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Local Aboriginal Land Council
DARKINJUNG

DARKINJUNG LOCAL ABORIGINAL LAND COUNCIL

Addendum to the Motorway Link Industrial Subdivision Biodiversity Certification Assessment Report

FINAL

January 2020

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Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Darkinjung Local Aboriginal Land Council

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Report No. 4567/R06
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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
1	Allison Riley/Ryan Parsons	2 July 2019	Les Seddon	9 July 2019
2	Allison Riley	11 October 2019	Allison Riley	11 October 2019
3	Kate Connolly	10 January 2020	Kate Connolly	10 January 2020
4	Kate Connolly	22 January 2020	Kate Connolly	22 January 2020

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1.0 Introduction

1.1 Purpose and Scope of this Report

Darkinjung Local Aboriginal Land Council (Darkinjung LALC) is seeking an industrial rezoning and associated subdivision at part Lot 1, and Lots 2 and 3 DP 1156997 380 Motorway Link, Wallarah, New South Wales (NSW) (hereafter referred to as the 'proposal site').

Darkinjung LALC is seeking to have the proposed site rezoned from RU6 –Transition to IN1- General Industry and E2 Environmental Conservation.

GHD Pty Ltd (GHD) were previously engaged to conduct the ecological assessments for the Development Footprint and prepared a Biodiversity Certification Assessment Report (BCAR – GHD 2018, refer to **Appendix A**). Umwelt (Australia) Pty Limited (Umwelt) was then engaged by Darkinjung LALC to complete the remaining biodiversity surveys in 2019.

The Development Footprint is located along Motorway Link Wallarah, NSW (refer to **Figure 1.1** and **Figure 1.2**) in the Central Coast Local Government Area (LGA). The Development Footprint covers an area of approximately 45 hectares (ha) and is surrounded by a mosaic of intact native vegetation, rural landholdings and the Pacific Motorway to the west.

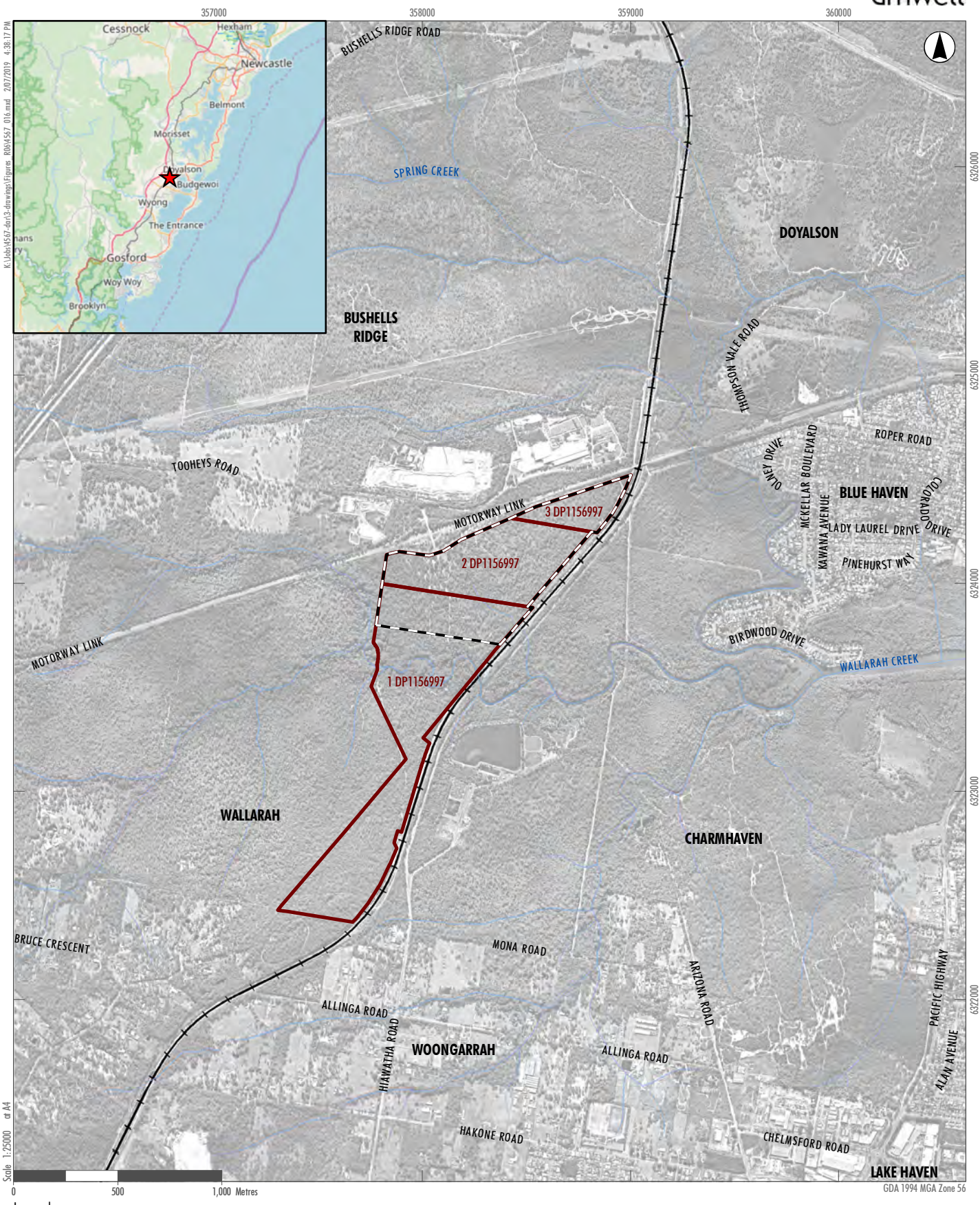
This report is therefore an Addendum to the GHD BCAR prepared in May 2018, and has been prepared by Umwelt to outline the surveys and results completed by Umwelt, in addition to those undertaken by GHD. It summarises the biodiversity impacts of the Industrial subdivision in accordance with the Biodiversity Assessment Method (BAM) under the *Biodiversity Conservation Act 2016* (BC Act).

Under the BC Act, options exist for the assessment and approval of biodiversity offsetting arrangements including standard biodiversity certification, strategic biodiversity certification or offsetting at the development application stage. Darkinjung LALC is yet to determine the method to be applied in this case. A BCAR framework has been used to assess biodiversity impacts and quantify potential offset obligations as part of the supporting information for the planning proposal.

Table 1.1 provides an outline of required BCAR sections and where these have been addressed in the GHD BCAR (GHD 2018) and Umwelt addendum report.

