detailed floristic surveys, including systematic plots and transects in order to:
    - confirmation with the Royal Botanic Gardens Sydney on the occurrence or otherwise of the likely Earps gum hybrid (*Eucalyptus parramattensis* subsp. *decadens* x *robusta*) occurring within the Mahogany-Baloskion Swamp Forest
    - collect appropriate vegetation integrity data for inclusion in a Biodiversity Development Assessment Report (BDAR) under the Biodiversity Assessment Method (BAM), if applicable.
- Targeted species-credit species surveys as applicable under the BAM and/or
- If the BAM is not applicable at the time of preparing the development application, update the Seven Part Tests of Significance under the EP&A Act and Assessments of Significance under the EPBC Act following the finalisation of the Master Plan and impact boundaries.

This assessment concludes that the proposed rezoning and use of the land for residential purposes could facilitate an acceptable ecological outcome on the site, subject to future detailed design and approvals.

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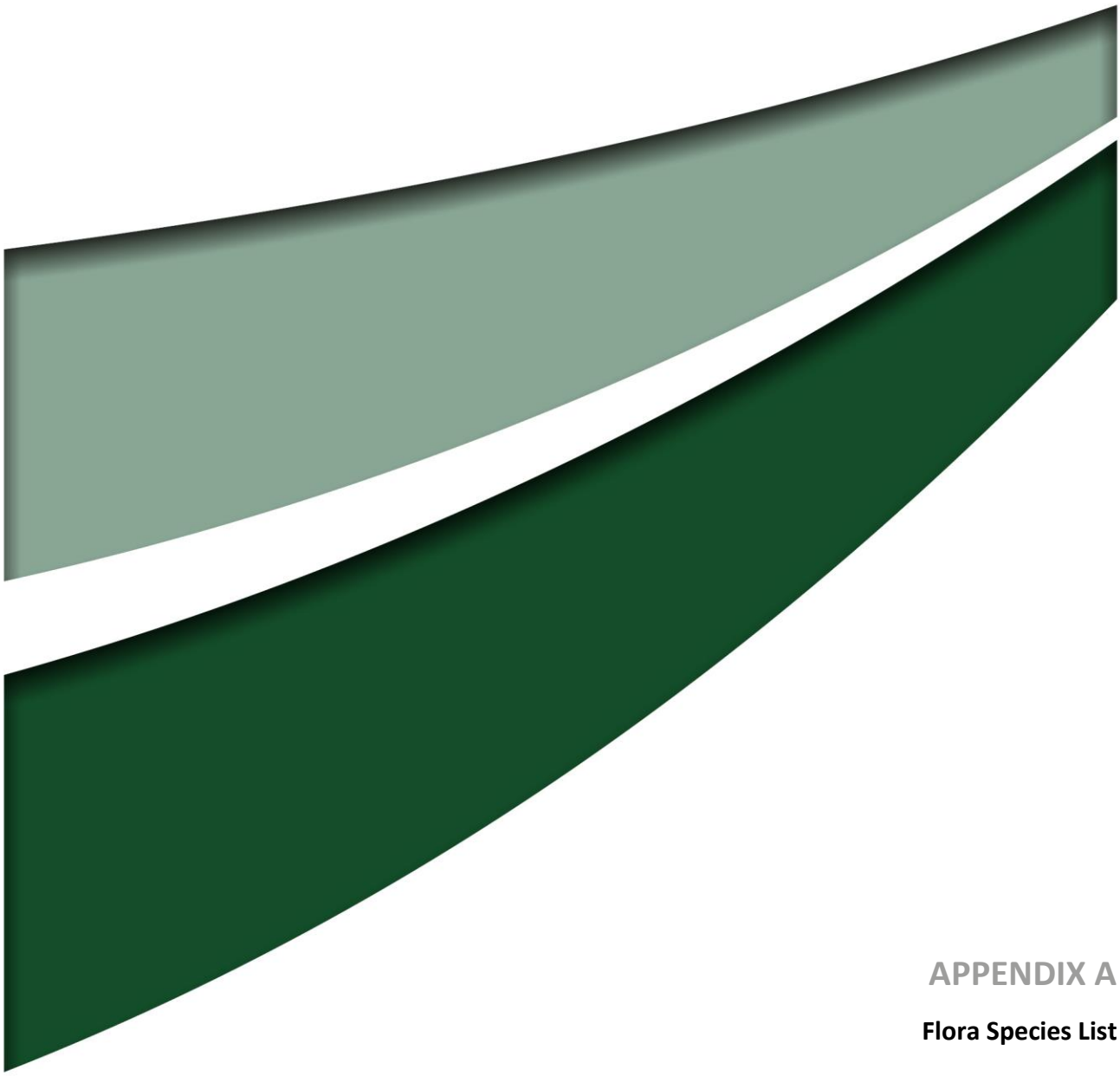


APPENDIX A

Flora Species List

Appendix A – Flora Species List

The following flora list was developed from surveys of the Study Area by SMEC (2008) Kleinfelder (2015) and Umwelt (2016). The list will not be comprehensive, because not all species are readily detected at any one time of the year. Many species flower only during restricted periods of the year, and some flower only once in several years. In the absence of flowering material, 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 native to the Study Area

subsp. subspecies

All vascular plants recorded or collected were identified using keys and nomenclature in Harden (1992, 1993, 2000 and 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 2016), the on-line plant name database maintained by the National Herbarium of New South Wales.

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

Family	*Scientific Name*	Common Name	TSC Act Status	EPBC Act Status
FILICOPSIDA (FERNS)				
Blechnaceae	*Blechnum cartilagineum*	gristle fern	-	-
Blechnaceae	*Doodia aspera*	prickly rasp fern	-	-
Dennstaedtiaceae	*Pteridium esculentum*	bracken	-	-
MAGNOLIOPSIDA (FLOWERING PLANTS) – LILLIDAE (MONOCOTS)				
Arecaceae	*Livistona australis*	cabbage tree palm	-	-
Arecaceae	**Phoenix canariensis*	Canary Island date palm	-	-
Asparagaceae	**Asparagus aethiopicus*	asparagus fern	-	-
Commelinaceae	*Commelina cyanea*		-	-
Cyperaceae	*Carex pumila*	`	-	-
Cyperaceae	**Cyperus brevifolius*		-	-

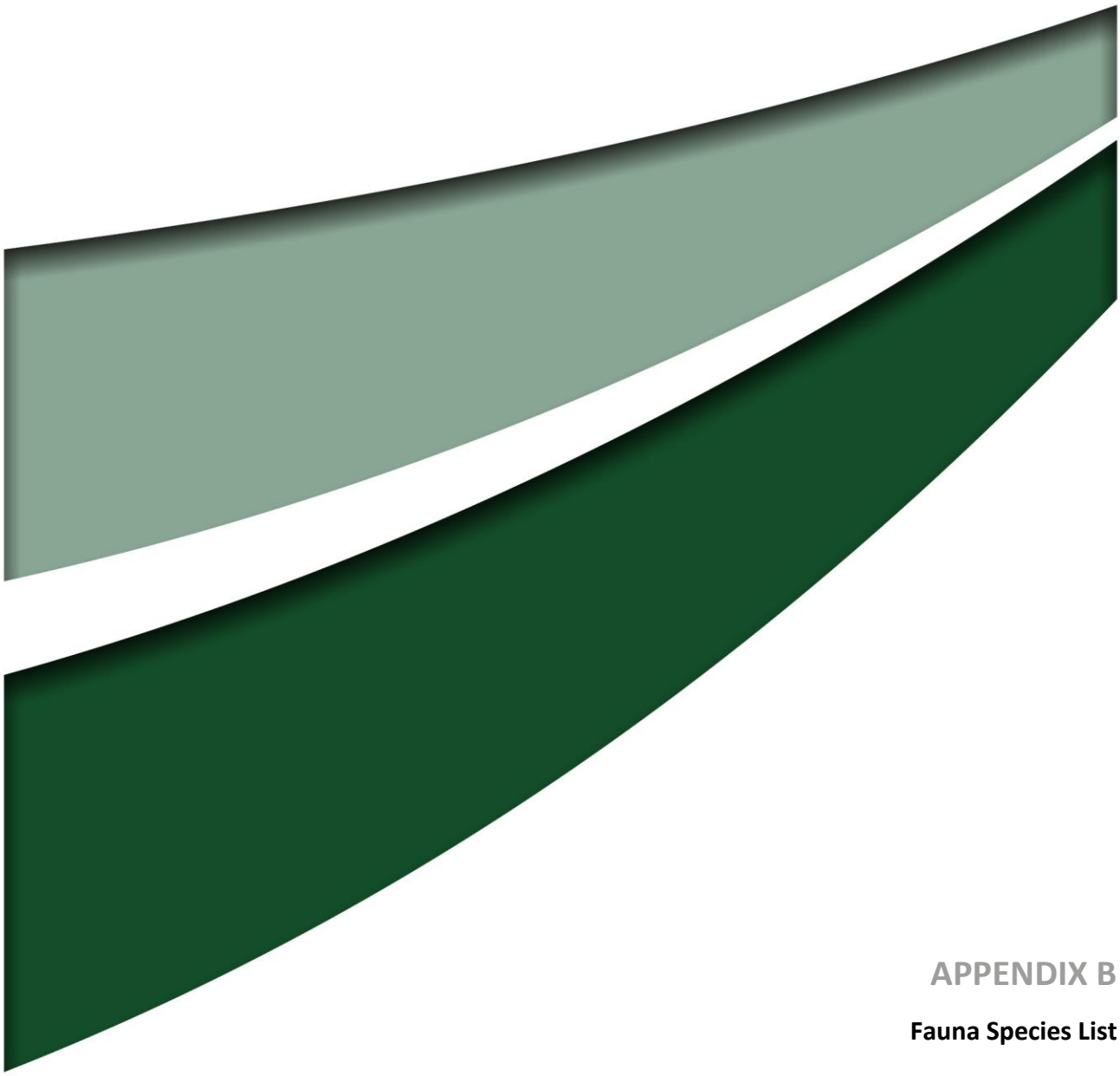
Family	*Scientific Name*	Common Name	TSC Act Status	EPBC Act Status
Cyperaceae	*Ficinia nodosa*	knobby club-rush	-	-
Cyperaceae	*Gahnia clarkei*	tall saw-sedge	-	-
Juncaceae	*Juncus pallidus*		-	-
Lomandraceae	*Lomandra filiformis*	wattle mat-rush	-	-
Lomandraceae	*Lomandra longifolia*	spiny-headed mat-rush	-	-
Orchidaceae	*Microtis parviflora*	Slender onion orchid	-	-
Phormiaceae	Dianella *caerulea* var. *caerulea*	blue flax-lily	-	-
Phormiaceae	*Dianella caerulea* var. *producta*	blue flax-lily	-	-
Poaceae	**Briza minor*	shivery grass	-	-
Poaceae	*Dichelachne crinita*	longhair plumgrass	-	-
Poaceae	*Digitaria divaricatissima*	umbrella grass	-	-
Poaceae	**Ehrharta erecta*	panic veltgrass	-	-
Poaceae	*Enneapogon nigricans*	niggerheads	-	-
Poaceae	**Eragrostis curvula*	African lovegrass	-	-
Poaceae	*Eragrostis leptostachya*	paddock lovegrass	-	-
Poaceae	*Imperata cylindrica*	blady grass	-	-
Poaceae	**Melinis repens*	red natal grass	-	-
Poaceae	*Microlaena stipoides* var. *stipoides*	weeping grass	-	-
Poaceae	*Panicum* sp.		-	-
Poaceae	**Pennisetum clandestinum*	kikuyu	-	-
Poaceae	*Rytidosperma fulvum*	wallaby grass	-	-
Poaceae	*Spinifex sericeus*	hairy spinifex	-	-
Poaceae	**Stenotaphrum secundatum*	buffalo grass	-	-
Poaceae	*Themeda triandra*	Kangaroo grass	-	-

Family	*Scientific Name*	Common Name	TSC Act Status	EPBC Act Status
MAGNOLIOPSIDA (FLOWERING PLANTS) – MAGNOLIIDAE (DICOTS)				
Aizoaceae	*Carpobrotus glaucescens*	pigface	-	-
Apiaceae	*Actinotus helianthi*	flannel flower	-	-
Apiaceae	**Aegopodium podagraria*	goutweed	-	-
Apiaceae	**Hydrocotyle bonariensis*		-	-
Apiaceae	*Platysace ericoides*		-	-
Asteraceae	**Chrysanthemoides monilifera*	bitou bush	-	-
Asteraceae	**Conyza sumatrensis*	tall fleabane	-	-
Asteraceae	*Euchiton sphaericus*		-	-
Asteraceae	**Senecio madagascariensis*	fire weed	-	-
Apocynaceae	**Gomphocarpus fruticosus*	cotton bush	-	-
Bignoniaceae	*Pandorea pandorana* subsp. *pandorana*	wonga wonga vine	-	-
Boraginaceae	**Heliotropium amplexicaule*	blue heliotrope	-	-
Cactaceae	**Opuntia stricta*	common prickly pear	-	-
Campanulaceae	*Wahlenbergia* sp.		-	-
Convolvulaceae	*Dichondra repens*	kidney weed	-	-
Dilleniaceae	*Hibbertia obtusifolia*	hoary guinea flower	-	-
Dilleniaceae	*Hibbertia* sp.		-	-
Ericaceae	*Leucopogon ericoides*	pink beard-heath	-	-
Ericaceae	*Monotoca scoparia*	tree broom-heath	-	-
Euphorbiaceae	*Ricinocarpos pinifolius*	wedding bush	-	-
Fabaceae (Faboideae)	*Aotus ericoides*		-	-
Fabaceae (Faboideae)	*Bossiaea ensata*	sword bossiaea	-	-
Fabaceae (Faboideae)	*Bossiaea stephensonii*		-	-
Fabaceae (Faboideae)	*Daviesia ulicifolia*	gorse bitter-pea	-	-
Fabaceae (Faboideae)	*Glycine clandestina*		-	-

Family	*Scientific Name*	Common Name	TSC Act Status	EPBC Act Status
Fabaceae (Faboideae)	*Hardenbergia violacea*	false sarsaparilla	-	-
Fabaceae (Mimosoideae)	*Acacia longifolia* subsp. *longifolia*	Sydney golden wattle	-	-
Fabaceae (Mimosoideae)	*Acacia longifolia* subsp. *sophorae*	coastal wattle	-	-
Fabaceae (Mimosoideae)	*Acacia ulicifolia*	prickly Moses	-	-
Goodeniaceae	*Scaevola calendulacea*	dune fan-flower	-	-
Haloragaceae	*Gonocarpus teucrioides*	germander raspwort	-	-
Lauraceae	*Cassytha glabella f. glabella*		-	-
Lauraceae	**Cinnamomum camphora*	camphor laurel	-	-
Loranthaceae	*Amyema congener* subsp. *congener*		-	-
Malvaceae	**Pavonia hastata*		-	-
Myrtaceae	*Angophora costata*	smooth-barked apple	-	-
Myrtaceae	*Angophora floribunda*	rough-barked apple	-	-
Myrtaceae	*Calytrix tetragona*			
Myrtaceae	*Eucalyptus parramattensis* x *robusta* subsp. *decadens*	Earp's gum	V^	V^
Myrtaceae	*Eucalyptus pilularis*	blackbutt	-	-
Myrtaceae	*Eucalyptus robusta*	swamp mahogany	-	-
Myrtaceae	*Leptospermum laevigatum*	coast teatree	-	-
Myrtaceae	*Leptospermum polygalifolium*	tantoon	-	-
Myrtaceae	*Leptospermum trinervium*	slender tea-tree	-	-
Myrtaceae	*Melaleuca nodosa*	prickly leaved paperbark	-	-
Pittosporaceae	*Billardiera scandens*	hairy apple berry	-	-
Plantaginaceae	**Plantago lanceolata*	lamb's tongue	-	-
Proteaceae	*Banksia integrifolia*	coast banksia	-	-
Proteaceae	*Banksia serrata*	old-man banksia	-	-

Family	*Scientific Name*	Common Name	TSC Act Status	EPBC Act Status
Proteaceae	*Persoonia laurina*	laurel geebung	-	-
Proteaceae	*Persoonia levis*	narrow leaved geebung	-	-
Rubiaceae	*Opercularia varia*	variable stinkweed	-	-
Sapindaceae	*Cupaniopsis anacardioides*	tuckeroo	-	-
Solanaceae	**Cestrum parqui*	green cestrum	-	-
Solanaceae	**Solanum chenopodioides*	whitetip nightshade	-	-
Verbenaceae	**Lantana camara*	lantana	-	-

^ Neither the OEH profile (OEH 2016) or the approved Commonwealth conservation advice (TSSC 2014) for Earp's gum discusses the inclusion of hybrids in the listed species, however in accordance with the precautionary principle, these individuals are being assessed as the threatened species.



APPENDIX B

Fauna Species List

Appendix B - Fauna Species List

The following fauna list was developed from surveys of the Study Area by SMEC (2008), Kleinfelder (2015) and Umwelt (2016).

The following abbreviations or symbols are used in the list:

asterisk (*)	Denotes species not indigenous to the Study Area
subsp.	Subspecies
MIG	Listed migratory species under the EPBC Act
V	Vulnerable under the TSC and/or EPBC Act
PD	Preliminary Determination

Birds recorded were identified using descriptions in Pizzey and Knight (2012) and the scientific and common name nomenclature of BirdLife International Taxonomic Checklist (2015) (formerly Birds Australia). Reptiles recorded were identified using keys and descriptions in Cogger (2000) and Wilson and Swan (2008) and the scientific and common name nomenclature of Cogger (2000).