Table 1.1 Directory of Key BCAR Sections

Section	GHD BCAR (GHD 2018)	Umwelt Addendum Report
Introduction	Section 1	**Section 1.0**
Methodology	Section 2	**Section 2.0**
Landscape Features	Section 3.1	**Section 1.2**
Native vegetation	Section 3.2	**Section 3.1**
Threatened species	Section 4.2	**Section 3.2**
Avoiding and minimising impacts	Section 5.2 and 5.3	Summary in **Section 4.0**
Impact Summary	Section 5	Summary in **Section 4.0**
Offset Requirements and Strategy	Section 6 and 7	Preliminary offset strategy in **Section 5.0**
Biodiversity Credit Report	Appendix D	**Appendix B**



Legend

- Development Footprint
- Lots 1, 2 & 3 DP1156997
- Watercourses
- Main Northern Railway

FIGURE 1.1

Locality Plan

Image Source: Nearmap (May 2019); Open Street Map (2019) Data source: NSW LPI (2019)

Legend

- Development Footprint
- Lots 1, 2 & 3 DP1156997
- Watercourses
- Main Northern Railway

FIGURE 1.2

Development Footprint

Image Source: Nearmap (May 2019); Open Street Map (2019) Data source: NSW LPI (2019)

1.2 Development Footprint Information

The Development Footprint contains remnant vegetation adjacent to existing disturbances such as rural-residential land and major roadways and rail lines. Intact vegetation is generally in moderate to good condition. Some areas, such as along internal tracks, contain small outbreaks of exotic plant species and disturbances such as rubbish. Landscape details are outlined in **Table 1.2** and **Figure 1.3**.

Table 1.2 Development Footprint Location in the Landscape

Development Footprint Location in the Landscape	
IBRA Bioregion	Sydney Basin
IBRA Subregion	Wyong
Mitchell Landscape	Sydney-Newcastle Coastal Alluvial Plains and Gosford-Cooranbong Coastal Slopes
LGA	Central Coast
Development Footprint Size	45 ha
Assessment Type	Site-based
Lot and DP	Part Lot 1, and Lots 2 and 3 DP 1156997
Connectivity Features	The Development Footprint is located within the corridor identified in the Central Coast Regional Plan 2036 (DPE 2016) as connecting the coast to the foothills and providing an inter-regional landscape break.

1.3 Report Preparation

This BCAR was prepared by Philippa Fagan (Ecologist), with review and technical direction from Kate Connolly (Principal Ecologist), Ryan Parsons (Principal Ecologist) and Allison Riley (NSW Ecology Manager). Field surveys were undertaken by a range of suitably qualified and experienced ecologists from Umwelt and GHD.

Table 1.3 below outlines the details of the Umwelt Accredited BAM Assessors involved in the survey, calculations and reporting for the Project.

Table 1.3 Accredited BAM Assessors and their Role on this Project

Name	Assessor ID	Role
Kate Connolly **Principal Ecologist**	BAAS17005	Project manager and review
Allison Riley ***NSW Ecology Manager***	BAAS17042	Review and technical direction
Ryan Parsons ***Principal Ecologist - Botanist***	BAAS17048	Review and technical direction
Philippa Fagan ***Ecologist - Botanist***	BAAS18117	BCAR preparation Field Surveys

1.4 Key Resources, Policies and Documents

The following key resources, policies and documents were used during the preparation of this BCAR:

- Biodiversity Assessment Method Order 2017 (OEH 2017)
- Biodiversity Assessment Method Operational Manual (Stage 1) (OEH 2018a)
- Biodiversity Assessment Method Calculator (Version 8).
- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities –Working Draft (DEC 2004)
- BioNet Atlas of NSW Wildlife database and mapping tool (OEH 2019a), accessed May 2019
- Threatened Biodiversity Data Collection (TBDC) (OEH 2019b), accessed May 2019
- Vegetation Information System (VIS) Classification Database (OEH 2019c), accessed May 2019
- NSW Guide to Surveying Threatened Plants (OEH 2016) and
- Department of the Environment and Energy (DoEE) Protected Matters Search Tool (DoEE 2019), accessed May 2019.

1.5 Summary of GHD Biodiversity Assessment

GHD was engaged by Darkinjung LALC to prepare a BCAR for the development footprint. Surveys undertaken by GHD are summarised in **Table 1.4**.

Table 1.4 Summary of GHD (and EcoLogical 2012) survey effort

Stage	Date	Survey Technique
Preliminary investigation of biodiversity values	October 2010-2012 (EcoLogical 2012)	Vegetation mapping Biometric plots Targeted threatened fauna surveys (including hair tubes, pitfall trapping, ultrasounds bat call recording, stag watching, call playback, bird surveys)
Targeted threatened flora survey	27-28 October 2016	Targeted *Tetratheca juncea, Acacia bynoeana, Genoplesium insigne* and *Thelymitra adorata* surveys
Targeted threatened flora survey	4-5 December 2018	Targeted survey *Cryptostylis hunteriana* and *Genoplesium insigne*

Stage	Date	Survey Technique
Targeted threatened fauna surveys	22-26 January 2018	Arboreal elliot traps Spotlighting Call playback Stag watching Harp trapping Ultrasonic call recording Active searches for scats and signs Camera traps Habitat assessments
BAM plot surveys	12 April 2018	Six BAM plot surveys; targeted threatened flora surveys, opportunistic fauna observations; fauna habitat assessment.

Vegetation zones reported by GHD are summarised in **Table 1.5**.

Table 1.5 Vegetation zones reported by GHD

Plant Community Type	PCT ID	Area	Vegetation Integrity Score	Conservation Significance
Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland on lowlands of the Central Coast	1636	43.5	61.5	Not listed
Smooth- barked Apple, Red Mahogany – Swamp Mahogany – *Melaleuca sieberi* heathy swamp woodland of coastal lowlands	1649	1.5	58.4	Swamp Sclerophyll Forest EEC

Five species credit species were recorded by GHD and/or EcoLogical during targeted surveys:

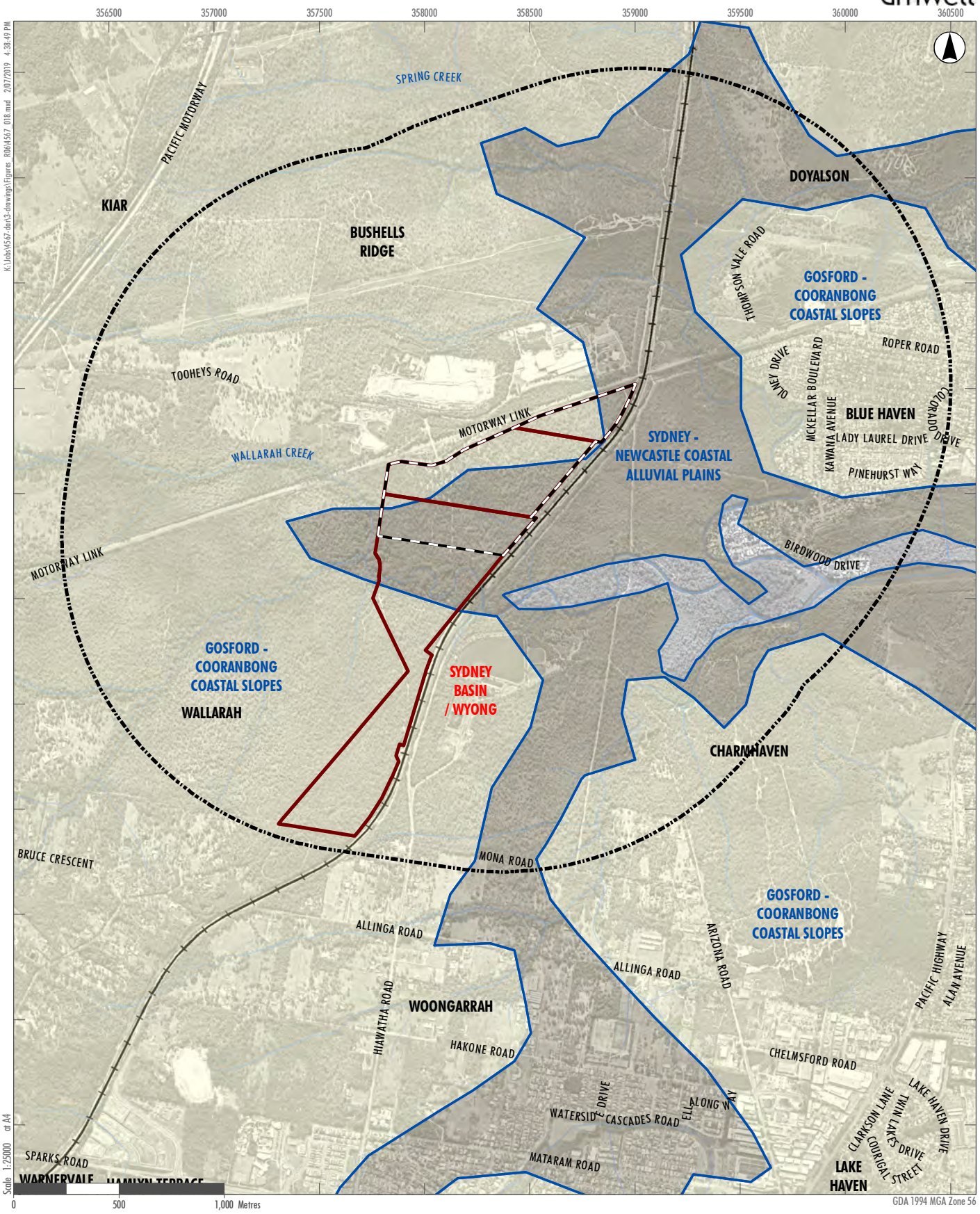
- *Tetratheca juncea* (black eyed Susan)
- *Angophora inopina* (Charmhaven apple)
- *Acacia bynoeana* (Bynoe's wattle)
- *Petaurus norfolcensis* (squirrel glider)
- *Crinnia tinnula* (wallum froglet) (recorded by EcoLogical 2010- 2012).

1.6 GHD Survey and Report Preparation

Field surveys were conducted and lead by accredited BAM assessors Gilbert Whyte and Arien Quin, and conducted by Gary Leonard, Bridie Halse, Emily Rindfliesh and Ben Lewis. Anabat analysis was completed by Craig Grabham. Credit calculations and reporting was performed by Arien Quin and peer reviewed by Dan Williams. Staff qualifications are presented in **Table 1.6**.

Table 1.6 Accredited BAM Assessors and their Role on this Project

Name	Project Role	Qualifications
Dan Williams	Principal Ecologist, credit calculations and report review	B. App. Sc. Cons Tech BAM accredited Assessor
Arien Quin	Senior Ecologist, BAM Plots, vegetation mapping, credit calculations, reporting	BA, BSc BAM accredited Assessor
Gilbert Whyte	Senior ecologist, targeted threatened species surveys	BEnv Sc, PHD, BA, BSc BAM accredited Assessor



Legend

- Development Footprint
- Lots 1, 2 & 3 DP1156997
- Watercourses
- Main Northern Railway
- 1500m Site Buffer

Mitchell Landscapes

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

IBRA Region / Sub Region

- Sydney Basin / Wyong

FIGURE 1.3

Landscape Features

Image Source: Nearmap (May 2019); Open Street Map (2019) Data source: NSW LPI (2019)

2.0 Methods

2.1 Gap Analysis

In 2018, GHD completed the majority of flora and fauna surveys as required by the BAM under the BC Act. Umwelt also completed surveys within the study area during summer (February) and spring (September) 2018. Umwelt completed the required surveys for the Wallarah site in May 2019.

Table 2.1 outlines the species-credit species predicted to occur by the BAM calculator or identified in the Development Footprint through the literature review and the targeted survey effort undertaken in accordance with BAM survey requirements. This table also notes where species-credit species were not considered to require further survey in accordance with Section 6.4 (Step 3) of the BAM (2017).

Table 2.1 Species credit species survey methodology and timing

Species	BAM Survey Period	GHD Survey Method(s)	Umwelt Survey Method(s)
Acacia bynoeana **Bynoe's Wattle**	September - March	Targeted threatened species transects during October 2016	Targeted threatened species transects during September 2018 and February 2019
Angophora inopina **Charmhaven Apple**	All year	Targeted threatened species transects during October 2016 and December 2018	Targeted threatened species transects during September 2018 and February 2019
Astrotricha crassifolia **Thick- leaf Star- hair**	All year	Targeted threatened species transects during October 2016 and December 2018	Targeted threatened species transects during September 2018 and February 2019
Anthochaera Phrygia **Regent Honeyeater**	NA OEH advised that the Development Footprint will not trigger the important habitat map for the regent honeyeater and the species can therefore be assessed as part of ecosystem credit requirements. Therefore no further assessment of this species is required.	-	-
Burhinus grallarius **Bush Stone- curlew**	All year	Spotlighting and Camera traps (22 – 26 January 2018)	Species not seen or heard during any surveys in September 2018, February or May 2019
Callistemon linearifolius **Netted Bottlebrush**	September - March	Targeted threatened species transects during October 2016	Targeted threatened species transects during September 2018 and February 2019
Callocephalon fimbriatum **Gang- gang Cockatoo**	October – January	Diurnal bird surveys (22 – 26 January 2018)	Habitat assessments and diurnal bird surveys (13, 14 and 16 May 2019)
Calyptorhynchus lathami **Glossy Black- cockatoo**	May – August	-	Habitat assessments, hollow inspections and diurnal bird surveys (13, 14 and 16 May 2019)
Cercartetus nanus **Eastern Pygmy Possum**	October – March	Spotlighting (22 -26 January 2018) Camera traps (22 – 26 January 2018)	-
Chalinolobus dwyeri **Large- eared Pied- bat**	September – March	Harp trapping (22 – 26 January 2018)	Breeding habitat assessments (13, 14 and 16 May 2019)

Species	BAM Survey Period	GHD Survey Method(s)	Umwelt Survey Method(s)
Crinia tinnula **Wallum Froglet**	All year	Spotlighting and nocturnal amphibian surveys (22 – 26 January 2018)	-
Cryptostylis hunteriana **Leafless Tongue Orchid**	November - February	Targeted threatened species transects during December 2018	Targeted threatened species transects during February 2019
Diuris praecox **Rough Doubletail**	July - August	Targeted threatened species transects on 2 August 2018. The north eastern portion of the site and disturbed tracks were targeted. This was not reported in the GHD BCAR, as this report was issued prior to these surveys being undertaken. Therefore, Umwelt have been provided these tracks by GHD, which have been reproduced in **Section 1.1**.	-
Eucalyptus camfieldii **Camfield's Stringybark**	All year	Targeted threatened species transects during October 2016 and December 2018	Targeted threatened species transects during September 2018 and February 2019
Genoplesium insigne **Variable Midge Orchid**	September - October	Targeted threatened species transects during October 2016	Targeted threatened species transects during September 2018
Grevillea parviflora **subsp. *parviflora*** **Small- flower Grevillea**	All year	Targeted threatened species transects during October 2016 and December 2018	Targeted threatened species transects during September 2018 and February 2019
Halieaeetus leucogaster **White- bellied Sea- eagle**	July – December	-	Searches for stick nests (26 and 27 September 2018, and 11 February 2019) Habitat assessments (13, 14 and 16 May 2019)
Heleioporus australiacus **Giant Burrowing Frog**	September – May	Habitat Assessments, Spotlighting and Nocturnal amphibian surveys (22 – 26 January 2018)	-
Hieraaetus morphnoides **Little Eagle**	August – October	Habitat assessments (22 – 26 January 2018)	Searches for stick nests (26 and 27 September 2018, and 11 February 2019) Habitat assessments (13, 14 and 16 May 2019)
Hoplocephalus bitorquatus **Pale- headed Snake**	November – March	Spotlighting (22 -26 January 2018)	-

Species	BAM Survey Period	GHD Survey Method(s)	Umwelt Survey Method(s)
Lathamus discolour **Swift Parrot (Breeding)**	N/A OEH advised that the development areas will not trigger the important habitat map for the swift parrot and the species can therefore be assessed as part of ecosystem credit requirements. Therefore no further assessment of this species is required.	-	-
Litoria aurea **Green and Golden Bell Frog**	November – March	Nocturnal amphibian surveys (22 – 26 January 2018)	-
Litoria brevipalmata **Green- thighed Frog**	October – March	Habitat assessments and Nocturnal amphibian surveys (22 – 26 January 2018)	-
Litoria littlejohni **Littlejohn's tree frog**	July – November	-	Habitat assessments (13, 14 and 16 May 2019)
Lophoictinia isura **Square- tailed Kite**	September – January	Diurnal bird surveys (22 – 26 January 2018)	Searches for stick nests (26 and 27 September 2018, and 11 February 2019)
Melaleuca groveana **Grove's Paperbark**	All year	Targeted threatened species transects during October 2016 and December 2018	Targeted threatened species transects during September and February
Miniopterus australis **Little Bentwing- bat**	December – February	Spotlighting and Harp trapping (22 – 26 January 2018)	Breeding habitat assessments (13, 14 and 16 May 2019)
Miniopterus schreibersii oceanensis **Eastern Bentwing- bat**	November – February	Spotlighting and Harp trapping (22 – 26 January 2018)	Breeding habitat assessments (13, 14 and 16 May 2019)
Myotis macropus **Southern Myotis**	November – March	Spotlighting and Harp trapping (22 – 26 January 2018)	-
Ninox connivens **Barking Owl (breeding)**	May – December	Call playback and Spotlighting (22 -26 January 2018)	Call playback, Spotlighting and Stag- watching (13, 14 and 16 May 2019)

Species	BAM Survey Period	GHD Survey Method(s)	Umwelt Survey Method(s)
Ninox strenua **Powerful Owl (breeding)**	May – August	Habitat assessment (22 -26 January 2018)	Call playback, Spotlighting and Stag- watching (13, 14 and 16 May 2019)
Pandion cristatus **Eastern Osprey**	April – November	-	Searches for stick nests (26 and 27 September 2018, and 11 February 2019) Habitat assessments and Stick nest searches (13, 14 and 16 May 2019)
Petalura gigantea **Giant Dragonfly**	December – January	Habitat assessment (22 -26 January 2018)	-
Petaurus norfolcensis **Squirrel Glider**	All year	Spotlighting (22 -26 January 2018) Camera traps (22 – 26 January 2018)	Spotlighting (13, 14 and 16 May 2019)
Petrogale penicillata **Brush- tailed Rock Wallaby**	N/A No suitable habitat	-	-
Phascogale tapoatafa **Brush- tailed Phascogale**	All year	Arboreal Elliot Traps and Camera traps (22 – 26 January 2018)	Spotlighting (13, 14 and 16 May 2019)
Phascolarctos cinereus **Koala**	All year	Spotlighting, Camera traps and Searches for scats and signs (22 – 26 January 2018)	Spotlighting (13, 14 and 16 May 2019)
Planigale maculata **Common Planigale**	All year	Arboreal elliot traps and Camera traps (22 -26 January 2018)	-
Prostanthera askania **Tranquility Mintbush**	September - December	Targeted threatened species transects during October 2016	Targeted threatened species transects during September 2018
Pteropus poliocephalus **Grey- headed Flying- fox**	October – December	Spotlighting (22 -26 January 2018)	Searches for camps (13, 14 and 16 May 2019)
Rutidosis heterogama **Heath Wrinklewort**	All year	Targeted threatened species transects during October 2016 and December 2018	Targeted threatened species transects during September 2018 and February 2019
Tetratheca glandulosa	July - November	Targeted threatened species transects during October 2016	Targeted threatened species transects during September 2018
Tetratheca juncea **Black- eyed Susan**	July - December	Targeted threatened species transects during October 2016 and December 2018	Targeted threatened species transects during September 2018