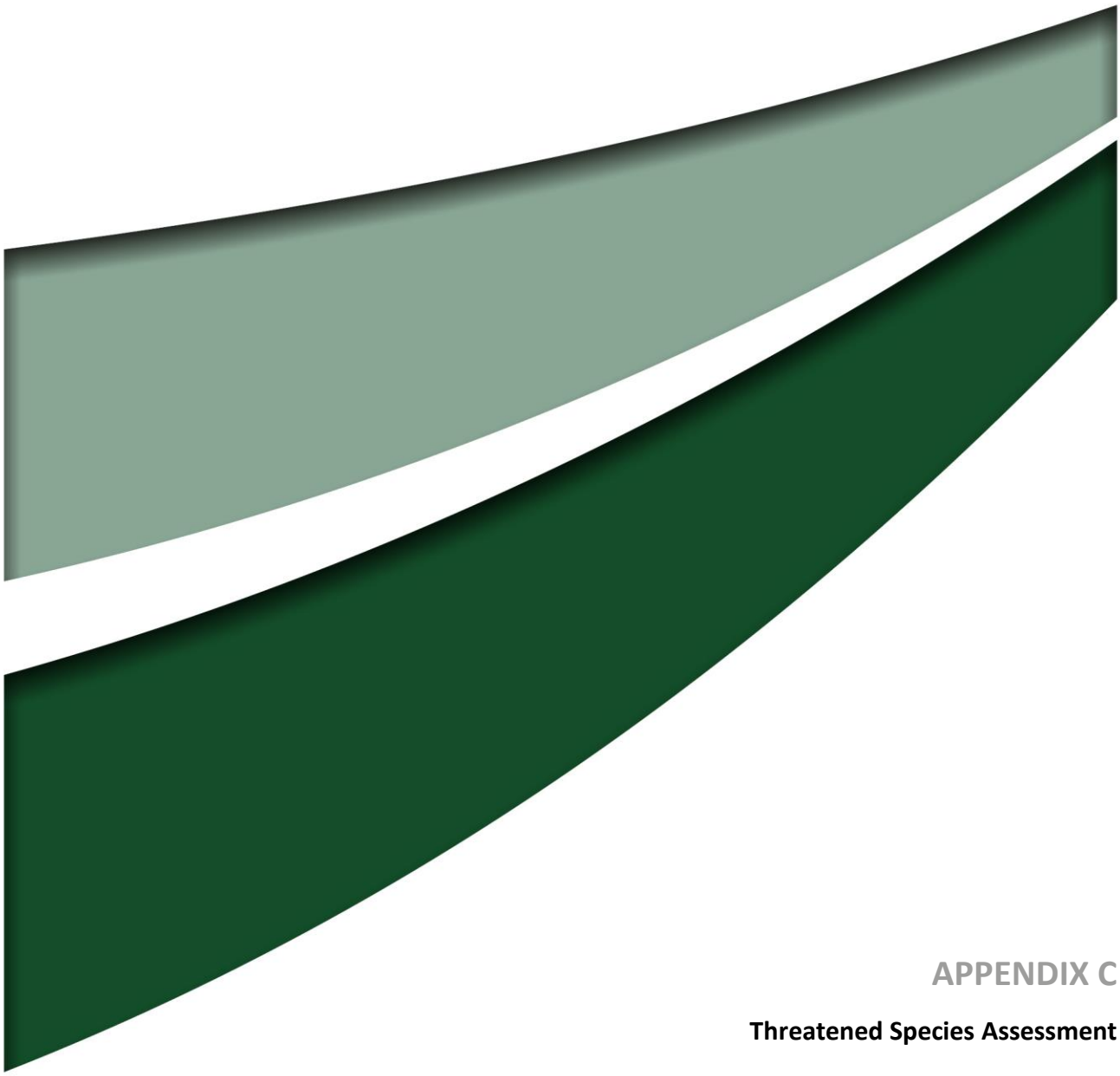
Amphibians recorded were identified using keys and descriptions in Cogger (2000), Robinson (1998), Anstis (2002) and Barker et al. (1995) and the scientific and common name nomenclature of Cogger (2000). Mammals recorded were identified using keys and descriptions in Menkhorst and Knight (2010). Bat species recorded were identified using keys and descriptions in Churchill (1998) and ecological information was obtained from Churchill (2008).

Scientific Name	Common Name	TSC Act Status	EPBC Act Status
AMPHIBIANS			
Hylidae			
Litoria fallax	eastern dwarf tree frog	-	-
Myobatrachidae			
Crinia signifera	brown froglet	-	-
REPTILES			
Scincidae			
Amphibolurus muricatus	jacky dragon	-	-
Ctenotus robustus	striped skink	-	-
BIRDS			
Phasianidae			
Coturnix ypsilophora	brown quail	-	-

Scientific Name	Common Name	TSC Act Status	EPBC Act Status
Columbidae			
*Streptopelia chinensis**	spotted dove	-	-
Ocyphaps lophotes	crested pigeon	-	-
Vanellus miles	masked lapwing	-	-
Accipitridae			
Haliaeetus leucogaster	white-bellied sea eagle	V	-
Laridae			
Chroicocephalus novaehollandiae	silver gull	-	-
Cacatuidae			
Cacatua roseicapillus	galah	-	-
Psittacidae			
Trichoglossus haematodus	rainbow lorikeet	-	-
Glossopsitta concinna	musk lorikeet	-	-
Cuculidae			
Cacomantis flabelliformis	fan-tailed cuckoo	-	-
Halcyonidae			
Dacelo novaeguineae	laughing kookaburra	-	-
Menuridae			
Menura novaehollandiae	superb lyrebird	-	-
Maluridae			
Malurus cyaneus	superb fairy-wren	-	-
Malurus lamberti	variegated fairy-wren	-	-
Acanthizidae			
Acanthiza chrysorrhoa	yellow-rumped thornbill	-	-
Acanthiza pusilla	brown thornbill	-	-
Meliphagidae			
Meliphaga lewinii	Lewin's honeyeater	-	-

Scientific Name	Common Name	TSC Act Status	EPBC Act Status
Lichenostomus chrysops	yellow-faced honeyeater	-	-
Lichenostomus penicillatus	white-plumed honeyeater	-	-
Manorina melanocephala	noisy miner	-	-
Anthochaera chrysoptera	little wattlebird	-	-
Anthochaera carunculata	red wattlebird	-	-
Phylidonyris niger	white-cheeked honeyeater	-	-
Eupetidae			
Psophodes olivaceus	eastern whipbird	-	-
Pachycephalidae			
Pachycephala pectoralis	golden whistler	-	-
Artamidae			
Cracticus torquatus	grey butcherbird	-	-
Gymnorhina tibicen	Australian magpie	-	-
Strepera graculina	pied currawong	-	-
Rhipiduridae			
Rhipidura albiscapa	grey fantail	-	-
Corvidae			
Corvus coronoides	Australian raven	-	-
Monarchidae			
Grallina cyanoleuca	magpie-lark	-	-
Zosterops lateralis	silvereye	-	-
Corcoracidae			
Corcorax melanorhamphos	white-winged chough	-	-
Pycnonotidae			
*Pyconotus jocosus**	red-whiskered bulbul	-	-

Scientific Name	Common Name	TSC Act Status	EPBC Act Status
Estrildidae			
Taeniopygia guttata	zebra finch	-	-
Neochmia temporalis	red-browed finch	-	-
Motacilidae			
Anthus novaeseelandiae	Australasian pipit	-	-
MAMMALS			
Tachyglossidae			
Tachyglossus aculeatus	short-beaked echidna	-	-
Macropodidae			
Macropus rufogriseus	red-necked wallaby	-	-
Pteropodidae			
Pteropus poliocephalus	grey-headed flying-fox	V	V
Molossidae			
Mormopterus norfolkensis	east coast freetail-bat	V	-
Vespertilionidae			
Miniopterus australis	little bentwing-bat	V	-
Miniopterus schreibersii oceanensis	eastern bentwing-bat	V	-
Vespadelus vulturnus	little forest bat	-	-
Felidae			
*Felis catus**	feral cat	-	-
Canidae			
*Vulpes vulpes**	red fox	-	-
Leporidae			
*Oryctolagus cuniculus**	European rabbit	-	-



APPENDIX C

Threatened Species Assessment

Appendix C - Threatened Species Assessment

Threatened and migratory species, endangered populations and threatened ecological communities (TECs) listed under the *Threatened Species Conservation Act 1995* (TSC Act) and/or *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) having the potential to occur in the Study Area have been identified based on the results of the searches of the Office of Environment and Heritage (OEH) Atlas of NSW Wildlife Database and Commonwealth Department of the Environment and Energy (DoEE) Protected Matters Database and are outlined in **Table 1**.

Additionally, migratory species listed under international agreements being the Bonn Convention (Bonn), China-Australia Migratory Bird Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA) or Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA) with potential to occur in the Study Area have also been identified based on the results of the searches and are outlined in **Table 2**.

Purely marine and pelagic species have been omitted from **Table 1** and **Table 2** due to a lack of suitable habitat.

The likelihood of a community/species to occur in the Study Area is noted using the following definitions:

Recorded	Species/community has been recorded within the Study Area.
Likely	Suitable habitat is present for this species/community and/or records of the species are known to occur in the immediate locality
Potential	Suitable habitat is present for this species/community and/or however records of the species are not known to occur in the immediate locality
Unlikely	Species/community is considered unlikely to occur within the Study Area due to lack of local records and/or lack of suitable habitat.
Not present	Species/community was not recorded in the Study Area and is not expected to occur due to its distribution, habitat requirements or lack of local records.

Species/communities with a reasonable potential to be impacted by the proposed rezoning were subject to preliminary Seven Part Tests of Significance under the EP&A Act and/or Assessments of Significance under the EPBC Act. It is expected that these assessments will be reviewed and revised following the finalisation of the Master Plan and impact boundaries as part of the future development application.

Abbreviations used within **Table 1** and **Table 2** include the following:

V	Vulnerable
E	Endangered
EEC	Endangered Ecological Community
EP	Endangered Population
CE	Critically Endangered
CEEC	Critically Endangered Ecological Community
VEC	Vulnerable Ecological Community
PD	Preliminary Determination
C	CAMBA
J	JAMBA
K	ROKAMBA
B	Bonn

Table 1 - Threatened Species and TECs Recorded or with Potential to Occur within 10 kilometres of the Study Area

Species Name		Status		Likelihood to Occur within the Study Area	Reasonable Potential to be Impacted by the Proposal
Common Name	***Scientific Name***	**TSC Act**	**EPBC Act**		
Threatened Ecological Communities					
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (TSC Act) *Subtropical and Temperate Coastal Saltmarsh* (EPBC Act)		EEC	VEC	Not present	No
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions		EEC	-	Not present	No
Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (TSC Act) *Littoral Rainforest and Coastal Vine Thickets of Eastern Australia* (EPBC Act)		EEC	CEEC	Not present	No
Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions (TSC Act) *Lowland Rainforest of Subtropical Australia* (EPBC Act)		EEC	CEEC	Not present	No
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions		EEC	-	Not present	No
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions		EEC	-	Not present (refer to **Appendix D**)	No
Sydney Freshwater Wetlands in the Sydney Basin Bioregion		EEC	-	Likely	**Yes**
Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions		EEC	-	Not present	No
Endangered Populations					
Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area	*Dromaius novaehollandiae*	EP	-	Unlikely	No

Species Name		Status		Likelihood to Occur within the Study Area	Reasonable Potential to be Impacted by the Proposal
Common Name	***Scientific Name***	**TSC Act**	**EPBC Act**		
Threatened Flora Species					
dwarf kerrawang	*Commersonia prostrata*	E	E	Unlikely	No
leafless tongue orchid	*Cryptostylis hunteriana*	V	V	Unlikely	No
sand doubletail	*Diuris arenaria*	E	-	Likely	**Yes**
rough doubletail	*Diuris praecox*	V	V	Likely	**Yes**
Camfield's Stringybark	*Eucalyptus camfieldii*	V	V	Unlikely	No
Earp's gum	*Eucalyptus parramattensis subsp. decadens*	V	V	**Recorded** (likely hybrid)	**Yes**
small-flower grevillea	*Grevillea parviflora subsp. parviflora*	V	V	Unlikely	No
	Maundia triglochinoides	V	-	Unlikely	No
biconvex paperbark	*Melaleuca biconvexa*	V	V	Unlikely	No
tall knotweed	*Persicaria elatior*	V	V	Unlikely	No
lesser swamp-orchid	*Phaius australis*	E	E	Unlikely	No
heath wrinklewort	*Rutidosis heterogama*	V	V	Unlikely	No
coast groundsel	*Senecio spathulatus*	E	-	Likely	**Yes**
magenta lilly pilly	*Syzygium paniculatum*	E	V	Unlikely	No
black-eyed Susan	*Tetratheca juncea*	V	V	Unlikely	No
	Zannichellia palustris	E	-	Unlikely	No
Threatened Fauna Species					
Amphibians					
wallum froglet	*Crinia tinnula*	V	-	Likely	**Yes**
green and golden bell frog	*Litoria aurea*	E	V	Unlikely	No
little John's Tree Frog	*Litoria littlejohni*	E	V	Unlikely	No
Birds					
regent honeyeater	*Anthochaera phrygia*	CE	E	Potential	**Yes**

Species Name		Status		Likelihood to Occur within the Study Area	Reasonable Potential to be Impacted by the Proposal
Common Name	*Scientific Name*	TSC Act	EPBC Act		
painted honeyeater	*Grantiella picta*	V	V	Unlikely	No
dusky woodswallow	*Artamus cyanopterus cyanopterus*	V	-	Potential	**Yes**
Australasian bittern	*Botaurus poiciloptilus*	E	E	Unlikely	No
bush stone-curlew	*Burhinus grallarius*	E	-	Unlikely	No
curlew sandpiper	*Calidris ferruginea*	E	CE	Unlikely	No
great knot	*Calidris tenuirostris*	V	CE	Unlikely	No
red knot	*Calidris canutus*	E	-	Unlikely	No
greater sand-plover	*Charadrius leschenaultii*	V	V	Unlikely	No
lesser sand-plover	*Charadrius mongolus*	V	E	Unlikely	No
white-fronted chat	*Epthianura albifrons*	V	-	Unlikely	No
sooty oystercatcher	*Haematopus fuliginosus*	V	-	Unlikely	No
pied oystercatcher	*Haematopus longirostris*	E	-	Unlikely	No
little eagle	*Hieraaetus morphnoides*	V	-	Potential	No
white-bellied sea eagle	*Haliaeetus leucogaster*	V	-	**Recorded**	**Yes**
swift parrot	*Lathamus discolor*	E	CE	Potential	**Yes**
broad-billed sandpiper	*Limicola falcinellus*	V	-	Unlikely	No
black-tailed godwit	*Limosa limosa*	V	-	Unlikely	No
bar-tailed godwit	*Limosa lapponica baueri*	-	V	Unlikely	No
northern Siberian bar-tailed godwit	*Limosa lapponica baueri*	-	CE	Unlikely	No
eastern bristlebird	*Dasyornis brachypterus*	E	E	Unlikely	No
turquoise parrot	*Neophema pulchella*	V	-	Potential	**Yes**
powerful owl	*Ninox strenua*	V	-	Likely	**Yes**
eastern curlew	*Numenius madagascariensis*	-	CE	Unlikely	No
eastern osprey	*Pandion cristatus*	V	-	Potential	**Yes**

Species Name		Status		Likelihood to Occur within the Study Area	Reasonable Potential to be Impacted by the Proposal
Common Name	*Scientific Name*	TSC Act	EPBC Act		
wompoo fruit-dove	*Ptilinopus magnificus*	V	-	Unlikely	No
Australian painted snipe	*Rostratula australis*	E	-	Unlikely	No
diamond firetail	*Stagonopleura guttata*	V	-	Unlikely	No
little tern	*Sternula albifrons*	E	-	Likely	**Yes**
eastern grass owl	*Tyto longimembris*	V	-	Unlikely	No
masked owl	*Tyto novaehollandiae*	V	-	Likely	**Yes**
terek sandpiper	*Xenus cinereus*	V	-	Unlikely	No
Mammals					
large-eared pied bat	*Chalinolobus dwyeri*	V	V	Unlikely	No
spotted-tailed quoll	*Dasyurus maculatus*	V	E	Potential	**Yes**
eastern false pipistrelle	*Falsistrellus tasmaniensis*	V	-	Potential	**Yes**
little bentwing-bat	*Miniopterus australis*	V	-	**Recorded**	**Yes**
eastern bentwing-bat	*Miniopterus schreibersii oceanensis*	V	-	**Recorded**	**Yes**
eastern freetail-bat	*Mormopterus norfolkensis*	V	-	**Recorded**	**Yes**
hoary wattled bat	*Chalinolobus nigrogriseus*	V	-	Potential	**Yes**
greater broad-nosed bat	*Scoteanax rueppellii*	V	-	Likely	**Yes**
yellow-bellied sheathtail-bat	*Saccolaimus flaviventris*	V	-	Potential	**Yes**
southern myotis	*Myotis macropus*	V	-	Likely	**Yes**
greater glider	*Petauroides volans*	-	V	Unlikely	No
squirrel glider	*Petaurus norfolcensis*	V	-	Likely	**Yes**
koala	*Phascolarctos cinereus*	V	-	Likely	**Yes**
long-nosed potoroo	*Potorous tridactylus*	V	V	Potential	**Yes**
New Holland mouse	*Pseudomys novaehollandiae*	-	V	Likely	**Yes**

Species Name		Status		Likelihood to Occur within the Study Area	Reasonable Potential to be Impacted by the Proposal
Common Name	*Scientific Name*	TSC Act	EPBC Act		
grey-headed flying-fox	*Pteropus poliocephalus*	V	V	**Recorded**	**Yes**
Fishes					
black rockcod	*Epinephelus daemelii*	-	V	Not present	No

Table 2 - Migratory Species Recorded or with Potential to Occur within 10km of the Study Area

Common Name	*Scientific Name*	International Convention	Likelihood to Occur within Study Area	Reasonable Potential to be Impacted by the Proposal
little tern	*Sternula albifrons*	B, C, J, K	Likely	**Yes**
crested tern	*Thalasseus bergii*	J	Likely	**Yes**
common sandpiper	*Actitis hypoleucos*	B, C, J, K	Unlikely	No
ruddy turnstone	*Arenaria interpres*	B, C, J, K	Unlikely	No
sharp-tailed sandpiper	*Calidris acuminata*	B, C, J, K	Unlikely	No
red knot	*Calidris canutus*	B, C, J, K	Unlikely	No
curlew sandpiper	*Calidris ferruginea*	B, C, J, K	Unlikely	No
pectoral sandpiper	*Calidris melanotos*	B, C, K	Unlikely	No
red-necked stint	*Calidris ruficollis*	B, C, J, K	Unlikely	No
great knot	*Calidris tenuirostris*	B, C, J, K	Unlikely	No
double-banded plover	*Charadrius bicinctus*	B	Unlikely	No
greater sand-plover	*Charadrius leschenaultia*	B, C, J, K	Unlikely	No
lesser sand-plover	*Charadrius mongolus*	B, C, J, K	Unlikely	No
oriental cuckoo	*Cuculus optatus*	C, J, K	Unlikely	No
Latham's snipe	*Gallinago hardwickii*	B, J, K	Unlikely	No
Swinhoe's snipe	*Gallinago megala*	B, C, J, K	Unlikely	No
pin-tailed snipe	*Gallinago stenura*	B, C, J, K	Unlikely	No

Common Name	*Scientific Name*	International Convention	Likelihood to Occur within Study Area	Reasonable Potential to be Impacted by the Proposal
white-throated needletail	*Hirundapus caudacutus*	C, J, K	Likely	**Yes**
fork-tailed swift	*Apus pacificus*	C, J, K	Likely	**Yes**
eastern osprey	*Pandion cristatus*	B	Potential	**Yes**
broad-billed sandpiper	*Limicola falcinellus*	B, C, J, K	Unlikely	No
bar-tailed godwit	*Limosa lapponica*	B, C, J, K	Unlikely	No
black-tailed godwit	*Limosa limosa*	B, C, J, K	Unlikely	No
black-faced monarch	*Monarcha melanopsis*	B	Unlikely	No
spectacled monarch	*Monarcha trivirgatus*	B	Unlikely	No
eastern yellow wagtail	*Motacilla tschutschensis*	C, K, J	Unlikely	No
satin flycatcher	*Myiagra cyanoleuca*	B	Unlikely	No
eastern curlew	*Numenius madagascariensis*	B, C, J, K	Unlikely	No
little curlew	*Numenius minutus*	B, C, J, K	Unlikely	No
whimbrel	*Numenius phaeopus*	B, C, J, K	Unlikely	No
ruff	*Philomachus pugnax*	B, C, J, K	Unlikely	No
Pacific golden plover	*Pluvialis fulva*	B, C, J, K	Unlikely	No
grey plover	*Pluvialis squatarola*	B, C, J, K	Unlikely	No
rufous fantail	*Rhipidura rufifrons*	B	Unlikely	No
grey-tailed tattler	*Tringa brevipes*	B, C, J, K	Unlikely	No
common greenshank	*Tringa nebularia*	B, C, J, K	Unlikely	No
terek sandpiper	*Xenus cinereus*	B, C, J, K	Unlikely	No

Preliminary Seven Part Tests under the *Environmental Planning and Assessment Act 1979*

Threatened species and TECs known to occur or considered to have reasonable likelihood to occur within the Study Area (based on known distribution and habitat requirements) and with reasonable potential to be impacted by the proposed rezoning are addressed in the following preliminary Seven Part Tests of Significance. These assessments have been conducted in accordance with Section 5A of the EP&A Act, based on the current Master Plan. It is expected that these assessments will be reviewed and revised following the finalisation of the Master Plan and impact boundaries as part of the future development application.

It is acknowledged that the *Biodiversity Conservation Act 2016* was implemented on 25 August 2017, repealing the TSC Act. The assessments in this report have not been updated to reflect the minor changes in relation to the replacement of the TSC Act by the BC Act. It is understood that threatened entities previously listed under the TSC Act were automatically transferred to be listed under the BC Act and the amended Assessment of Significance Test (now outlined in Section 7.3 of the BC Act) does not materially change the assessment outcome. Consideration of the BC Act and its implications on the Project will be addressed at the DA phase of the project, as required.

The following threatened species have been recorded in the Study Area, or are likely to occur and therefore have the potential to be impacted by the proposed rezoning:

Threatened Ecological Communities

- *Sydney Freshwater Wetlands in the Sydney Basin Bioregion EEC*

Threatened Flora Species

- Earp's gum (*Eucalyptus parramattensis* subsp. *decadens*)
- rough doubletail (*Diuris praecox*)
- sand doubletail (*Diuris arenaria*)
- coast groundsel (*Senecio spathulatus*)

Threatened Fauna Species

- wallum froglet (*Crinia tinnula*)
- little tern (*Sternula albifrons*)
- regent honeyeater (*Anthochaera phrygia*)
- swift parrot (*Lathamus discolor*)
- turquoise parrot (*Neophema pulchella*)
- dusky woodswallow (*Artamus cyanopterus cyanopterus*)
- white-bellied sea eagle (*Haliaeetus leucogaster*)

- eastern osprey (*Pandion cristatus*)
- powerful owl (*Ninox strenua*)
- masked owl (*Tyto novaehollandiae*)
- koala (*Phascolarctos cinereus*)
- squirrel glider (*Petaurus norfolcensis*)
- long-nosed potoroo (*Potorous tridactylus*)
- grey-headed flying-fox (*Pteropus poliocephalus*)
- eastern false pipistrelle (*Falsistrellus tasmaniensis*)
- little bentwing-bat (*Miniopterus australis*)
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*)
- east coast freetail-bat (*Mormopterus norfolkensis*)
- hoary wattled bat (*Chalinolobus nigrogriseus*)
- greater broad-nosed bat (*Scoteanax rueppellii*)
- yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*)
- southern myotis (*Myotis macropus*).

All assessments are undertaken without any consideration of impact mitigation or offsetting and are based on the current indicative Master Plan. Any changes to the indicative Master Plan following this assessment may require a revised Seven Part Test assessment under the EP&A Act.

Species descriptions are referenced from the Office of Environment and Heritage (OEH 2016) and Department of the Environment and Energy (2016) online species profiles, unless otherwise noted.

Threatened Ecological Communities

The following threatened ecological community is considered in this assessment:

- Sydney Freshwater Wetlands in the Sydney Basin Bioregion

The beach wetland vegetation community is considered likely to conform to the NSW Scientific Committee determination to list Sydney Freshwater Wetlands in the Sydney Basin Bioregion as an EEC (NSWSC 2000). The community covers approximately 3.2 hectares of the Study Area and is dominated by the constituent canopy species *Carex pumila or Ficinia nodosa*.

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;

Not applicable.

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

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

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

The proposed rezoning is unlikely to result in the removal or disturbance of *Sydney Freshwater Wetlands in the Sydney Basin Bioregion EEC*. No development is proposed in this area, however the proposed rezoning may result in increased human access to the sand dunes. The proposed rezoning is not likely to have an adverse effect on the extent of the community such that its local occurrence would be placed at the 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;

No development is proposed in the area containing *Sydney Freshwater Wetlands in the Sydney Basin Bioregion EEC*, however the proposed rezoning may result in increased human access to the sand dunes. Furthermore, disturbed remnants are considered to form part of the EEC where the natural soil and associated seedbank is partially intact. The proposed rezoning is unlikely to disturb the natural soil and associated seedbank in the sand dunes. The proposed rezoning is unlikely to result in the loss of species diversity that would adversely modify the composition of the community such that its local occurrence may be placed at risk of extinction.

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

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

The current Master Plan indicates no disturbance of this community.

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

Fragmentation of remnants of the community within the Study Area is unlikely to increase as a result of the proposed rezoning due to the location of the *Sydney Freshwater Wetlands in the Sydney Basin Bioregion EEC* on the sand dunes. This community largely occurs as small remnants across Stockton beach and is unlikely to be further fragmented or isolated from other areas of habitat as a result of the proposed rezoning.

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 habitat for this community within the Study Area is not likely to be important to its long-term survival in the locality.

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

The Study Area is not located in proximity to any areas of declared or recommended critical habitat. The proposed rezoning will not have an adverse effect on any critical habitat.

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

A recovery plan has not been prepared for this community. There are no threat abatement plans of relevance to the proposed rezoning.

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

The proposed rezoning will not contribute to the operation of any key threatening processes listed under the TSC Act relevant to the EEC.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the proposed rezoning is unlikely to result in a significant impact on the *Sydney Freshwater Wetlands in the Sydney Basin Bioregion EEC* due to the small area of the community and the unlikely impacts associated with the rezoning.

This assessment has been undertaken based on the current Master Plan. It is expected that these assessments will be reviewed and revised following the finalisation of the Master Plan and impact boundaries as part of the future development application.

Threatened Flora Species

The following threatened flora species are considered in this assessment:

- Earp's gum (*Eucalyptus parramattensis* subsp. *decadens*)
- rough doubletail (*Diuris praecox*)
- sand doubletail (*Diuris arenaria*)
- coast groundsel (*Senecio spathulatus*)

An atypical eucalypt was recorded within the Study Area that may be Earp's gum hybrids (*Eucalyptus parramattensis* subsp. *decadens* x *robusta*). This species is known to hybridise with *Eucalyptus robusta* in the Worimi Regional Park just north of the Study Area (Bell and Driscoll 2010). Most specimens appear closest to *Eucalyptus robusta*, and this parent seems to be the more dominant, resulting in a hybrid swarm of specimens very difficult to identify to species level (Bell and Driscoll 2010). Neither the OEH profile (OEH 2016) or the approved Commonwealth conservation advice (TSSC 2014) discusses the inclusion of hybrids in the listed species, however in accordance with the precautionary principle, these individuals are being assessed as the threatened species.

Rough doubletail (*Diuris praecox*) and sand doubletail (*Diuris arenaria*) were subject to targeted surveys on 8 September 2016 during the known flowering period for the species. These species were not recorded within the Study Area, despite other known populations flowering in the locality, however suitable habitat is known to occur within the Study Area.

Coast groundsel (*Senecio spathulatus*) has not been recorded within the Study Area, but has been previously recorded on the Stockton sand dunes approximately 10km northeast of the Study Area (Bell and Driscoll 2010).

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;

Two likely Earp's gum hybrids (*Eucalyptus parramattensis* subsp. *decadens* x *robusta*) have been recorded in the Study Area within the Mahogany-Baloskion Swamp Forest in the northeast of the site. The species generally occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath understorey. It also occurs as an emergent in dry or wet heathland. Often where this species occurs, it is a community dominant. The proposed rezoning currently disturbs the two individuals recorded at the site. This area of disturbance is primarily associated with the APZ which will selectively retain important canopy species such as the Earp's gum hybrids.

Rough doubletail and sand doubletail have not been recorded within the Study Area however suitable habitat occurs on the margins and disturbed tracks associated with the Frontal Dune Blackbutt-Apple Forest. The proposed rezoning currently excludes this habitat from direct development disturbances. These species are known to occur on coastal heath and dry grassy eucalypt forest on sandy flats and have been primarily recorded along the Tomaree Peninsula.

Coast groundsel has not been recorded in the Study Area however suitable habitat occurs on the frontal sand dunes on the far eastern portion of the Study Area. This species has been previously recorded on the Stockton sand dunes (Bell and Driscoll 2010). No development is proposed in this area, however the proposed rezoning may result in increased human access to the sand dunes.

The proposed rezoning may result in the loss of a small area of likely Earp's gum hybrids and minor indirect disturbances to areas of suitable habitat for rough doubletail, sand doubletail and coast groundsel. It is not considered that the loss of this habitat may result in an adverse effect on the life cycle of these species such that a viable local population of these species will be likely to be placed at risk of extinction.

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

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

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

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

The proposed rezoning may result in the loss of two likely Earp's gum hybrids and minor indirect impacts to suitable habitat for rough doubletail, sand doubletail and coast groundsel. Given the availability of other higher quality habitat in the adjacent Worimi Conservation Lands, it is unlikely that these species depend on the habitats within the Study 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 proposed rezoning would result in the loss of two likely Earp's gum hybrids and minor indirect impacts to suitable habitat for rough doubletail, sand doubletail and coast groundsel. Consequently the level of fragmentation and isolation will increase for these species where these impacts occur.

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

The proposed rezoning would result in the loss of two likely Earp's gum hybrids and minor indirect impacts to suitable habitat for rough doubletail, sand doubletail and coast groundsel. The Study Area occurs and the southernmost extent of high quality continuous habitat within the Worimi Conservation Lands occurring between Nelson Bay and Fern Bay. The Study Area has been previously disturbed as part of the activities on the Rifle Range and the habitats for these species are generally weed infested and fragmented.

It is unlikely that the habitat to be disturbed as part of the proposed rezoning would be considered important to the long-term survival of these species in the locality and the region.

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

The Study Area is not located in proximity to any areas of declared or recommended critical habitat. The proposed rezoning will not have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for rough doubletail, sand doubletail or coast groundsel. A draft National Recovery Plan has been prepared for Earp's gum (OEH 2011). The Recovery Plan includes a specific objective to provide appropriate protection to the potentially distinct population (i.e. hybrid form) of Earp's gum around Fern Bay. Any impacts to the likely hybrids of Earp's gum in the Study Area would contravene this objective. Samples of these potential hybrids have been sent to Royal Botanic Gardens Sydney for formal identification.

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

The proposed rezoning will contribute to the operation of the following key threatening processes listed under the TSC Act relevant to these species:

- Clearing of native vegetation.
- High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition.
- Invasion, establishment and spread of *Lantana camara*.
- Invasion of native plant communities by *Chrysanthemoides monilifera*.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the proposed rezoning is unlikely to result in a significant impact on rough doubletail, sand doubletail or coast groundsel due to the minor and indirect impacts on potential habitat and no impact on known individuals. Further investigations into the likely Earp's gum hybrid occurring within the Study Area is required to determine the conservation status and importance of the Earp's gum hybrid population occurring within the Study Area.

This assessment has been undertaken based on the current Master Plan. It is expected that these assessments will be reviewed and revised following the finalisation of the Master Plan and impact boundaries as part of the future development application.

Threatened Fauna Species

The following threatened fauna species are considered in this assessment:

- wallum froglet (*Crinia tinnula*)
- little tern (*Sternula albifrons*)
- regent honeyeater (*Anthochaera phrygia*)
- swift parrot (*Lathamus discolor*)
- turquoise parrot (*Neophema pulchella*)
- dusky woodswallow (*Artamus cyanopterus cyanopterus*)
- white-bellied sea eagle (*Haliaeetus leucogaster*)
- eastern osprey (*Pandion cristatus*)
- powerful owl (*Ninox strenua*)
- masked owl (*Tyto novaehollandiae*)
- koala (*Phascolarctos cinereus*)
- squirrel glider (*Petaurus norfolcensis*)
- long-nosed potoroo (*Potorous tridactylus*)
- grey-headed flying-fox (*Pteropus poliocephalus*)
- eastern false pipistrelle (*Falsistrellus tasmaniensis*)
- little bentwing-bat (*Miniopterus australis*)
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*)
- east coast freetail-bat (*Mormopterus norfolkensis*)
- hoary wattled bat (*Chalinolobus nigrogriseus*)
- greater broad-nosed bat (*Scoteanax rueppellii*)
- yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*)
- southern myotis (*Myotis macropus*)

Potential habitat occurs within the Study Area for the wallum froglet; woodland birds such as regent honeyeater, dusky woodswallow, swift parrot, turquoise parrot; large forest owls including powerful owl, masked owl, coastal birds such as eastern osprey, little tern; and threatened mammal species being spotted-tailed quoll, squirrel glider, koala, long-nosed potoroo; and micro-bat species being eastern false pipistrelle, hoary wattled bat, greater broad-nosed bat, yellow-bellied sheathtail bat and southern myotis.

Grey-headed flying-fox, east coast freetail-bat, eastern bentwing-bat and little bentwing-bat have been recorded utilising the habitats of the Study Area.

White-bellied sea eagle was also recorded flying over the habitats of the Study Area. This species was recently listed as vulnerable under the TSC Act (NSWSC 2016) and should also be considered in any future development applications for the project.

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;

Grey-headed flying-fox, east coast freetail-bat, eastern bentwing-bat and little bentwing-bat have been recorded utilising the habitats of the Study Area. Up to five grey-headed flying-foxes were observed foraging in the forested habitats of the Study Area in April 2007. No flying-fox camps have been recorded in the Study Area and east coast freetail-bat, eastern bentwing-bat and little bentwing-bat were detected using Anabat recorders in May 2016. The forested areas of the Study Area are likely to provide suitable foraging habitat for these species and potential hollow resources for little bentwing-bat and east coast freetail-bat. One white-bellied sea eagle was recorded flying over the habitats of the Study Area.

No other threatened species are known to occur in the Study Area. Two preferred koala feed trees, being swamp mahogany (*Eucalyptus robusta*) and likely Earp's gum hybrids (*Eucalyptus parramattensis* subsp. *decadens* x *robusta*) occur within the Mahogany-Baloskion Swamp Forest. The koala has been recorded in adjacent habitats associated with Fern Bay and the Worimi Regional Park. Furthermore, the squirrel glider has been recorded in adjacent similar habitat in Fern Bay. *Banksia serrata* in the forest understorey provides suitable foraging habitat for the species. Powerful owl and masked owl have also been recorded in the habitats of the Worimi Conservation Lands and may utilise the Study Area for foraging resources. Little tern has been previously recorded nesting in mined dunes along the south-western edge of the Worimi Conservation Lands and may also use the similar habitats of the Study Area.

Potential habitat also occurs for wallum froglet, regent honeyeater, dusky woodswallow, swift parrot, turquoise parrot, eastern osprey, spotted-tailed quoll, long-nosed potoroo and micro-bat species being eastern false pipistrelle, hoary wattled bat, greater broad-nosed bat, yellow-bellied sheathtail bat and southern myotis. These species have not been recorded in the Study Area.

The proposed rezoning may result in the loss of approximately 2.1 hectares of potential and likely forest foraging habitat for a range of threatened species in the forested areas of the site. However it is noted that hollow resources in the Study Area occur in low densities in these habitats. The Study Area contains preferred and supplementary koala habitat as per Lunney *et al.* (1998) with up to 1.6 hectares of buffer around preferred habitat potentially impacted by the proposed rezoning. 2.1 hectares of known foraging habitat for grey-headed flying-fox, east coast freetail-bat, eastern bentwing-bat and little bentwing-bat may be impacted.

It is not considered that the loss of this habitat may result in an adverse effect on the life cycle of these species such that a viable local population of these species will be likely to be placed at risk of extinction.