Species	BAM Survey Period	GHD Survey Method(s)	Umwelt Survey Method(s)
Tyto novaehollandiae **Masked Owl (breeding)**	May – August	Call playback and Spotlighting (22 -26 January 2018)	Call playback, Spotlighting and Stag- watching (13, 14 and 16 May 2019)
Tyto tenebricosa **Sooty Owl (breeding)**	May – August	Habitat assessments (22 -26 January 2018)	Call playback, Spotlighting and Stag- watching (13, 14 and 16 May 2019)
Uperoleia mahonyi **Mahony's Toadlet**	October – March	Habitat assessments, Nocturnal amphibian surveys and Spotlighting (22 -26 January 2018)	-

2.2 Umwelt Survey Methodology

2.2.1 Literature and Database Review

A review of previous documents and reports relevant to the Project was undertaken. This included ecological reports, previous ecological surveys undertaken in the vicinity of the Development Footprint and also relevant ecological database searches. The information obtained was used to inform survey design where required and was also used to assist in the assessment of potentially occurring ecosystem-credit and species-credit species. Relevant documents and resources included:

- Darkinjung Local Aboriginal Land Council: Motorway Link Industrial Subdivision Biodiversity Certification Assessment Report (GHD 2018)
- OEH BioNet Atlas of NSW Wildlife database and mapping tool (OEH 2019a), accessed March 2019
- OEH Threatened Biodiversity Data Collection (OEH 2019b) for known/predicted threatened species in the Wyong IBRA subregion, accessed March 2019
- PlantNET (Botanic Gardens Trust 2019) database search for threatened plants within a 10 km radius of the site, accessed March 2019
- DoEE Protected Matters Search Tool (DoEE 2019) for known/predicted EPBC Act-listed species, accessed March 2019
- VIS Classification Database (OEH 2019c), accessed April 2019.

The results of these database searches, literature review and TBDC review were used to review and design the appropriate survey requirements for remaining species-credit species.

2.2.2 Umwelt Field Survey

Fauna surveys, habitat assessments and vegetation mapping review was undertaken by Umwelt over the following survey periods, and is detailed in **Figure 2.1**:

- 26 and 27 September 2018
- 11 February 2019 and
- 13, 14 and 16 May 2019.

2.2.3 Vegetation Mapping

Vegetation mapping was undertaken by GHD during field surveys in 2018 (refer to GHD 2018). Umwelt ground-truthed this vegetation mapping using the following key steps as part of the May 2019 surveys.

2.2.4 Plant Community Type (PCT) Allocation

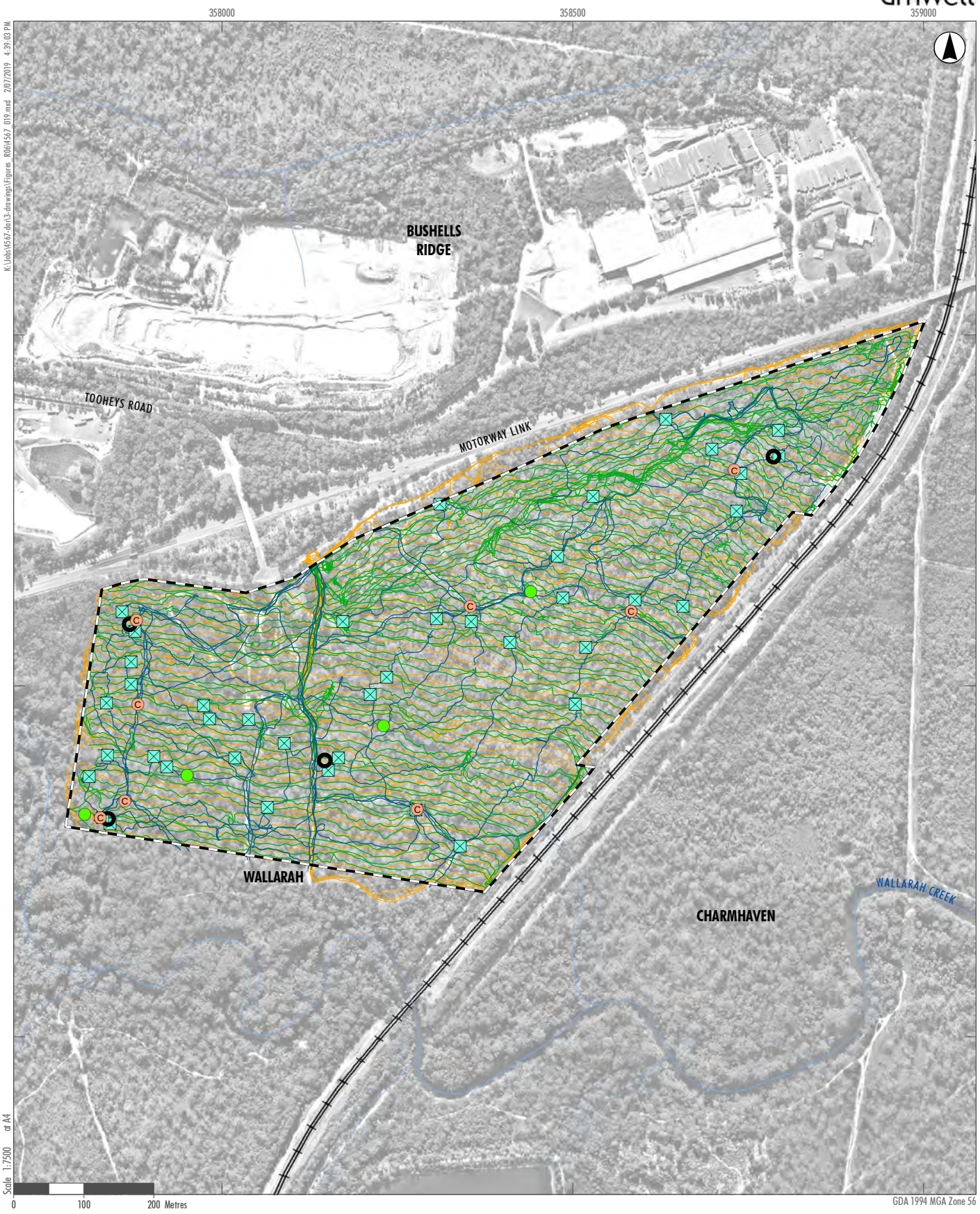
Each of the plant community types (PCTs) described within the Development Footprint by GHD were verified by Umwelt during field surveys. For each vegetation community described, the profiles for each of the PCTs were interrogated and the selection of PCT verified, based on the dominant species observed in each stratum layer by Umwelt and the floristic plot data recorded by GHD (2018).