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

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

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

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

The proposed rezoning may result in the loss of approximately 2.1 hectares of forest habitat that includes preferred feed trees for the koala and likely foraging habitat for a range of threatened species. Given the availability of other higher quality habitat in the adjacent Worimi Conservation Lands, it is unlikely that these species depend on the habitats within the Study 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 proposed rezoning would result in the loss approximately 2.1 hectares of forest habitat that includes preferred feed trees for the koala and likely foraging habitat for a range of threatened species. The proposed rezoning may introduce significant barriers for some of these species such that it will prevent movement of individuals between proximate areas of habitat. Highly mobile species such as grey-headed flying-fox, micro-bats and birds are unlikely to be substantially affected. The Study Area contains intact vegetation primarily along its northern boundaries. While this allows some east to west fauna movement from the coastal dune area to the Hunter River estuary, the value of this is limited due to residential areas and Nelson Bay Road to the west of the Study Area. Connectivity from the south of the site to Stockton is currently highly fragmented as a result of previous residential and urban development.

As some forest habitat will be removed as part of the Project, the level of fragmentation and isolation within the Study Area will increase 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 proposed rezoning would result in the loss approximately 2.1 hectares of forest habitat that contains likely foraging habitat for a range of threatened species. Hollow-bearing tree resources for roosting habitat occur in low densities in the Study Area.

While the Study Area is known to contain small areas of preferred koala feed trees and preferred and supplementary koala habitat as per Lunney *et al.* (1998), the site has been previously disturbed as part of the activities on the Rifle Range and the habitats for these species are generally weed infested and fragmented. Sand dune habitat in relation to the little tern, which has been recorded nesting in mined dunes along the south-western edge of the Worimi Conservation Lands, is not expected to be impacted by the proposed rezoning, however the proposed rezoning may result in increased human access to the sand dunes. Key foraging trees being swamp mahogany (*Eucalyptus robusta*) for species such as grey-headed flying-fox (DECCW 2009), regent honeyeater (DoE 2016) and swift parrot (Saunders 2011) occur in small discrete areas of the Study Area.

The Study Area occurs and the southernmost extent of high quality continuous habitat within the Worimi Conservation Lands occurring between Nelson Bay and Fern Bay. It is unlikely that the habitat to be disturbed as part of the proposed rezoning would be considered important to the long-term survival of these species in the locality and the region.

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

No critical habitat has been listed within or adjacent to the Study Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

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

The following recovery plans have been prepared:

- National recovery plan for the wallum sedge frog and other wallum-dependent frog species (Meyer *et al.* 2006)
- Little tern (*Sterna albifrons*) Recovery Plan (NPWS 2003)
- National Recovery Plan for the Regent Honeyeater (*Anthochaera phrygia*) (DoE 2016)
- National Recovery Plan for the Swift Parrot (*Lathamus discolor*) (Saunders 2011)
- Approved Recovery Plan for the Large Forest Owls (DEC 2006)
- Recovery Plan for the Koala (*Phascolarctos cinereus*) (DECC 2008)
- National Recovery Plan for the Spotted-tailed Quoll (*Dasyurus maculatus*) (DELWP 2016)
- Draft Recovery Plan for the Grey-headed Flying-fox (*Pteropus poliocephalus*) (DECCW 2009)

Any impacts to known habitat for these species in the Study Area are likely to contravene the objectives of these recovery plans.

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

The proposed rezoning may contribute to the operation of the following key threatening processes listed under the TSC Act relevant to these species:

- Aggressive exclusion of birds by noisy miners (*Manorina melanocephala*).
- Clearing of native vegetation.
- Invasion, establishment and spread of *Lantana camara*.
- Invasion of native plant communities by *Chrysanthemoides monilifera*.
- Removal of dead wood and dead trees.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the proposed rezoning is unlikely to result in a significant impact on wallum froglet, regent honeyeater, dusky woodswallow, swift parrot, turquoise parrot, powerful owl, masked owl, eastern osprey, little tern, spotted-tailed quoll, squirrel glider, long-nosed potoroo, eastern false pipistrelle, hoary wattled bat, greater broad-nosed bat, yellow-bellied sheathtail bat and southern myotis due to the minor and indirect impacts on potential habitat and no impact on known individuals.

Furthermore, due to the highly mobile nature of these species and the availability of higher quality habitats in the locality, the proposed rezoning is unlikely to result in a significant impact on white-bellied sea eagle, grey-headed flying-fox, east coast freetail-bat, eastern bentwing-bat and little bentwing-bat, which have been recorded utilising the habitats of the Study Area. While the Study Area contains preferred koala feed trees and preferred and supplementary koala habitat, this area is minimal, fragmented and the species has not been recorded at this southern extremity of the potential extent of the Port Stephens koala population. Based on the current Master Plan, the proposed rezoning is unlikely to result in a significant impact on the koala.

This assessment has been undertaken based on the current Master Plan. It is expected that these assessments will be reviewed and revised following the finalisation of the Master Plan and impact boundaries as part of the future development application.

Preliminary Assessment of Significance under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires an Assessment of Significance relating to the potential impacts of a Project on listed matters of national environmental significance (MNES). These assessments have been conducted in accordance with the Significant Impact Guidelines 1.1 (DoE 2013), based on the current Master Plan. It is expected that these assessments will be reviewed and revised following the finalisation of the Master Plan and impact boundaries as part of the future development application.

Under the EPBC Act, the approval of the Commonwealth Minister for the Environment is required for any action that may have a significant impact on 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
- a water resource, in relation to coal seam gas development and large coal mining development.

A search of the Department of Environment and Energy Protected Matters Search Tool in September 2016 and collated information from literature reviews identified three threatened ecological communities, 32 threatened species and 35 terrestrial migratory species listed under the EPBC Act that are known to occur, or considered to have the potential to occur on the basis of habitat modeling within the Study Area. Each of these has been included in **Tables 1** and **2** (note that purely marine or pelagic species were excluded due to lack of habitat), together with an indication of those species that warrant further assessment by way of an Assessment of Significance.

As outlined in **Tables 1** and **2**, the following EPBC Act listed species and communities are considered to have the potential to occur or be impacted by the Project and are subject to an Assessment of Significance below:

Critically Endangered and Endangered Species

- swift parrot (*Lathamus discolor*)
- regent honeyeater (*Anthochaera phrygia*)
- spotted-tailed quoll (*Dasyurus maculatus maculatus*) SE mainland population

Vulnerable Species

- Earp's gum (*Eucalyptus parramattensis* subsp. *decadens*)
- rough doubletail (*Diuris praecox*)
- long-nosed potoroo (*Potorous tridactylus*)
- koala (*Phascolarctos cinereus*) combined populations of Qld, NSW and the ACT
- New Holland mouse (*Pseudomys novaehollandiae*)
- grey-headed flying-fox (*Pteropus poliocephalus*)

Migratory Species Listed under International Conventions

- little tern (*Sternula albifrons*)
- crested tern (*Thalasseus bergii*)
- white-throated needletail (*Hirundapus caudacutus*)
- fork-tailed swift (*Apus pacificus*)
- eastern osprey (*Pandion cristatus*)

Critically Endangered and Endangered Species

The following critically endangered and endangered species are considered in this assessment:

- swift parrot (*Lathamus discolor*)
- regent honeyeater (*Anthochaera phrygia*)
- spotted-tailed quoll (*Dasyurus maculatus maculatus*) SE mainland population

Species descriptions, in the Assessments of Significance below, are referenced from the Office of Environment and Heritage (OEH 2016) and Department of the Environment and Energy (2016) online species profiles, unless otherwise noted.

In this case, a *population* means:

- a geographically distinct regional population, or collection of local populations; or
- a regional population, or collection of local populations, that occurs within a particular bioregion.

The swift parrot occurs as a single population that migrates annually from breeding grounds in Tasmania to the winter foraging grounds on the coastal plains and slope woodlands of mainland eastern Australia (Saunders 2011). Approximately 200 mature birds (10 per cent of the total estimated population) are known to over-winter in the Lower Hunter Region of New South Wales (Saunders 2002). The swift parrot has not been recorded within the Study Area however it has been recorded approximately 8 km north of the Study Area near Williamtown feeding on swamp mahogany.

Although there appears to be minor behavioural differences between regent honeyeaters in the three main areas inhabited by the species (the Bundarra-Barraba area in NSW, the Capertee Valley in NSW, and north-eastern Victoria), the direction and extent of movements, including evidence of movement between breeding sites, and a lack of discernable genetic differences between the sites suggest that the regent honeyeater occurs as a single, contiguous population (Garnett and Crowley 2000). The regent honeyeater has not been recorded within the Study Area however it has been recorded approximately 15 km north of the Study Area near Medowie.

There is very little research-based literature that allows confident definition of population size or population boundaries of the spotted-tailed quoll. There are few recent records of this species occurring from the Port Stephens local area and no important southeast mainland populations around Port Stephens are listed in the National Recovery Plan (DELWP 2016). It is considered likely that any individuals of this species around the Study Area would be part of a broad regional population that included the Tomaree Peninsula and the Karuah – Raymond Terrace area.

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 the swift parrot, regent honeyeater or spotted-tailed quoll have been recorded within the Study Area. The proposed rezoning may result in the loss of a small area of key feed tree individuals for swift parrot and regent honeyeater and up to 2.1 hectares of forested foraging habitat for the spotted-tailed quoll. The Study Area is not known as a historical or important foraging site for these species.

It is considered unlikely that the proposed rezoning will lead to a decrease in the size of a *population* of the swift parrot, regent honeyeater or spotted-tailed quoll.

- **reduce the area of occupancy of the species; or**

The swift parrot, regent honeyeater and spotted-tailed quoll have not been recorded within the Study Area. The proposed rezoning may result in the loss of a small area of key feed tree individuals for these species. While the proposed rezoning will remove potential habitat for these species, it is not likely to lead to a significant reduction in known habitat in the region. Substantial areas of similar habitats for these species are protected in proximity to the Study Area, including the Worimi Conservation Lands.

The proposed rezoning may result in a reduction of the potential area of occupancy for the swift parrot, regent honeyeater and spotted-tailed quoll, however this is unlikely to substantially reduce the area of known occupancy in the locality or region.

- **fragment an existing *population* into two or more populations; or**

The swift parrot, regent honeyeater and spotted-tailed quoll have not been recorded within the Study Area. The swift parrot and regent honeyeater are highly dispersive and it is unlikely that the proposed rezoning would create a significant change to the species' dispersal capacity or create a significant barrier the movement of the species. The spotted-tailed quoll occupies home ranges of several hundred to several thousand hectares in size (DELWP 2016). Connectivity from the south of the site to Stockton is currently highly fragmented as a result of previous residential and urban development and the proposed rezoning is unlikely to fragment an existing *population* of spotted-tailed quoll.

It is unlikely that the Project may result in the fragmentation of an existing *population* into two or more *populations*.

- **adversely affect habitat critical to the survival of a species; or**

Habitat critical to the survival of the swift parrot includes those areas of priority habitat for which the species has a level of site fidelity or possess phenological characteristics likely to be of importance to the swift parrot (Saunders 2011). The Study Area contains 2.3 hectares dominated by swamp mahogany (*Eucalyptus robusta*) being a key feed tree species for the swift parrot. The proposed rezoning is unlikely to substantially adversely affect habitat that is critical to the survival of the species.

Habitat critical to the survival of the regent honeyeater includes any breeding or foraging areas where the species is likely to occur and any newly discovered breeding for foraging locations (DoE 2016). The Study Area contains 2.3 hectares dominated by swamp mahogany (*Eucalyptus robusta*) being a key feed tree species for the regent honeyeater. The proposed rezoning is unlikely to substantially adversely affect habitat that is critical to the survival of the species.

Habitat that is critical to the survival of the spotted-tailed quoll includes large patches of forest with adequate denning resources and relatively high densities of medium-sized mammalian prey (DELWP 2016). This habitat is likely to occur in the adjacent Worimi Conservation Lands and the adjoining forested habitats in the north of the Study Area. The proposed rezoning is unlikely to substantially adversely affect habitat that is critical to the survival of the species.

- **disrupt the breeding cycle of a population; or**

The swift parrot 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 regent honeyeater 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 2007. Nests are usually placed in the canopy of mature trees with rough bark, e.g. ironbarks, sheoaks (*Casuarina*) and rough-barked apple (*Angophora floribunda*).The regent honeyeater has not been previously recorded in the Study Area and it is unlikely to contain breeding habitat for the species.

The spotted-tailed quoll generally dens in rock shelters, small caves, hollow logs or tree hollows and utilises numerous dens within its home range. Potential den sites were not recorded in the Study Area. The spotted-tailed quoll has not been previously recorded in the Study Area and it is unlikely to contain breeding habitat for the species.

The proposed rezoning is not expected to disrupt the breeding cycle of *populations* of the swift parrot, regent honeyeater or the spotted-tailed quoll.

- **modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline; or**

The proposed rezoning will involve the removal of a small area of key feed tree individuals for swift parrot and regent honeyeater and 2.1 hectares of potential forested foraging habitat for spotted-tailed quoll. The Lower Hunter and Port Stephens area supports other areas of habitat that contain suitable woodland and forest vegetation that would also provide potential habitat for these species.

It is considered unlikely that the proposed rezoning will modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the swift parrot, regent honeyeater and spotted-tailed quoll 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;**

The proposed rezoning is not expected to result in invasive species that are harmful to the swift parrot, regent honeyeater or spotted-tailed quoll becoming established in the species' habitat.

- **introduce disease that may cause the species to decline; or**

Relevant for the swift parrot, psittacine beak and feather disease 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. Beak and feather disease 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 proposed rezoning will introduce beak and feather disease or any other disease that may cause the swift parrot, regent honeyeater or spotted-tailed quoll to decline.

- **interfere with the recovery of the species.**

The following recovery plans have been prepared:

- National Recovery Plan for the Swift Parrot (*Lathamus discolor*) (Saunders 2011)
- National Recovery Plan for the Regent Honeyeater (*Anthochaera phrygia*) (DoE 2016)
- National Recovery Plan for the Spotted-tailed Quoll (*Dasyurus maculatus*) (DELWP 2016).

Any impacts to known habitat for these species in the Study Area are likely to contravene the objectives of these recovery plans. The swift parrot, regent honeyeater and spotted-tailed quoll have not been recorded within the Study Area, however potential foraging habitat has been identified. It is considered unlikely that the proposed rezoning will interfere with the recovery of the swift parrot, regent honeyeater or spotted-tailed quoll throughout Australia.

Conclusion

The proposed rezoning is unlikely to result in a significant impact on the populations of the swift parrot, regent honeyeater or spotted-tailed quoll. Although the Study Area provides potential foraging habitat for these species, they have not been recorded utilising the potential habitat within the Study Area or in the immediate surrounds.

This assessment has been undertaken based on the current Master Plan. It is expected that these assessments will be reviewed and revised following the finalisation of the Master Plan and impact boundaries as part of the future development application.

Vulnerable Species

The following vulnerable species are considered in this assessment:

- Earp's gum (*Eucalyptus parramattensis* subsp. *decadens*)
- rough doubletail (*Diuris praecox*)
- long-nosed potoroo (*Potorous tridactylus*)
- koala (*Phascolarctos cinereus*) combined populations of Qld, NSW and the ACT
- New Holland mouse (*Pseudomys novaehollandiae*)
- grey-headed flying-fox (*Pteropus poliocephalus*)

In the case of a vulnerable species, 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.

An atypical eucalypt was recorded within the Study Area that may be Earp's gum hybrids (*Eucalyptus parramattensis* subsp. *decadens* x *robusta*). This species is known to hybridise with *Eucalyptus robusta* in the Worimi Regional Park just north of the Study Area (Bell and Driscoll 2010). Most specimens appear closest to *Eucalyptus robusta*, and this parent seems to be the more dominant, resulting in a hybrid swarm of specimens very difficult to identify to species level (Bell and Driscoll 2010). Neither the OEH profile (OEH 2016) or the approved Commonwealth conservation advice (TSSC 2014) for the species discusses the inclusion of hybrids in the listed species, however in accordance with the precautionary principle, these individuals are being assessed as the threatened species. The Recovery Plan for Earp's gum (OEH 2011) outlines the importance of the potentially distinct population (i.e. hybrid form) of Earp's gum around Fern Bay. The likely Earp's gum hybrids in the Study Area may constitute an *important population*.

Rough doubletail (*Diuris praecox*) was subject to targeted surveys on 8 September 2016 during the known flowering period for the species. This species were not recorded within the Study Area, despite other known populations flowering in the locality, however suitable habitat is known to occur within the Study Area. It is unlikely an *important population* of rough doubletail occurs within the Study Area.

Records of the long-nosed potoroo are scarce within the Port Stephens LGA. The species is known to occur in greater densities in the Barrington Top National Park to the north and the Watagans National Park to the west of the Study Area. It is not considered that an *important population* of long-nosed potoroo occurs in the Study Area as it has not been identified as containing a key source population either for breeding or dispersal; populations that are necessary for maintaining genetic diversity, and/or populations that are near the limit of the species' range.

Koala (*Phascolarctos cinereus*) is known to occur in eucalypt woodlands and forests from the north-eastern Queensland, along the eastern coast of NSW, to the south-east corner of South Australia. The koala has not been recorded within the Study Area, however it has been recorded in adjacent habitats associated with Fern Bay and the Worimi Regional Park. Koalas occurring within the Port Stephens LGA are likely to comprise an *important population*, in accordance with the criteria listed above.

The Study Area is unlikely to be core habitat for the Port Stephens koala population, however individuals may occur infrequently as they move through the landscape around Fern Bay.

Genetic evidence indicates that the New Holland mouse once formed a single continuous population on mainland Australia and the distribution of recent subfossils further suggest that the species has undergone a large range contraction since European settlement (Breed and Ford, 2007). In NSW, the New Holland mouse is known from: Royal National Park (NP) and the Kangaroo Valley; Kuringai Chase NP; and Port Stephens to Evans Head near the Queensland border (DoE 2015). While the species has not been recorded in the Study Area, coastal dune vegetation occurring in the Port Stephens LGA is likely to comprise an *important population* of the species.