Further detail regarding this allocation for individual PCTs is outlined in **Section 3.1.1**.

2.2.5 Threatened Ecological Community Delineation Techniques

PCTs in the Development Footprint were compared to TECs listed under the Commonwealth EPBC Act and NSW BC Act. An assessment of similarity with the NSW Scientific Committee Final Determinations was undertaken, as well as the Commonwealth Threatened Species Scientific Committee Listing and Conservation Advice. The following approach was used:

- analysis of GHD floristic plot assessments
- comparison with published species lists, including lists of 'important species' as identified on the listing advice provided by the NSW Scientific Committee and/or Commonwealth Threatened Species Scientific Committee
- comparison with habitat descriptions and distributions for listed TECs
- assessment using guidelines published by the Commonwealth Department of Environment and Energy (DoEE) and the NSW OEH
- comparison with other assessments of TECs in the region.



Legend

- Development Footprint
- Watercourses
- Main Northern Railway
- Call Playback Locations
- Stag Watch
- Rapid Assessment Locations
- Hollow Bearing Trees
- May 2019 Survey Tracklog
- Spring 2018 Flora Survey Tracklog
- Summer 2019 Flora Survey Tracklog

FIGURE 2.1

Survey Effort

Image Source: Nearmap (May 2019); Open Street Map (2019) Data source: NSW LPI (2019)

2.2.6 Ecosystem-credit Species

Ecosystem-credit species are those threatened species that can be predicted by vegetation surrogates and landscape features. Ecosystem-credit species are not required to be specifically targeted during field surveys, however an assessment of the suitability of habitat in the Development Footprint is undertaken to determine the species presence or otherwise in the vegetation zones identified.

Table 4-1 within the GHD BCAR outlines the ecosystem credit species predicted by the BAM calculator or identified in the literature review.

2.2.7 Species-credit Species

Targeted and opportunistic surveys and walking transects for species-credit species were undertaken across the Development Footprint (refer to **Figure 2.1**).

Species-credit surveys considered the following survey guidelines:

- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* – Working Draft (DEC 2004)
- *NSW Guide to Surveying Threatened Plants* (OEH 2016)
- *Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians* (DECC 2009)
- *Draft Survey Guidelines for Australia's Threatened Orchids* (DoE 2013).

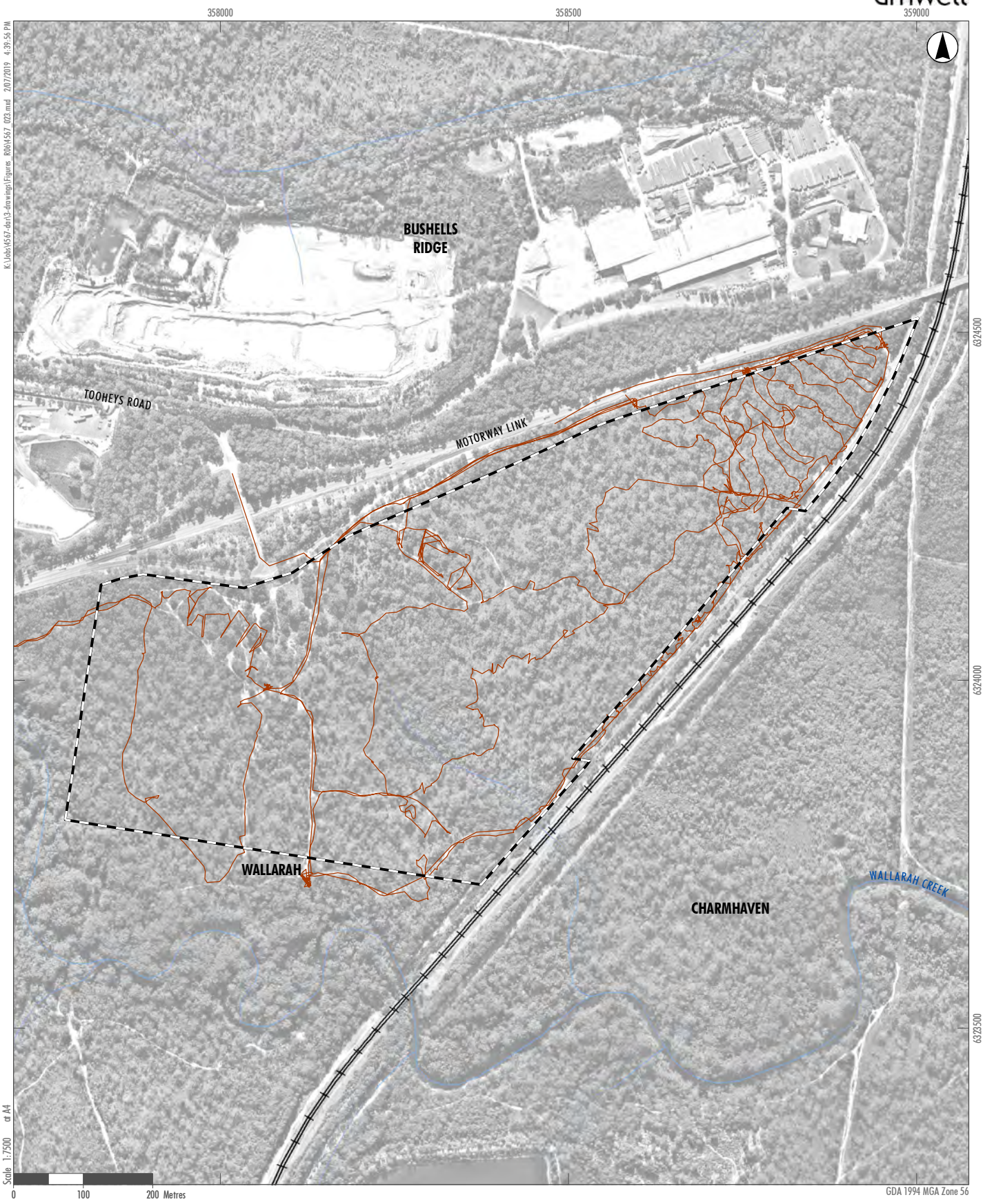
Further to the surveys undertaken by Umwelt, targeted threatened species transects on 2 August 2018 were undertaken by GHD. The north eastern portion of the site and disturbed tracks were targeted. This was not reported in the GHD BCAR, as this report was issued prior to these surveys being undertaken. Therefore, Umwelt have been provided these tracks by GHD, which have been reproduced on **Figure 2.2**.