Grey-headed flying-fox (*Pteropus poliocephalus*) has been recorded within the Study Area. Up to five individuals were observed foraging in the forested habitats of the Study Area in April 2007. No flying-fox camps have been recorded in the Study Area. The closest active camp is located approximately 5 km to the southwest of the Study Area near Carrington (DoEE 2016). From these camps, the species can travel up to 50 km in one night in search of food where they feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines. It is likely that the species utilises the Project Area as foraging habitat. The Study Area is likely to provide suitable foraging habitat for a local population the species.

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;**

No *important populations* of the rough doubletail, long-nosed potoroo or New Holland mouse have been recorded within the Study Area. Known habitat for likely Earp's gum hybrids (*Eucalyptus parramattensis* subsp. *decadens*), koala and grey-headed flying-fox have been recorded in the Study Area, however the Study Area is unlikely to be important for an important population of these species.

The proposed rezoning may result in the loss of approximately two key feed tree individuals for koala, two Earp's gum hybrids, 2.1 hectares of foraging habitat for grey-headed flying-fox and up to 17.9 hectares of forest and shrubland foraging habitat for long-nosed potoroo and New Holland mouse. The Study Area is unlikely to be frequently utilised by the Port Stephens koala population or be depended on by local grey-headed flying-fox colonies.

It is considered unlikely that the proposed rezoning will lead to a decrease in the size of an important population of the rough doubletail, long-nosed potoroo, New Holland mouse, koala and grey-headed flying-fox. The proposed rezoning may result in a short-term decrease in the local distinct population of Earp's gum hybrids. It is likely this species can be selectively retained and replanted in the post-construction landscape.

- **reduce the area of occupancy of an important population, or;**

No *important populations* of the rough doubletail, long-nosed potoroo or New Holland mouse have been recorded within the Study Area.

The proposed rezoning may result in the loss of approximately two key feed trees for koala, two Earp's gum hybrids and 2.1 hectares of foraging habitat for grey-headed flying-fox. Due to the small area of impact, retention of forested vegetation and existing fragmentation within the Study Area, the proposed rezoning is unlikely to reduce the area of the important population of koala or a local population of grey-headed-flying-fox.

The proposed rezoning may result in a reduction in the area of occupancy for the locally occurring Earp's gum hybrid population in the Study Area and the locality.

- **fragment an existing important population into two or more populations, or;**

No *important populations* of the rough doubletail, long-nosed potoroo or New Holland mouse have been recorded within the Study Area.

The grey-headed flying fox is highly dispersive and it is unlikely that the proposed rezoning would create a significant change to the species' dispersal capacity or create a significant barrier the movement of the species. The spotted-tailed quoll occupies home ranges of several hundred to several thousand hectares in size (DELWP 2016). Connectivity from the south of the site to Stockton is currently highly fragmented as a result of previous residential and urban development and the proposed rezoning is unlikely to fragment an existing population of koala.

It is unlikely that the proposed rezoning may result in the fragmentation of an existing *important population* into two or more populations.

- **adversely affect habitat critical to the survival of a species, or;**

No habitat critical to the survival for rough doubletail, long-nosed potoroo or New Holland mouse have been recorded within the Study Area.

The Draft National Recovery Plan for Earp's gum (OEH 2011) does not identify habitat critical to the survival of the species, noting that all habitat where the species occurs contributes to the long-term conservation of the species. Given that the Study Area contains a small area of likely hybrid Earp's gum separate to the known populations of Earp's gum in the Tomago sandbeds, it is unlikely that this area would be habitat critical to the survival of the species.

The Study Area contains preferred and supplementary koala habitat as per Lunney *et al.* (1998) with up to 2.3 hectares of preferred habitat, 3.6 hectares of buffer habitat and 15.9 hectares of supplementary koala habitat. According to the EPBC Act Referral Guidelines for the Vulnerable Koala (DoE 2014), koala habitat is defined as forest or woodland containing species that are known koala food trees or shrubland with emerging food trees. According to the Koala Habitat Assessment Tool in the EPBC Act Referral Guidelines, the preferred habitats within the Study Area score 7 out of 10 and are therefore considered to contain habitat critical to the survival of the species (DoE 2014). The proposed rezoning may result in the loss of 1.6 hectares of buffer around preferred habitat. The current Master Plan has sought to avoid impacts in the area containing preferred koala habitat.

According to the draft National Recovery Plan for the grey-headed flying-fox (DECC 2009), foraging habitat is considered critical to the survival of the species if it is productive during winter and spring and productive during the final weeks of gestation, and during the weeks of birth, lactation and conception. Swamp mahogany (*Eucalyptus robusta*) dominated forest communities in the Study Area are productive during winter, during which food bottlenecks have been identified. The Study Area is considered to comprise an area of foraging habitat for this species but is unlikely to contain significant breeding and roosting habitat.

- **disrupt the breeding cycle of an important population, or;**

No *important populations* of the rough doubletail, long-nosed potoroo or New Holland mouse have been recorded within the Study Area.

The proposed rezoning may result in the loss of two likely Earp's gum hybrids in the Study Area. It is likely that the population within the Study Area is part of the Fern Bay *important population* of a distinct hybrid

type of the species. The reduction of size of this population may result in the disruption of the breeding cycle of the hybrid type of this species.

While koala breeding has not been recorded in the Study Area, suitable foraging habitat was recorded. The retention of preferred and supplementary habitat on the site will enable the species to utilise optimal habitats and breeding is not considered likely to be adversely impacted. The proposed rezoning is not expected to disrupt the breeding cycle of an *important population* of this species.

No grey-headed flying-fox breeding populations or camps have been identified in the Study Area. The proposed rezoning is not expected to disrupt the breeding cycle of an *important population* of this species.

- **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or;**

The proposed rezoning may result in the loss of approximately two key feed trees for koala, two Earp's gum hybrids, 2.1 hectares of foraging habitat for grey-headed flying-fox and up to 17.9 hectares of forest and shrubland habitat for long-nosed potoroo and New Holland mouse. The Study Area is unlikely to be frequently utilised by the Port Stephens koala population or be depended on by local grey-headed flying-fox colonies.

It is considered unlikely that the proposed rezoning will modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the rough doubletail, long-nosed potoroo, New Holland mouse, koala and grey-headed flying-fox would decline.

- **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;**

There are not any invasive species that are likely to become established as a result of the proposed rezoning that may impact upon any habitat relevant to the koala, grey-headed flying-fox, long-nosed potoroo or New Holland mouse.

Weed invasion by common coastal exotic species such as bitou bush (*Chrysanthemoides monilifera*) and lantana (*Lantana camara*) would threaten the establishment of vulnerable flora species such as rough doubletail and Earp's gum. It is expected that this threat would be managed within the construction and post-construction phases of the proposed rezoning.

- **introduce disease that may cause the species to decline; or**

No diseases that may cause rough doubletail, grey-headed flying-fox, long-nosed potoroo or New Holland mouse to decline are likely to be introduced as a result of the proposed rezoning that may impact upon any habitat relevant to the

Key biological pathogens that have the most risk of impacting Earp's gum include the disease-causing rusts to plants of the Myrtaceae family (particularly myrtle rust (*Uredo rangelii*)) and the soil pathogen causing root-rot (*Phytophthora cinnamomi*). The presence of these pathogens has not been specifically identified within the Study Area, however both are known to occur throughout NSW. The proposed rezoning is not expected to introduce or exacerbate any diseases that may cause Earp's gum to decline.

The koala 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 populations. It has been predicted that up to half of the koalas in south-east Queensland have reproductive disease likely to result in infertility (TSSC 2012).

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 populations in Queensland and New South Wales have the koala retrovirus (TSSC 2012).

The proposed rezoning does not involve any processes that are likely to introduce a disease for the koala or Earp's gum that may cause these species to decline.

- **interfere substantially with the recovery of the species.**

The following recovery plans have been prepared:

- Draft National Recovery Plan for Earp's Dirty Gum *Eucalyptus parramattensis* subsp. *decadens* (OEH 2011)
- Recovery Plan for the Koala (*Phascolarctos cinereus*) (DECC 2008)
- Draft Recovery Plan for the Grey-headed Flying-fox (*Pteropus poliocephalus*) (DECCW 2009)

Any impacts to known habitat for these species in the Study Area are likely to contravene the objectives of these recovery plans. Rough doubletail, koala, long-nosed potoroo or New Holland mouse have not been recorded within the Study Area, however potential foraging habitat has been identified. It is considered unlikely that the proposed rezoning will interfere with the recovery of the Rough doubletail, Earp's gum, koala, long-nosed potoroo, New Holland mouse or grey-headed flying-fox throughout Australia.

Conclusion

The proposed rezoning is unlikely to result in a significant impact on the populations of the rough doubletail, long-nosed potoroo or New Holland mouse. Although the Study Area provides potential foraging habitat for these species, they have not been recorded utilising the potential habitat within the Study Area or in the immediate surrounds.

While the Study Area contains preferred koala feed trees and preferred and supplementary koala habitat, this area is minimal, fragmented and the species has not been recorded at this southern extremity of the potential extent of the Port Stephens koala population. Based on the current Master Plan, the proposed rezoning is unlikely to result in a significant impact on the koala.

While, the proposed rezoning is unlikely to result in a significant impact on Earp's gum, further investigations into the likely hybrid occurring within the Study Area is required to determine the conservation status and importance of the potential population occurring within the Study Area.

This assessment has been undertaken based on the current Master Plan. It is expected that these assessments will be reviewed and revised following the finalisation of the Master Plan and impact boundaries as part of the future development application.

Migratory Species under International Conventions

The following migratory species are considered in this assessment:

- little tern (*Sternula albifrons*)
- crested tern (*Thalasseus bergii*)
- white-throated needletail (*Hirundapus caudacutus*)
- fork-tailed swift (*Apus pacificus*)
- eastern osprey (*Pandion cristatus*)

None of the migratory species above have been recorded within the Study Area, however the little tern has been previously recorded nesting in mined dunes along the south-western edge of the Worimi Conservation Lands. Likely habitat for the species occurs in the sandy dune habitats of the Study for little tern and crested tern. Potential habitat has been identified for white-throated needletail, fork-tailed swift and eastern osprey.

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 habitats within the Study Area for migratory species listed under international conventions is not considered to meet the criteria listed above, and important habitat is not likely to occur.

The Draft Referral Guideline for 14 Birds Listed as Migratory Species under the EPBC Act (DoE 2015) defines important habitat for the white-throated needletail, fork-tailed swift and eastern osprey. Important habitat for white-throated needletail includes tree hollows in tall trees on ridge tops (DoE 2015). Otherwise the species is almost entirely aerial (DoE 2015). Important habitat for fork-tailed swift includes open plains to woodland areas, however the species is almost entirely aerial (DoE 2015). Important habitat for the eastern osprey includes Bays, estuaries, along tidal stretches of large coastal rivers, mangrove swamps, coral and rock reefs, terrestrial wetlands and coastal lands of tropical and temperate Australia and off shore islands (DoE 2015).

No guidelines are available for little tern or crested tern. Little terns and crested terns inhabit sheltered coastal environments, including lagoons, estuaries, river mouths and deltas, lakes, bays, harbours and inlets, especially those with exposed sandbanks or sand-spits, and also on exposed ocean beaches (DoE 2016). The Study Area contains suitable sand dune habitat to the east of the site. Little tern has been previously recorded nesting in mined dunes along the south-western edge of the Worimi Conservation Lands, however this has not been recorded within the Study Area.While this is not expected to be impacted by the proposed rezoning, the proposed rezoning may result in increased human access to the sand dunes.

The habitats within the Study Area for migratory species listed under international conventions is not considered to meet the criteria listed above, and *important habitat is* not likely to occur.

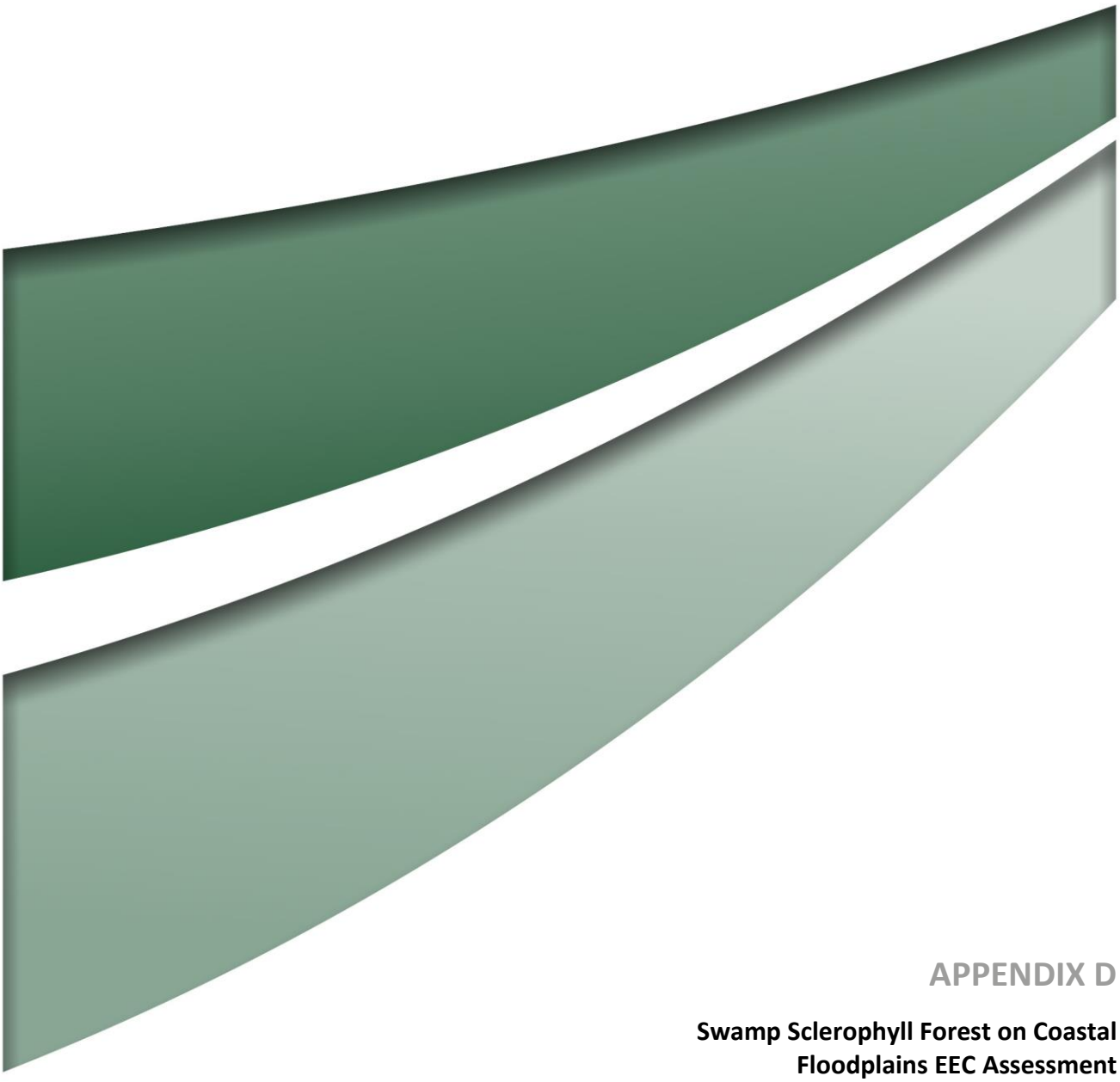
The proposed rezoning is considered likely to result in a significant impact on migratory species if there is a real chance or possibility that it will:

- ***substantially modify and/or destroy an area of important habitat for a migratory species;***
- ***seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species; and/or***
- ***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 considered to comprise *important habitat* for any of the identified migratory species listed above, and therefore the proposed rezoning is not likely to substantially modify or destroy important migratory species habitat. Similarly, the proposed rezoning will not seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species; or result in an invasive species that is harmful to migratory species becoming established within the Study Area.

Conclusion

The proposed rezoning is not likely to result in a significant impact on any migratory species listed under the EPBC Act or international conventions.



APPENDIX D

Swamp Sclerophyll Forest on Coastal Floodplains EEC Assessment

Swamp Sclerophyll Forest on Coastal Floodplains EEC under the TSC Act Assessment

The potential presence of *Swamp Sclerophyll Forest on Coastal Floodplains EEC* under the TSC Act within the Mahogany-Baloskion Swamp Forest in the Study Area was highlighted in the constraints assessment. Although this EEC is usually associated with alluvial flats and coastal floodplains and does not typically occur within the coastal sand plains, the EEC has been identified along Nelson Bay Road approximately 2km north of the Study Area and previous judgements (such as Motorplex v Port Stephens Council NSW LEC 74) have indicated that the EEC may occur on sand plains that have hydrological, geographical or floristic associations with coastal floodplains.

As a result of the uncertainty, further investigations into the potential presence of the community were undertaken. Vegetation was sampled within this vegetation community at the Study Area by two ecologists on 1 November 2016 within one 400 square metre plot and along a walking transect. An assessment of the community was then undertaken against the Final Determination for the EEC (NSWSC 2004).

In order for the vegetation community Mahogany – Baloskion Swamp Forest to be the *Swamp Sclerophyll Forest on Coastal Floodplains EEC*, it must satisfy the description of the EEC provided in the final determination of the NSW Scientific Committee (2004). This description includes the main components of:

- Edaphic (soils), topographic/locational and
- Floristic structure and composition.

The Mahogany – Baloskion Swamp Forest in the Study Area does not meet the NSW Scientific Committee's description for most of these components.

Edaphic (soils), Topographical and Locational

The Final Determination for *Swamp Sclerophyll Forest on Coastal Floodplains EEC* states the community:

> *"generally occurs below 20 m (though sometimes up to 50 m) elevation, often on small floodplains or where the larger floodplains adjoin lithic substrates or coastal sand plains in the NSW North Coast, Sydney Basin and South East Corner bioregions".*

The NSW Scientific Committee also states that this EEC is:

> *"associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with the coastal floodplains".*

Although Mahogany – Baloskion Swamp Forest in the Study Area does occur below 20m ASL, it does not occur on or in association with the floodplain. A floodplain landform is defined by the Scientific Committee as a:

> *"level landform patterns on which there may be active erosion and aggradation by channelled and overbank stream flow with an average recurrence interval of 100 years or less"*

The Study Area does not occur on the floodplain nor is it associated with alluvial floodplains: it occurs on ancient sand-dunes behind Stockton Beach. Furthermore, it is not alluvial in nature: the sandy soils in the Study Area have formed from beach sand deposits, and stream formation (exhibiting channelised flow) is

weak. Furthermore, soil in the Study Area was recorded during field work as coarse sand with minor loam; sandy loams or humic clay loams were not recorded.

Floristic Composition and Structure

The Final Determination for *Swamp Sclerophyll Forest on Coastal Floodplains EEC* states the community:

> *"is typically open forest, although partial clearing may have reduced the canopy to scattered trees. In some areas the tree stratum is low and dense, so that the community takes on the structure of scrub. The community also includes some areas of fernland and tall reedland or sedgeland, where trees are very sparse or absent. Typically these forests, scrubs, fernlands, reedlands and sedgelands form mosaics with other floodplain forest communities and treeless wetlands, and often they fringe treeless floodplain lagoons or wetlands with semi-permanent standing water"*

Vegetation mapped as Mahogany – Baloskion Swamp Forest in the Study Area does form an open forest with areas that are low and dense that has a scrub structure. However, apart from dense patches of bracken fern (*Pteridium esculentum*), which are likely associate with past disturbance and bushfire, there are no areas of fernland, reedland or sedgeland in this community. The understorey is typically dry and sclerophyllous in nature, which is more typical of dry, open forest, including coast teatree (*Leptospermum laevigatum*), tantoon (*L. polygalifolium* subsp. *cismontanum*), common fringe-myrtle (*Calytrix tetragona*) and tree broom-heath (*Monotoca elliptica*) dominant.

The ground cover is also more typical of dry, coastal, sclerophyllous forest, including pomax (*Pomax umbellata*), spiny-headed mat rush (*Lomandra longifolia*) and bracken (*Pteridium esculentum*). Presence also are species that are non-typical of Swamp Sclerophyll EEC, including pigface (*Carpobrotus glaucescens*) and old-man banksias (*Banksia serrata*), which are common on sandy, coastal soils.

Furthermore, there were no areas of semi-permanent standing water, except in areas immediately downslope and adjacent to residential areas where water is most likely running off from gardens and drainage from impermeable surfaces such as roads and driveways.

The Final Determination for *Swamp Sclerophyll Forest on Coastal Floodplains EEC* provides a list of 59 characteristic plant species. A total of 24 native species were recorded in the Mahogany – Baloskion Swamp Forest community within the Study Area. Of these 24 species, only six occur on the EEC's list of characteristic plant species. This is represented by the following ratios:

- 10% of the EEC list of characteristic plant species were recorded in the Study Area; and
- 24% of the species recorded in the Study Area are on the EEC list of characteristic plant species.

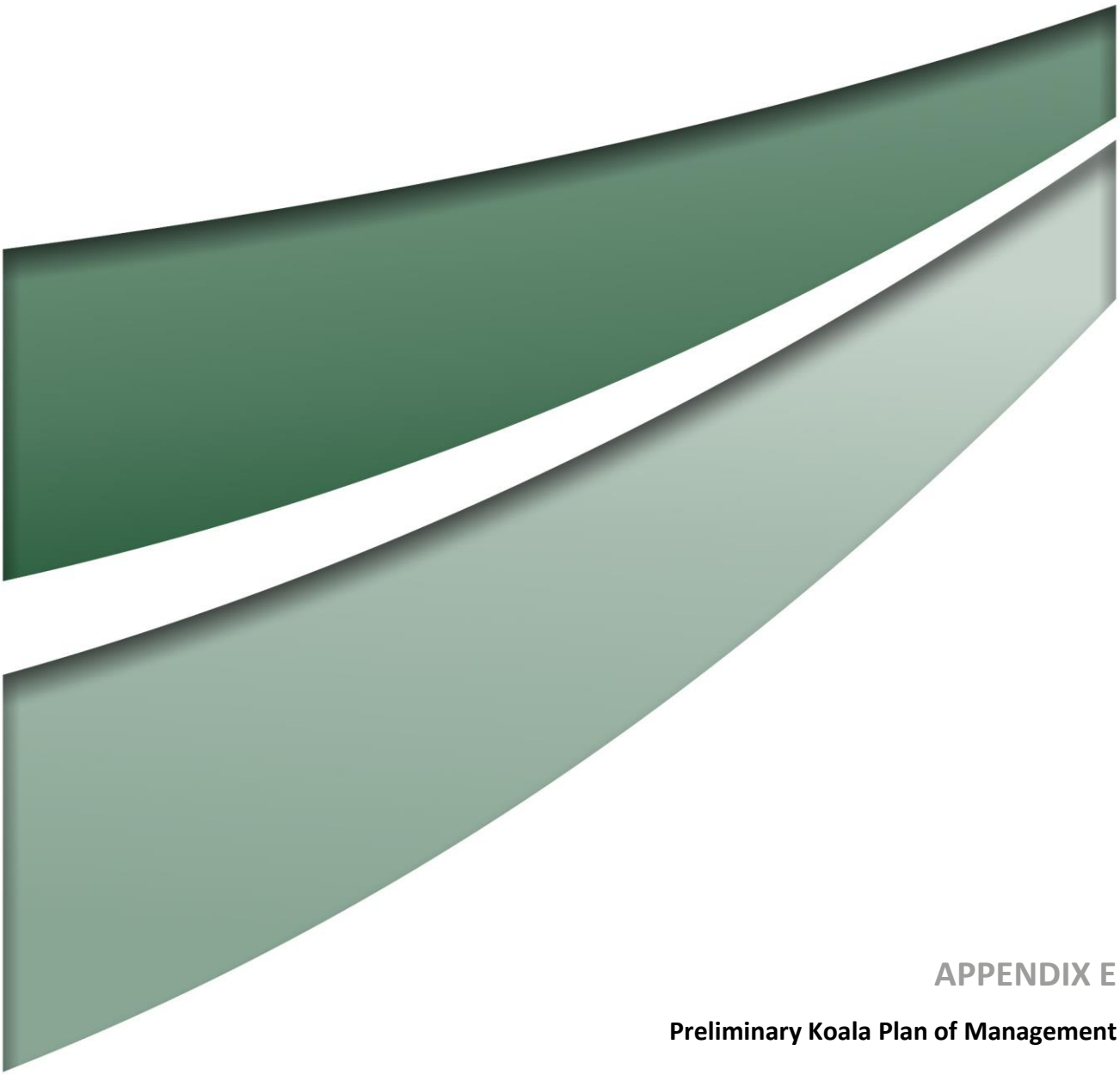
The Scientific Committee does state that:

> *"the total species list of the community is considerably larger than that given...with many species present at only one or two sites or in low abundance. The species composition of a site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance".*

However, the proportion of EEC characteristic plant species recorded in the Mahogany – Baloskion Swamp Forest is low. Additionally, the number of the most widespread and abundant plant species in the EEC that are present in the Study Area is low, with swamp mahogany (*Eucalyptus robusta*) the only dominant tree recorded.

Conclusion

Given the above information, the Mahogany – Baloskion Swamp Forest in the Study Area does not conform to the description of the *Swamp Sclerophyll Forest on Coastal Floodplains EEC*.



APPENDIX E

Preliminary Koala Plan of Management

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Quality outcomes

DHA

PRELIMINARY KOALA PLAN OF MANAGEMENT

Rifle Range
Defence Housing Project

May 2018

PRELIMINARY KOALA PLAN OF MANAGEMENT

Rifle Range
Defence Housing Project

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Defence Housing Australia

Project Director:	Rebecca Vere
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Report No.	3764/R03/Final
Date:	May 2018

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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	**Date**	**Name**	**Date**
Final	Rebecca Vere	29/05/2018	Rebecca Vere	29/05/2018

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Appendices

1.0 Introduction

Defence Housing Australia (DHA) proposes to rezone the former Rifle Range at Fern Bay (refer to **Figure 1.1**) from the current Environmental Conservation (E2) to Low Density Residential (R2) and National Parks and Reserve (E1) under the Port Stephens Local Environmental Plan (LEP) 2013 to allow for a residential subdivision and conservation.

The site has been subject to ongoing investigations (including ecological survey) as a potential development site since 2008. The ecological features identified as part of such investigations (including current and previous field survey) have been used to guide the design of an appropriate Master Plan for the proposed development, with the aim of providing a development approach which balances the economic potential of the Study Area with appropriate biodiversity conservation outcomes for the broader Stockton area.

This Preliminary Koala Plan of Management (KPoM) has been prepared in recognition of the presence of preferred koala habitat, including suitable koala feed trees, on or within the vicinity of the site and as required by Port Stephens Council and in consideration of State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP 44).

1.1 Project Description

DHA has an ongoing requirement for additional housing in the Newcastle area to cater for Newcastle-based Defence members and their families and to replace existing DHA dwellings that do not meet current standards. In response to this, DHA have recently purchased two sites: Fort Wallace, Stockton, NSW and the Rifle Range, Fern Bay, NSW. DHA intends to obtain the necessary planning approvals to develop these sites for residential use with a mix of housing suitable for both Australian Defence Force (ADF) personnel and the private market.

The proposed Master Plan for the Rifle Range site includes a mix of residential typologies primarily placed within the former Rifle Range footprint (refer to **Figure 1.2**). The Master Plan has sought to retain the Rifle Range landscape and focus development within the previously disturbed areas of the site.

1.2 Objectives

The objectives of this KPoM are to:

- identify the location and characteristics of the core koala habitat identified within the Study Area
- identify the potential impacts of the Project to core koala habitat identified within the Study Area
- provide management measures to minimise the potential impacts on core koala habitat associated with the re-zoning project.

Image Source: Nearmap (May2016)
Data Source: LPI NSW (2009)

0 1.0 2.0 2.5km
1:50 000

Legend

- Site Boundary
- National Park
- State Conservation Area
- Regional Park
- Hunter Estuary Wetlands Ramsar Site

FIGURE 1.1

Locality Map

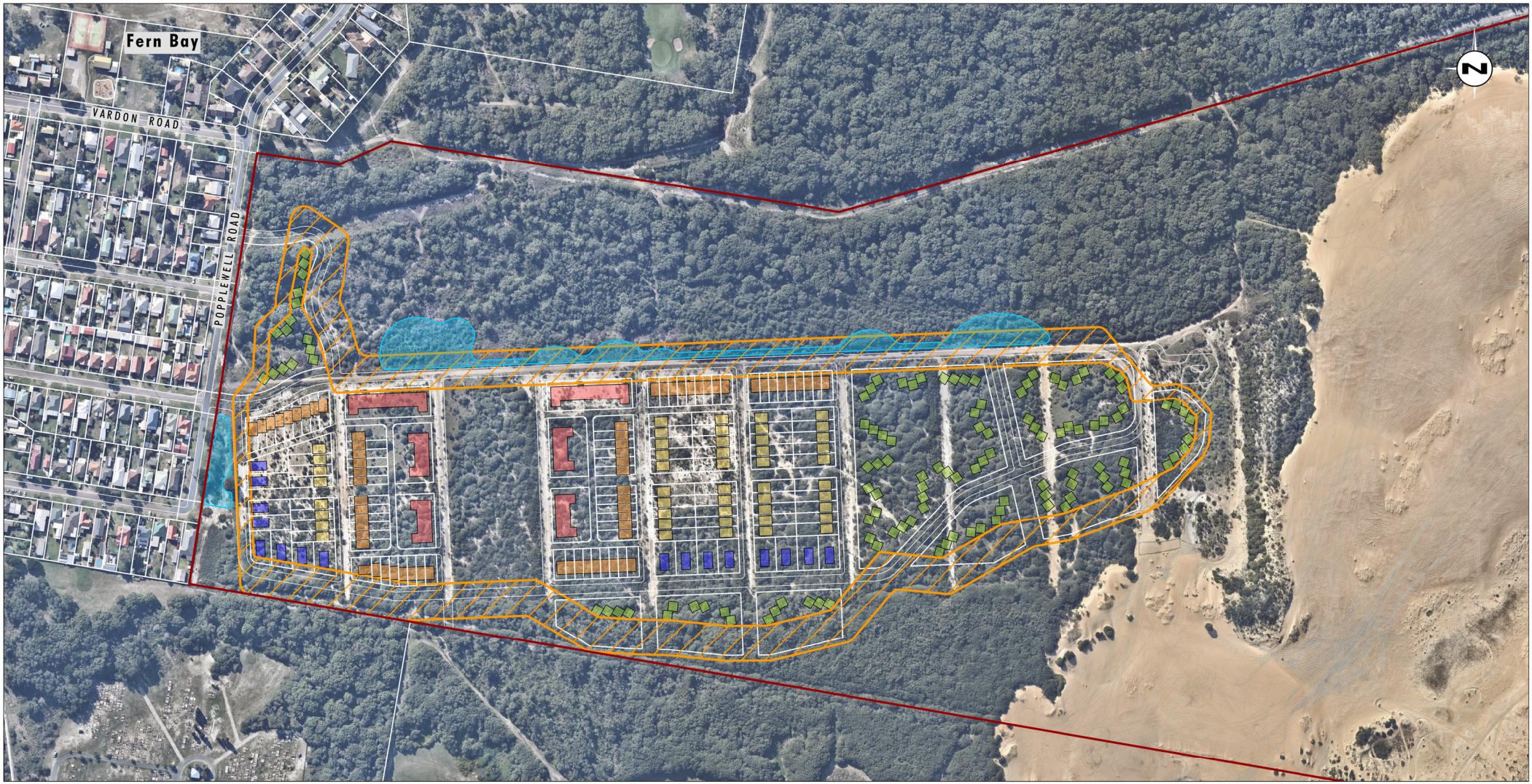

Image Source: Nearmap (Apr 2018)
Data Source: LPI NSW (2009), Architectus (2018)

0 100 200 250m
1:5000

Legend

- Site Boundary
- Asset Protection Zone
- Stormwater Detention Basin (Subject to design resolution)
- Dune Apartment
- Townhouse
- Courtyard Home
- Cluster Home
- Single Eco Home

FIGURE 1.2

Proposed Master Plan

File Name (A4): R03/3764_012.dgn
20180524 16.08

1.3 Legislative Requirements

The *Environmental Planning and Assessment Act 1979* (EP&A Act) makes provision for a range of environmental planning instruments, which additionally provide for protection of koala habitat, including State Environmental Planning Policies and Local Environmental Plans. The main provisions of the state and local planning instruments are provided below.

1.3.1 Port Stephens Council Comprehensive Koala Plan of Management

The Port Stephens Council Comprehensive Koala Plan of Management (CKPoM) was prepared by Port Stephens Council and the Australia Koala Foundation to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas, to ensure permanent free-living populations over their present range and to reverse the current trend of population decline in the Port Stephens LGA.

The report provides guidelines for koala habitat assessments, habitat conservation measures and performance criteria to facilitate targeted koala conservation and management across the Port Stephens koala population. Broad-scale mapping of preferred, supplementary and marginal koala habitat is outlined for the Port Stephens LGA. According to this habitat mapping, the Study Area contains preferred and supplementary habitat as well as buffer vegetation for the koala.

This site specific KPoM was prepared in response to the presence of primary koala habitat in accordance with the Port Stephens CKPoM and the high level of historic usage of the site by koalas indicating the presence of 'core' koala habitat in accordance with SEPP 44.

1.3.2 SEPP 44 – Koala Habitat Protection

State Environmental Planning Policy 44 – Koala Habitat Protection is a policy made under EP&A Act. SEPP 44 is currently under review. The proposed amendment will update the controls to better protect koala habitat. The update will bring the SEPP into line with the current planning system and support councils to prepare comprehensive plans of management. The amendments will also improve the application of the SEPP by recognising the extent of tree species important to koalas. Explanation of Intended Effect was on public exhibition from 18 November 2016 through 3 March 2017. Submissions are now being reviewed. As such, any reference to SEPP 44 in this report relates to the current SEPP 44 as at 28 May 2018.

SEPP 44 aims to encourage the appropriate conservation and management of areas of natural vegetation that provide habitat for koalas, to ensure permanent free-living populations over their present range and to reverse the current trend of population decline. Any development application in an identified local government area, affecting land of one hectare or greater, including adjoining lands on the same holding, must be assessed under SEPP 44.

Assessment under SEPP 44 is based on an initial determination of whether the subject land constitutes potential koala habitat. This is determined by assessing whether the eucalypt species listed in Schedule 2 constitute 15 per cent or more of the total number of trees in the upper or lower strata of the tree component of the subject land. If potential koala habitat is present, the area must be further assessed to determine if the land is core koala habitat. This is primarily determined by completing field surveys and literature searches to determine if a population of koalas is present within the subject land.

The proposed Project is not subject to assessment under SEPP 44 as it lies in the Port Stephens local government area which has prepared a Comprehensive Koala Plan of Management, however the key components of the SEPP have been considered in the preparation of this Plan.

1.3.3 NSW *Biodiversity Conservation Act 2016*

The NSW *Biodiversity Conservation Act 1995* (BC Act) provides protection for threatened plants and animals native to NSW. Species listed under Schedule 1 of the BC Act are considered to be threatened in NSW. The koala (*Phascolarctos cinereus*) is listed as a Vulnerable species within Schedule 1 of the BC Act. The koala has additionally been listed as an Endangered Population in Pittwater LGA, the Hawks Nest/Tea Gardens LGA and between the Tweed River and Brunswick River east of the Pacific Highway in northern NSW, which are not relevant to this KPoM.

Protection of the koala (including its habitat) is provided by integrating the conservation of the species into the development control process under the EP&A Act (which includes SEPP 44).

1.3.3.1 Approved Recovery Plan for the Koala (*Phascolarctos cinereus*) (DECC 2008)

A Recovery Plan for the Koala has been prepared by OEH (DECC 2008) under the requirements of the now repealed *Threatened Species Conservation Act 1995*.

This recovery plan is the formal recovery plan for the koala in NSW and considers the conservation requirements of the species across its known range in NSW. It identifies the actions needed and parties responsible for undertaking the identified actions. It also provides a framework for localised recovery efforts throughout NSW, including the management issues relevant to the koala.

Although this document is primarily aimed at actions to be undertaken by government authorities many of the issues presented are applicable, and the recovery objectives and proposed recovery actions have been considered in the development of this KPoM.