2.2.8 Targeted and Meandering Transects

Targeted transects for threatened floristic species were conducted on the site during the months of September 2018 and February 2019, targeting the flowering periods of prospective threatened species. Transects were walked by two ecologists in parallel traverses ten metres apart in suitable habitat, during which the vegetation was continually searched for threatened species.

Meandering transects were walked across the entirety of the Development Footprint during targeted flora surveys, and the majority of the Development Footprint during fauna habitat assessments or targeted fauna surveys in May 2019. Opportunistic sampling of vegetation was undertaken along these transects, particularly searches for threatened or otherwise significant species, endangered populations and TECs.

Meandering transects provided invaluable information on spatial patterns of vegetation that informed confirmation of the existing vegetation community mapping of the Development Footprint.



Legend

- Development Footprint
- GHD Survey Effort for *Diuris praecox*
- Watercourses
- Main Northern Railway

FIGURE 2.2

GHD Survey Effort for *Diuris praecox*

Image Source: Nearmap (May 2019); Open Street Map (2019) Data source: NSW LPI (2019); GHD (May 2018)

2.2.9 Call Playback

Call- playback was undertaken for barking owl (*Ninox connivens*), powerful owl (*Ninox strenua*), masked owl (*Tyto novaehollandiae*) and sooty owl (*Tyto tenebricosa*) over three nights during May 2019 within the Development Footprint. This involved playing the call of the species for five minutes, followed by a listening period of five minutes. Opportunistic observations were completed throughout all Umwelt survey periods.

Surveys were also undertaken to the south of the Development Footprint over two nights during August 2018 within the riparian vegetation for a separate project.

If any species were heard or seen, call playback was immediately ceased to prevent disturbance to the lifecycle of these species.

2.2.10 Spotlighting

Nocturnal spotlighting searches were undertaken over three nights in May 2019 in suitable habitat between sunset and midnight using 30 watt hand-held spotlights and head torches.

2.2.11 Habitat Assessments

Habitat assessments and targeted searches were conducted in May 2019 over 2 days to identify potential breeding habitat available for the four owl species mentioned above, as well as glossy black- cockatoo (*Callocephalon fimbriatum*) and gang- gang cockatoo (*Calyptorhynchus lathami*) across the Development Footprint. This was conducted by walking transects across the study area approximately 20 m apart and specifically targeting very large trees (> 60 cm diameter) in search of suitable hollows. Glossy black-cockatoos typically utilise hollows greater than 15 cm diameter that are situated higher than 5 m off the ground, while gang-gang cockatoos typically utilise hollows greater than 9 cm diameter at a similar height. Therefore, any hollows meeting these requirements were recorded and inspected visually for any evidence of occupation (e.g. whitewash, owl pellets, chewing around entrance, sounds).

Habitat assessments were also conducted within the Development Footprint for littlejohn's tree frog (*Litoria littlejohni*) which requires permanent or ephemeral wet areas.

2.2.12 Stag - watching

Several suitable hollows (larger than 20 cm) were stagwatched at dusk during May 2019. Observers were in place at least fifteen minutes prior to sunset and continued to watch the hollow until one hour after sunset. Anything entering or exiting the hollow was recorded.

2.2.13 Microbat Habitat Assessments

Habitat assessments for suitable breeding habitat for large- eared pied bat (*Chalinolobus dwyeri*), little bentwing- bat (*Miniopterus australis*) and eastern bentwing- bat (*Miniopterus schreibersii oceanensis*) were conducted over two days in May 2019. Suitable breeding habitat includes caves, scarps, rocky areas, overhangs, crevices, cliffs, escarpments or old mines.

2.2.14 Weather Conditions

Table 2.2 below outlines the weather conditions for the Umwelt fauna surveys. Data is derived from the Central Coast weather station at Lake Macquarie (061412) from the Bureau of Meteorology (2019).

Table 2.2 Weather Conditions for Fauna Surveys

Date	Daily Data			Monthly Data		
	Min-Max Temp.	Rainfall (mm)	Relative Humidity (%)	Min-Max Temp (mean)	Rainfall (total) (mm)	Relative Humidity (mean) (%)
13 May 2019	13.6-19.4	0	57	7.1-21.9	14.0	61.5
14 May 2019	13.0-19.8	2.4	62			
16 May 2019	7.0-18.7	0	64			

3.0 Results

3.1 Native Vegetation within the Development Footprint

3.1.1 Plant Community Types and Vegetation Zones

Surveys of the Development Footprint by GHD (2018) identified two Plant Community Types (PCTs) and one condition class (refer to **Figure 3.1**). Umwelt confirmed these PCTs during their surveys in 2019, and detailed descriptions of these PCTs can be found in the GHD BCAR for the site (GHD 2018). These are:

- PCT1636 Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodlands on lowlands of the Central Coast (good condition)
- PCT1649 Smooth- barked Apple – Red Mahogany – Swamp Mahogany – *Melaleuca sieberi* heathy swamp woodland of coastal lowlands (good condition).

Umwelt assessed the areas of the vegetation communities mapped by GHD and found that the total areas of each vegetation community had been incorrectly reported and entered into the BAM Calculator. It appears that the areas of tracks and cleared areas had not been deducted from the total area of vegetation. As a result, Umwelt have adjusted the total areas of vegetation communities, and updated the areas within the BAM Calculator, with vegetation integrity scores provided in **Table 3.1**.