1.3.4 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides the legislation to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places (also known as matters of national environmental significance).

The combined populations of the koala in Queensland, New South Wales and the Australian Capital Territory were listed as Vulnerable under the EPBC Act in May of 2012. The koala was listed as Vulnerable due to a substantial decline over three generations (TSSC 2012).

A recovery plan for the koala was recommended as part of the listing advice and is due to be prepared following the expiration of the National Koala Conservation and Management Strategy 2009–2014.

1.3.4.1 National Koala Conservation and Management Strategy 2009-2014

This Management Strategy was prepared by the Natural Resource Management Ministerial Council (NRMMC 2009) to provide a national coordinating framework for the numerous koala plans and actions that have been developed and are being undertaken by various state and local governments across Australia. Being a policy document, this Management Strategy does not provide any legislative powers or obligations. Importantly, the Management Strategy provides overarching policies and directions for action for the integration of national and state koala policies in order to work towards the goal of conserving koalas and their habitat. This Management Strategy has been considered in the development of this KPoM.

1.3.4.2 EPBC Act Referral Guidelines for the Vulnerable Koala (DoE 2014)

These koala referral guidelines (the guidelines) aim to address this complexity and provide guidance that can be applied consistently across the entire listed distribution of the koala. The guidelines break down the significant impact decision and guide proponents on important requirements, particularly on information expectations, survey planning, standards for mitigating impacts and guidance on significant impact.

In accordance with the Referral Guidelines, the habitat assessment tool was applied to the Study Area which determined that the extent of vegetation that contains at least one known koala food tree corresponds to a range of forest and woodland communities occurring in the Study Area. This includes:

- Mahogany-Baloskion Swamp Forest.

As the assessment of koala habitats resulted in a score greater than five using the Referral Guidelines habitat assessment tool (refer to **Appendix 1**), the Study Area is considered to contain habitat critical to the survival of the species (DoE 2014).

2.0 Ecology of Koalas

2.1 General Information

The koala (*Phascolarctos cinereus*) is an arboreal marsupial with fur ranging from grey to brown above, and is generally white below. It has large furry ears, a prominent black nose and no tail. It spends most of its time in trees and has long, sharp claws, adapted for climbing. Adult males weigh 6–12 kg and adult females weigh 5–8 kg. During breeding, males advertise with loud snarling coughing and bellowing (OEH 2016).

This species has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. It was briefly historically abundant in the 1890s in the Bega District on the south coast of NSW, although not elsewhere, and it now occurs in sparse and possibly disjunct populations. Koalas are also known from several sites on the southern tablelands (OEH 2016). Under the IUCN red list of threatened species the koala is listed as being in the category of least concern.

Koalas inhabit eucalypt woodlands and forests, and feed on the foliage of at least 70 known eucalypt species and 30 non-eucalypt species, selecting preferred browse species in various regions. This species is generally inactive for most of the day, feeding and moving mostly at night. Koalas spend most of their time in trees, but will descend and traverse open ground to move between trees, when required. Home range size varies with quality of habitat, ranging from less than two hectares to several hundred hectares in size. This species is generally solitary, however has complex social hierarchies based on a dominant male with a territory overlapping several females and sub-ordinate males on the periphery. Females breed at two years of age and produce one young per year (OEH 2016).

The breeding season for koalas peak between September and February and animals are most active during this period (DECC 2008). The gestation period for the koala is 35 days. Following birth, the young remains in the pouch for approximately 6 months, and on leaving the pouch, remains dependent on its mother and is carried on her back. Young reach independence at about 12 months old, although they can remain in the mother's home range for a further two to three years (Mitchell and Martin 1990). After this time, young animals of both sexes disperse to establish their own home range areas (Ramsay 1999). Dispersal distances range from one to 11 km although movements in excess of 50 km have been recorded (DECC 2008).

2.2 Habitat Quality

The quality of forest and woodland communities as habitat for koalas is influenced by a range of factors, including:

- **Species and size of trees present**: the most important factor influencing koala occurrences is the suite of tree species available. Koalas rely exclusively on regionally specific primary and/or secondary food tree species (DECC, 2008). Adequate floristic diversity is also important. The quality of habitat is also influenced by the presence of suitable shelter trees.

- **Structural diversity of the vegetation**: it has been found that koala activity is greater in structurally diverse forest with the majority of trees 50–80 cm DBH (DECC, 2008). Some groundcover vegetation and other features, such as hollow logs, are useful in providing shelter while on the ground and refuge in extreme weather conditions.

- **Soil nutrients**: in general, vegetation on more fertile soils provides the most suitable habitat for koalas due to the greater availability of nutrients within leaves (Cork *et al.* 1990).

- **Climate and rainfall**: koalas rely primarily on the moisture within their food to meet their water requirements.

- **Size and disturbance history of the habitat patch**: small, fragmented or highly disturbed habitats are less likely to be able to support koalas in the long term due to edge effects, limited resource availability and increased predation (DECC 2008). Vegetation corridors are important to support continued koala movements where dispersal and recruitment are impeded by barriers such as large areas of open ground and roads.

2.3 Preferred Koala Feed Tree Species

Koalas feed on the foliage of eucalypt tree species and in some areas exhibit extremely strong preferences for particular eucalypt species. SEPP 44 lists preferred koala feed trees in Schedule 2 of the SEPP. These species are listed in **Table 2.1** below.

Table 2.1 Preferred Koala Feed Trees listing 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

The Recovery Plan for the Koala (DECC 2008) documents the preferred feed trees in each of seven management areas identified in the Recovery Plan. The Study Area occurs within the North Coast Management Area, and **Table 2.2** outlines the primary, secondary and supplementary species that have been identified in that Management Area.

Table 2.2 Preferred Koala Feed Trees in the North Coast Management Area

Scientific Name	Common Name
Primary Food Tree Species	
Eucalyptus microcorys	tallowwood
Eucalyptus tereticornis	forest red gum
Eucalyptus robusta	swamp mahogany
Eucalyptus parramattensis	Parramatta red gum
Eucalyptus amplifolia	cabbage gum
Secondary Food Tree Species	
Eucalyptus seeana	narrow-leaved red gum
Eucalyptus glaucina	slaty red gum
Eucalyptus propinqua	small-fruited grey gum
Eucalyptus resinifera	red mahogany
Eucalyptus notabilis	mountain mahogany
Eucalyptus moluccana	grey box
Eucalyptus melliodora	yellow box
Eucalyptus largeana	craven grey box
Eucalyptus biturbinata	grey gum
Eucalyptus canaliculata	large-fruited grey gum
Eucalyptus rummeryi	steel box
Eucalyptus rudderi	Rudder's box
Eucalyptus quadrangulata	white-topped box
Stringybarks/Supplementary Species	
Eucalyptus tindaliae	stringybark
Eucalyptus eugeniodes	thin-leaved stringybark
Eucalyptus globoidea	white stringybark
Eucalyptus agglomerata	blue-leaved stringybark
Eucalyptus cameronii	diehard stringybark

The Port Stephens Comprehensive Koala Plan of Management (PSC 2002) documents three tree species known to be feed trees for koalas in the Port Stephens LGA. **Table 2.3** outlines these species.

Table 2.3 Feed Tree Species for Koala in the Port Stephens Local Government Area

Scientific Name	Common Name
Eucalyptus robusta	swamp mahogany
Eucalyptus parramattensis	Parramatta red gum
Eucalyptus tereticornis	forest red gum

3.0 Regional and Local Koala Habitat Populations

3.1 Koala Habitat

3.1.1 Regional Koala Habitat

In New South Wales, koalas inhabit a range of forest and woodland communities, including coastal forests, woodlands on the tablelands and western slopes, and woodland communities along watercourses in the western plains in areas dominated by the genus *Eucalyptus*. On the NSW North Coast important koala population centres are at Port Stephens, Port Macquarie, Coffs Harbour, Ballina, Lismore and Tweed (DECC 2008).

The Australian Koala Foundation's Port Stephens Koala Habitat Atlas (Phillips *et al.* 1996), confirmed the following tree species as being preferentially utilised by koalas within the Port Stephens LGA: swamp mahogany (*Eucalyptus robusta*) and Parramatta red gum (*E. parramattensis*) on all substrates where they occur; and forest red gum (*Eucalyptus tereticornis*) where it occurs on soils derived from Quaternary alluvials and volcanics.

Koala habitat in the Port Stephens area has been mapped and presented in the Port Stephens Council Koala Plan of Management (PSC 2002). Koala habitat identification was undertaken by Lunney *et al.* (1998) and incorporated into the CKPoM which identified the following habitat types for koalas in the Port Stephens area:

- Preferred koala habitat
- Supplementary koala habitat
- Marginal koala habitat
- Habitat buffers
- Habitat linking areas.

Preferred habitat on the coastal strip of Port Stephens generally occurs in the intact Swamp Sclerophyll Forest community and supplementary habitat includes areas where the Swamp Sclerophyll Forest intergrades with the Smooth-barked Apple Blackbutt Forest vegetation community. Lunney *et al.* (1998) identified approximately 7,366 hectares of preferred habitat, 9,778 hectares of supplementary and 22,781 hectares of marginal koala habitat in the Port Stephens LGA.

3.1.2 Local Koala Habitat

The koala has not been recorded within the Study Area, however it has been recorded in adjacent habitats associated with Fern Bay and the Worimi Regional Park. Koalas occurring within the Port Stephens LGA are likely to comprise an important population in the region. The Study Area is unlikely to be core habitat for the Port Stephens koala population, however individuals may occur infrequently as they move through the landscape around Fern Bay.

Preferred habitat on the coastal strip of Port Stephens generally occurs in the intact Swamp Sclerophyll Forest community and supplementary habitat includes areas where the Swamp Sclerophyll Forest intergrades with the Smooth-barked Apple Blackbutt Forest vegetation community. The Port Stephens Koala Habitat Planning Map (PSC 2007) maps the Study Area as 'mainly cleared' with edges of 'supplementary habitat' occurring to the north of the site in association with the Frontal Dune Blackbutt-Apple Forest and the Worimi Conservation Lands.

However, based on the habitat categories by Lunney *et al.* (1998), it is likely that the Mahogany-Baloskion Swamp Forest would meet the definition of Category B vegetation detailed by Lunney *et al.* (1998) and therefore would be considered preferred koala habitat in the Port Stephens LGA. The Frontal Dune Blackbutt-Apple Forest is likely to confirm to Category C vegetation and would be considered supplementary koala habitat. The remaining vegetation in the Study Area is classified as 'other vegetation'. Koala habitat within the Study Area, mapped by Umwelt in consideration of Lunney *et al.* (1998), is shown in **Figure 3.1**.

The koala was targeted during surveys undertaken in May 2016 including SAT, call playback and spotlighting surveys. No evidence (scats, scratches, etc) of koala occupation was recorded in the Study Area. While the koala has not been specifically recorded within the Study Area, the species has been recorded as recently as 2015 in habitats associated with Fern Bay approximately 1.5km north of the Study Area.

A map of the extent and quality of the habitat in the Study Area for the koala is provided as **Figure 3.1**. This map has been prepared in accordance with the Port Stephens CKPoM and Lunney *et al*. (1998) and defines the area of preferred, supplementary and marginal habitat, and also the relevant buffer and linking areas.

Table 3.1 below outlines the area of each koala habitat type mapped in the Study Area according to the Port Stephens CKPoM with a justification of the koala habitat categories as per Lunney *et al.* (1998). 2.3 hectares of preferred koala habitat has been identified in the Study Area, as shown in **Table 3.1**. **Table 3.1** outlines the broad habitat types and allocation to koala habitat categories as per Lunney et al. (1998) within the Study Area.

Table 3.1 Extent of Koala Habitat Identified in the Study Area

Vegetation Community	Dominant Overstorey Species	Habitat Category (as per Lunney *et al.* 1998)	Justification (as per Lunney *et al.* 1998)	Area (ha) in Study Area
Frontal Dune Blackbutt-Apple Forest	*Angophora costata* *Eucalyptus pilularis*	Supplementary	Meets category C vegetation	17.5
Mahogany-Baloskion Swamp Forest	*Eucalyptus robusta* *Eucalyptus parramattensis* subsp. *decadens* x *robusta*	Preferred	Meets category B vegetation	2.3
Coastal Tea-tree – Banksia Scrub	N/A	Other vegetation	Considered to be excluded vegetation	20.5
Foredune Spinifex	N/A	Other vegetation	Considered to be excluded vegetation	1.4

Vegetation Community	Dominant Overstorey Species	Habitat Category (as per Lunney *et al.* 1998)	Justification (as per Lunney *et al.* 1998)	Area (ha) in Study Area
Beach Wetlands	N/A	Other vegetation	Considered to be excluded vegetation	3.2
Cleared land/sand dunes	N/A	Other vegetation	Considered to be excluded vegetation	66.7
Total Preferred Koala Habitat				**2.3**
Total Supplementary Habitat				**15.9**
Total Buffer Around Preferred Habitat				**3.6**
TOTAL				**21.8**

Koalas feed on the foliage of eucalypt tree species and in some areas exhibit extremely strong preferences for particular eucalypt species. As outlined in **Section 2.3**, the SEPP 44 lists preferred koala feed trees as does the CKPoM (PSC 2002) and the Approved Recovery Plan for the Koala (DECC 2008). These species are outlined in **Table 3.2** below as well as counts of preferred feed tree species in the Study Area as a result of the koala habitat tree survey. **Figure 3.2** shows the location of koala feed trees across the Study Area.

Table 3.2 Preferred/Primary Koala Feed Trees

Preferred/Primary Koala Feed Tree Species	SEPP 44	Port Stephens Comprehensive Koala Plan of Management	Approved Recovery Plan for the Koala^	Number Recorded in the Study Area
swamp mahogany *Eucalyptus robusta*	✓	✓	✓	148
Parramatta red gum *Eucalyptus parramattensis*	-	✓	✓	2 (likely hybrid with *E. robusta*)
forest red gum *Eucalyptus tereticornis*	✓	✓	✓	-
tallowwood *Eucalyptus microcorys*	✓	-	✓	-
grey gum *Eucalyptus punctata*	✓	-	-	-
ribbon or manna gum *Eucalyptus viminalis*	✓	-	-	-

Preferred/Primary Koala Feed Tree Species	SEPP 44	Port Stephens Comprehensive Koala Plan of Management	Approved Recovery Plan for the Koala^	Number Recorded in the Study Area
river red gum *Eucalyptus camaldulensis*	✓	-	-	-
broad-leaved scribbly gum *Eucalyptus haemastoma*	✓	-	-	-
scribbly gum *Eucalyptus signata*	✓	-	-	-
white box *Eucalyptus albens*	✓	-	-	-
bimble box or poplar box *Eucalyptus populnea*	✓	-	-	-
cabbage gum *Eucalyptus amplifolia*	-	-	✓	-
Total				**150**

^Appendix 2 – North Coast Koala Management Area

Image Source: Nearmap (May2016)
Data Source: LPI NSW (2009), Atlas (2016)

0 100 250 500m
1:10 000

Legend

- Site Boundary
- Koala Habitat Entities:
  - Preferred Koala Habitat
  - 50m Buffer around Preferred Koala Habitat
  - Supplementary Koala Habitat
  - Other Vegetation
  - Mainly Cleared

FIGURE 3.1

Koala Habitat in the Study Area (Mapped by Umwelt)

Image Source: Nearmap (May2016)
Data Source: LPI NSW (2009), Atlas (2016)

0 100 250 500m
1:10 000

Legend

- Site Boundary
- *Eucalyptus parramattensis* subsp. *decadens* x *robusta*
- *Eucalyptus robusta*

FIGURE 3.2

Koala Feed Trees in the Study Area

3.1.3 Availability of Alternative Koala Habitat and Corridor Function

Figure 3.1 identifies the vegetation communities likely to comprise koala habitat within the Study Area. This koala habitat has been determined by refining the broad koala habitat mapping outlined in the Port Stephens Council Comprehensive Koala Plan of Management (PSC 2002).

The majority of this habitat occurs in large, relatively continuous patches in the northern parts of the Study Area (refer to **Figure 3.1**). Review and analysis of regional vegetation mapping data indicates that those communities that were recorded during vegetation surveys within the Study Area occur extensively in the local area and region.

The Study Area occurs on the southern edge of extensive areas of forested habitat within the Worimi Conservation Lands and adjacent vegetated areas along the Port Stephens coast that provide connectivity and movement corridors for a wide range of flora and fauna species from Fern Bay to Nelson Bay. The protection of landscape connections is important to ensure the exchange of genetic material and ensure adequate feeding area, breeding grounds and allow for migration for koalas.

The rezoning may result in the loss of up to 3.2 hectares of preferred, buffer and supplementary koala habitat south of Worimi Conservation Lands which will result in the loss of a small area of the southern extent of continuous habitat between Fern Bay and Nelson Bay. It is considered unlikely that the residential development as a result of the rezoning will restrict ecological vectors from moving from one habitat to another throughout the wider area or have substantial adverse impacts on the movement corridors and connectivity for species. The Worimi Conservation Lands include substantial areas of likely koala habitat on the basis of suitable vegetation communities.

3.2 Koala Populations

3.2.1 Regional Populations

The Study Area falls within Koala Management Area 1: North Coast (DECC 2008). On the NSW North Coast important koala population centres are at Port Stephens, Port Macquarie, Coffs Harbour, Ballina, Lismore and Tweed. In addition to these population centres, numerous small koala populations occur along the coast but many are separated as a result of urban and rural development, roads and other forms of fragmentation.

The Koala Recovery Plan (DECC 2008) has identified the Hawks Nest and Tea Gardens as comprising an important endangered koala population. This area is the closest regionally important population of the koala, occurring approximately 20 km to the northeast of the Study Area. It is unlikely that the individuals recorded within the Study Area would substantially interact with this population.

3.2.2 Local Population

Some population estimates have been derived for the Port Stephens LGA, with Phillips *et al.* (1996) concluding that historical estimates of population size suggest well below 1,000 individuals distributed over the entire Port Stephens LGA area and likely between 350-500 animals in total. Later population viability analysis modelling by Lunney *et al.* (2007) utilised a starting population within their study area of 7,000 hectares of the Tomago sandbeds of 800 individuals in 1998.

The koala has not been recorded within the Study Area, however it has been recorded in adjacent habitats associated with Fern Bay and the Worimi Regional Park. An Atlas of NSW Wildlife point buffer search identified 145 koala records within a 10 km radius of the Study Area. The Study Area contains two preferred koala feed trees, being swamp mahogany (*Eucalyptus robusta*) and likely Earps gum hybrids (*Eucalyptus parramattensis* subsp. *decadens* x *robusta*) occurring in the northwest of the site in the Mahogany-Baloskion Swamp Forest.

4.0 Potential Impacts from the Proposal

Approximately 21.8 hectares of preferred, buffer and supplementary koala habitat have been identified in the Study Area, with 3.2 hectares to be potentially impacted by the rezoning proposal. Due to the records of the species on the locality and the known occurrence of koala feed trees on the site, it is considered likely that the Study Area provides a small area of core koala habitat as described by SEPP 44. The potential impacts of the rezoning proposal are discussed below.

4.1 Increased Traffic

The proposed residential development as a result of the rezoning proposal will result in an increase in local traffic flows to and from the residential areas during construction and operation of the site. This will be primarily due to increased vehicle movements associated with residents accessing housing areas.

4.2 Lighting and Dust

Operational impacts that may impact upon the normal behaviour patterns of the koala include fugitive lighting impacts. Research into the impacts of altered lighting indicates that it can trigger behavioural and physiological responses including changes in foraging behaviour, disruptions of seasonal day length trigger cues for critical behaviour, disorientation and temporary blindness and interference with predator prey relationships.

The generation of dust during construction has the potential to impact on habitat through the deposition of dust on plant surfaces and the subsequent influence this can have on physiological processes. This can result in decreased plant health and in extreme cases plant death, as well as increased susceptibility to pathogens and other disturbances. The potential impacts of dust on koala includes degraded air or water quality and through impacts on food and habitat sources.

Impacts from these elements as a result of the rezoning proposal are expected to be minor and the koala is expected to continue to occupy the habitats in the wider locality in co-existence with the proposed residential development. Lighting and dust impacts will be mitigated through the application of mitigation measures to minimise lighting and dust impacts in the locality.

4.3 Noise and Vibration

The potential noise and vibration sources from the rezoning proposal include operational noise, construction noise and road traffic noise. Noise and vibration impacts can affect fauna physiology and behaviour, particularly by causing disruption to communication including mating calls, territorial calls and alarm calls. In additional to physiological impacts, this can also result in habitat loss through avoidance.

The proposed equipment being used during construction are not anticipated to create any noticeable vibration impacts due to the nature of the equipment being used and the considerable separation distances to adjoining receivers. Impacts are expected to be minor and the koala is expected to continue to occupy the habitats in the wider locality in co-existence with the proposed residential development.

4.4 Clearance of Vegetation/Loss of Habitat

The clearing of native vegetation (particularly of koala feed trees) is a major threat facing the koala across its range and the clearing of vegetation may reduce the extent of koala habitat by up to approximately two koala feed tree individuals, which represents approximately 1.3 per cent of the extent of the koala feed trees in the Study Area.

The proposed rezoning may result in adverse impacts on the koala through the removal and disturbance of known koala habitat and koala feed trees. Mitigation measures to minimise these impacts are outlined in **Section 6.0**.

4.5 Increased Competition for Resources

The removal of approximately 3.2 hectares of preferred, buffer and supplementary koala habitat may reduce the area of occupancy of the koala in the Study Area. A reduction in koala habitat may have minor adverse impacts to locally-occurring koala individuals through increased competition for resources, including consideration of the ongoing availability of suitable territories and home ranges, mates and other habitat features such as specific feed species and foraging resources within the Study Area. However, the species has not been recorded utilising the resources within the Study Area.

Increased resource competition is expected to have minor impacts on the known population of the koala in the Port Stephens locality.

5.0 Threatening Processes

Koalas are known to be susceptible to a number of identified threatening processes. These are recognised within the Koala Recovery Plan (DECC 2008) as being (in order of general importance):

- habitat loss and fragmentation
- habitat degradation
- road kills
- dog attacks
- fire
- logging
- disease
- severe weather conditions
- swimming pools
- overbrowsing.

There are currently 38 key threatening processes listed under the BC Act. Of these, the following have the koala specifically listed as being potentially affected:

- forest eucalypt dieback associated with over-abundant psyllids and bell miners
- clearing of native vegetation
- invasion, establishment and spread of *Lantana camara*
- predation and hybridisation of feral dogs (*Canis lupus familiaris*)
- anthropogenic climate change
- high frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition
- infection of native plants by *Phytophthora cinnamomi*
- predation by the European red fox (*Vulpes vulpes*)
- predation by the feral cat (*Felis catus*)
- removal of dead wood and dead trees.

The proposed rezoning is expected to have a minor impact on the exposure of the koala to the key threatening process of clearing of native vegetation. It is not expected that the proposal will exacerbate any of the other threatening processes that are known to adversely affect the koala.

6.0 Management Strategies

6.1 Impact Avoidance

DHA undertook a detailed constraints study to guide the design of the Master Plan. Through this process, different building locations were considered and DHA has sought to minimise the biodiversity impacts associated with the proposed development. Key factors in selecting the location of the disturbance footprints included the likely impacts on important ecological features, including threatened species, TECs and/or their habitats.

Ecological site inspections were undertaken in May 2016 within the Study Area to provide information on the early design phase of the Master Plan. In November, targeted surveys of the koala feed trees were undertaken to determine the extent of food resources for the koala within the Study Area. The final layout of the Master Plan was determined in consideration of the biodiversity values of the Study Area. It was found that the area north of the Study Area contained higher value vegetation and fauna habitat in structured woodland areas than the lower quality scattered woodland trees and exotic groundcovers dominating the central portion of the Study Area and therefore the disturbance area for the development was focused in the areas of lower ecological value.

In addition to avoiding areas of high conservation value, the proposed development includes provision for large lots with minimal building envelopes and strategic Asset Protection Zones (APZs) to retain as much vegetation surrounding and within the residential buildings as possible. This should allow continued connectivity in a north/south direction across the site following the completion of construction. This was considered to provide an important mechanism particularly for the movement of the koala, and also allows for the targeted selected retention of important habitat features such as hollow-bearing trees.

6.2 Pre-clearance Surveys and Clearance Supervision

A robust tree felling procedure will be implemented to minimise the potential for impacts on native fauna specie, including the koala. Tree felling supervision will be undertaken by an appropriately qualified and experienced ecologist after pre-clearance surveys have identified potential threatened species habitat. The supervising ecologist will be licensed by the relevant field survey and ethics authorities to allow for capture, housing, transport and possibly ethical euthanizing of injured fauna.

The pre-clearance survey will include the following:

- the demarcation of areas approved for clearing to reduce risk of accidental clearing
- habitat resources and habitat trees should be identified and marked (note: habitat trees are those containing hollows, cracks or fissures and spouts, active nests, dreys or other signs of recent fauna usage. Other habitat features to be identified include fallen timber/hollow logs, burrows and boulder piles)
- the potential presence of threatened flora and fauna species, endangered populations and TECs should be identified. Surveys will include detailed searches for koalas
- visual canopy inspection of all trees to be removed by suitably experienced and licensed ecologist to ensure that the koala is not injured during tree felling operations. Should a koala be identified during these surveys, works will avoid this area until the individual has moved on into surrounding remnant vegetation.

On the day of habitat tree felling, the following is to be undertaken:

- all habitat trees will be subject to a visual inspection to survey for threatened species
- trees previously identified as containing fauna will be shaken and then felled, providing no threatened species are identified
- all reasonable attempts will be made to reduce the impact of felling on all fauna species. This may include delaying felling trees with fauna present or felling in sections to reduce potential for injury
- the lowering of hollow-bearing trees will be done as gently as possible with heavy machinery
- if a threatened species is identified in a habitat tree on the day of felling, the supervising person is to advise the most appropriate method to minimise potential harm. This may include leaving the tree overnight, further shaking to encourage the animal to vacate the tree, gradual removal of branches to discourage ongoing use, soft-felling of the tree with the animal in the tree, or measures to capture and relocate the animal to secure habitats
- uninjured animals should be released on the day of capture into nearby suitable secure habitat and should not be held for extended periods of time, and
- injured animals will be taken to the nearest veterinary clinic or wildlife carer as soon as possible for assessment and treatment. If required, the supervising person may ethically euthanize fauna.

All personnel who will capture/handle/house and/or transport native fauna species (injured or uninjured) will be appropriately licensed under the requirements of the NSW Animal Ethics Committee.

6.3 Traffic and Vehicle Strike Mitigation

To reduce potential impacts as a result of increased traffic levels it is recommended that 'Koala Warning' signs and 'Injured Native Wildlife' signs be installed in appropriate locations as a reminder to take care when driving on site. This should also be enhanced by an enforced on-site speed limit of 40 km/h to ensure adequate reaction time for drivers of vehicles in the event that a koala is encountered.

Furthermore, koala exclusion fencing should be investigated as a way of excluding the koala from the active areas of the proposed residential development. Exclusion fencing can also be used to guide koalas towards koala-safe crossing points. The Study Area occurs on the southern edge of extensive areas of forested habitat within the Worimi Conservation Lands that provide connectivity and movement corridors for fauna species to the north. The Study Area contains intact vegetation primarily along its northern boundaries. Connectivity from the south of the site to Stockton is currently highly fragmented as a result of previous residential and urban development. The value for koala movement to the southern portion of the Study Area and towards Stockton is very low, with no koala records known to occur south of the Stockton Centre to the suburb of Stockton. The use of koala exclusion fencing is unlikely to result in a loss of connectivity and movement to quality habitats to the south of the site for koala or other threatened species.

Suitable fencing designs may include (Gleeson and Gleeson 2012):

- Floppy-top fences – chainmesh fence with curved mesh at the top of the fence
- Top hat fences - chainmesh fence with a formed curve attached to the top of the fence
- Metal-sheeted mesh fences - chainmesh fence fitted with a metal sheet on the top portion of the fence.

6.4 Dog Management

Domestic dog and koala encounters can be minimised though the confinement of dogs to the house or in an appropriately fenced part of the yard. Koalas are most vulnerable to dog attack at night, however, koalas may travel through backyards during daylight hours at any time of the year. The following measures should be considered for the proposed residential development:

- Use koala exclusion fencing around the dog's enclosures/yards
- Management of vegetation adjacent to fencing to ensure koala exclusion fencing effectiveness, or
- Designate a development dog-free by using a covenant (as part of a condition of approval) to prohibit dogs being kept on the property in perpetuity.

6.5 Swimming Pool Mitigation

Koala mortality as a result of drowning in swimming pools can be mitigated by requiring one or more of the following measures:

- Trailing a length of stout rope (minim diameter of 50mm) secured to a stable poolside fixture
- Pool design to allow for an easy escape (e.g. shallow steps)
- Exclusion fencing around pools.

6.6 Targeted Koala Feed Tree Planting

The Master Plan for the proposed residential development will focus on planting endemic species in the unbuilt areas of the site and target vegetation communities and habitats of the Study Area. This can include preferred koala feed trees for the locality such as swamp mahogany (*Eucalyptus robusta*) and Earps gum (*Eucalyptus parramattensis* subsp*. decadens*).

7.0 Conclusions

The Study Area contains approximately 2.3 hectares of preferred habitat for the koala, which has been identified as core koala habitat as defined under SEPP 44 and Lunney *et al.* (1998). This was identified as core koala habitat due to the presence of SEPP 44 preferred koala feed trees, however the species has not been recorded the Study Area.

Up to 3.2 hectares of preferred, buffer and supplementary habitat for the koala may be removed as a result of the proposed residential development and the Project may have minor adverse impacts on the local koala population. Mitigation measures are identified in **Section 6.0** of this KPoM have been developed to reduce the level of impact on this species.

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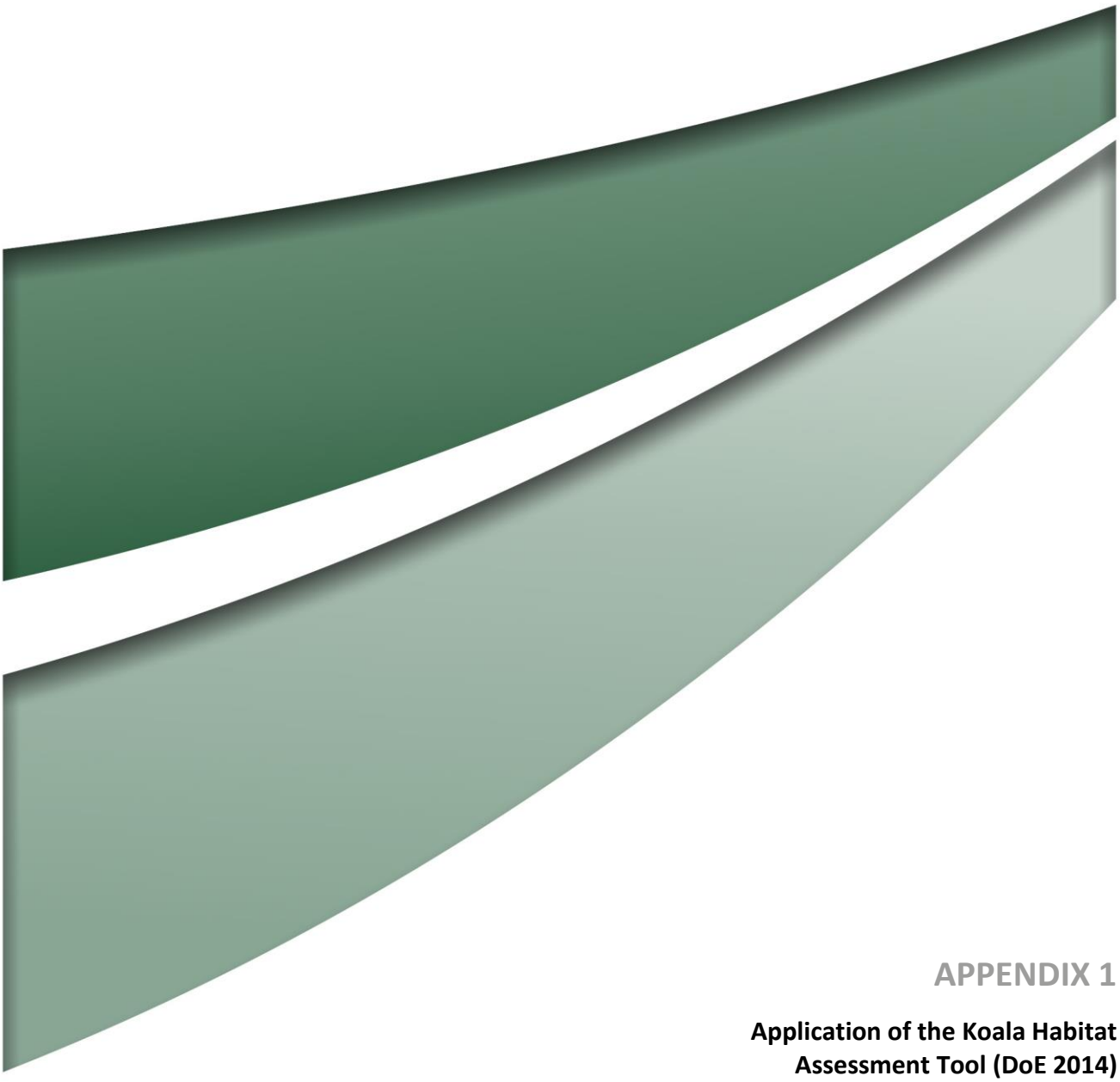

APPENDIX 1

Application of the Koala Habitat Assessment Tool (DoE 2014)

Koala Habitat Assessment Tool (Table 4 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**	**Desktop:** • EPBC PMST report identified the koala or koala habitat as 'known to occur' in the Study Area. • Atlas of NSW Wildlife point buffer search identified 0 koala records within the Study Area and 145 records within a 10 km radius of the Study Area. **On-ground:** • The koala has not been recorded on the site. • This species has been recorded in adjacent habitats associated with Fern Bay and the Worimi Regional Park.
	+1 (medium)	Evidence of one or more koalas within 5 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 in the canopy. **OR** 1 food tree species that alone accounts for >50% of the vegetation in the relevant strata.	**2**	**Desktop:** The Port Stephens Council CKPoM maps the site as mainly cleared. **On-ground:** This Study Area contains two known koala feed trees being swamp mahogany (*Eucalyptus robusta*) and likely Earp's gum hybrids (*Eucalyptus parramattensis* subsp. *decadens* x *robusta*) listed as important for koalas in the Port Stephens LGA (PSC 2002) and SEPP 44 feed species.
	+1 (medium)	Has forest or woodland with only 1 species of known koala food tree present in the canopy.		
	0 (low)	None of the above.		
Habitat connectivity	+2 (high)	Area is part of a contiguous landscape ≥ 500 ha.	**2**	The Study Area borders the Worimi Regional Park and Worimi Conservation Lands that extend along the Stockton Bight to the north in Nelson Bay. Land to the south and east is fragmented.
	+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.	**1**	**Desktop:** A desktop search has failed to locate any reports on koala mortality from vehicle strike or dog attack within the local area. **On-ground:** It is expected that the local koala population is adversely affected by vehicle strike associated with Nelson Bay and by dogs
	+1 (medium)	Evidence of infrequent or irregular koala mortality		

Koala Habitat Assessment Tool (Table 4 from DoE 2014)			Study Area Assessment	
Attribute	**Score**	**Coastal**	**Allocated Score**	**Score Justification**
		from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence.		occurring in the local rural residential area.
	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.		
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.	**1**	**Desktop:** Table 1 of the 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." and "Maintain corridors and connective habitat that allow movement of koalas between large areas of habitat." Despite the small size of the koala habitat within the Study Area, surrounding connected habitats are likely to be important for the local koala population. The habitat present for the koala in the study area is consistent with this description. **On-ground:** No clearing of preferred koala habitat is proposed. Disturbance of buffer and supplementary habitat will not result in fragmentation of retained habitats and is not likely to influence the recovery objectives.
	+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			**7**	**≥ 5 indicates habitat critical for the survival of the koala.**

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