Table 3.1 Vegetation communities within the Development Footprint

PCT Name	Area (ha)	Composition	Structure	Function	Current Vegetation Integrity Score
PCT1636 Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodlands on lowlands of the Central Coast (good condition)	41.4	68.3	71.3	47.7	61.5
PCT1649 Smooth-barked Apple – Red Mahogany – Swamp Mahogany – *Melaleuca sieberi* heathy swamp woodland of coastal lowlands (good condition).	1.4	70.4	78.0	36.3	58.4

Legend

- Development Footprint
- Watercourses
- Main Northern Railway

Plant Community Types (GHD - May 2018)

- PCT 1636 Scribbly Gum-Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast
- PCT 1649 Smooth-barked Apple - Red Mahogany - Swamp mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands

FIGURE 3.1

Plant Community Types

Image Source: Nearmap (May 2019); Open Street Map (2019) Data source: NSW LPI (2019); GHD (May 2018)

3.1.2 Exotic Vegetation

The Development Footprint contains very few exotic species, and no areas have been mapped as exotic vegetation. A number of weeds recorded by GHD in the Development Footprint are classed as High Threat Weed species under the BAM, including whisky grass (*Andropogon virginicus*) and Rhodes grass (*Chloris gayana*), and are identified in the flora species list in Appendix C of the GHD BCAR (GHD 2018).

3.1.3 Threatened Ecological Communities

As per the assessment undertaken by GHD (2018), PCT 1649 Smooth- barked Apple – Red Mahogany – Swamp Mahogany – *Melaleuca sieberi* Heathy Swamp Woodland of Coastal Lowlands is considered to be consistent with Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions, listed as an Endangered Ecological Community under the BC Act.

3.2 Threatened Species

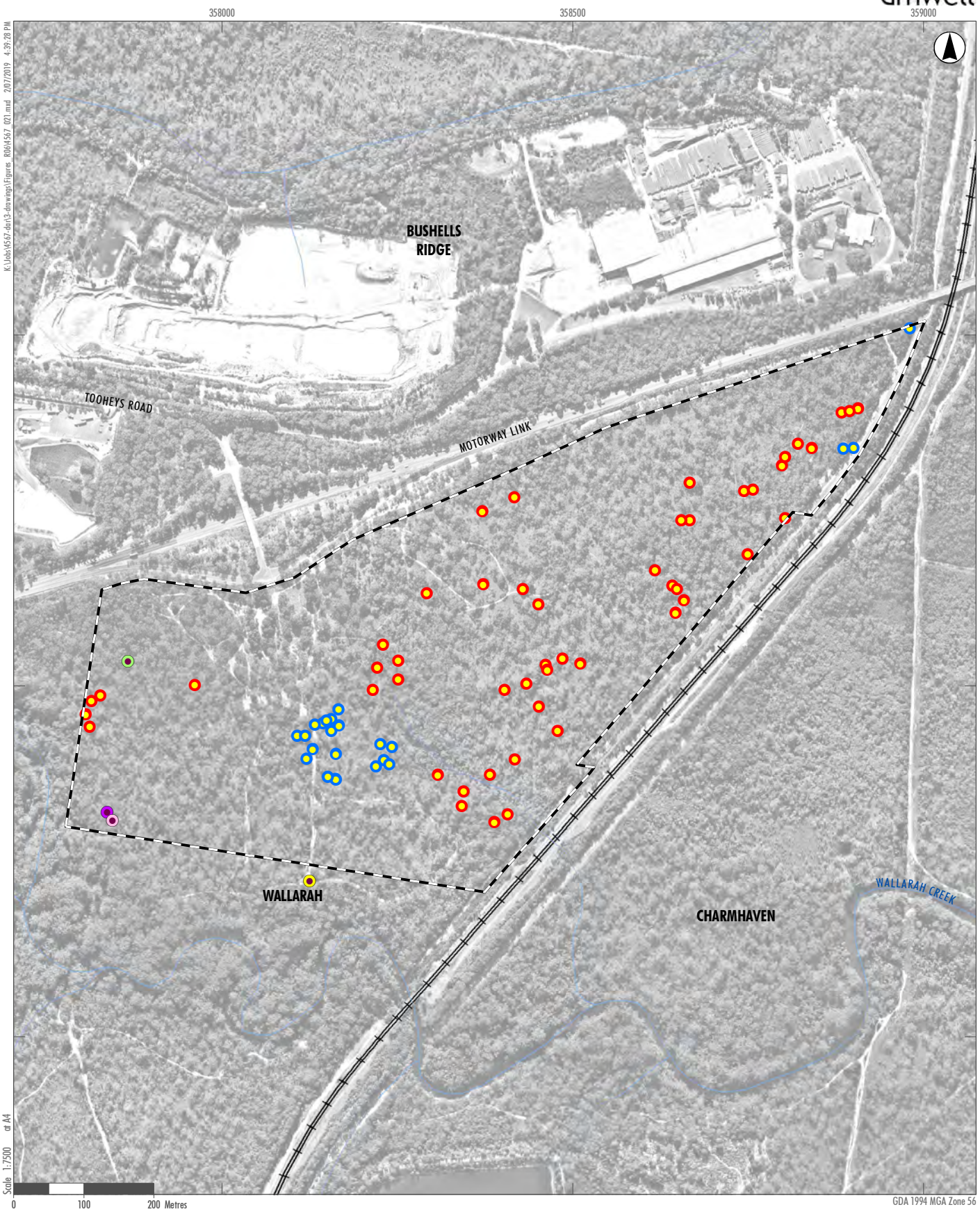
3.2.1 Ecosystem-credit Species

A list of the ecosystem-credit species predicted to occur by the BAM Calculator and/or the literature review in the vegetation zones within the Development Footprint is provided in Table 4-1 within the GHD BCAR (GHD 2018). Threatened ecosystem-credit species recorded by Umwelt are shown on **Figure 3.2** and presented in **Table 3.2**.

Table 3.2 Ecosystem-credit Species Recorded within the Development Footprint

Species	BC Act	EPBC Act	Species Presence	Umwelt Comment
varied sittella *Daphoenositta chrysoptera*	V	-	Yes (GHD 2018)	Five individuals detected during May 2019
little lorikeet *Glossopsitta pusilla*	V	-	Yes (GHD 2018)	-
eastern freetail- bat *Mormopterus norfolkensis*	V	-	Yes (GHD 2018)	No roosting habitat present
little bentwing- bat *Miniopterus australis*	V	-	Yes (GHD 2018)	No roosting habitat present
grey- headed flying- fox *Pteropus poliocephalus*	V	V	Yes (GHD 2018)	No camps present
barking owl *Ninox connivens*	V	-	Yes (no breeding detected)	One individual flew in and perched above observers during call- playback in May 2019. No evidence of nesting/breeding was detected in the Development Footprint, however there are many suitable hollows present (> 20 cm diameter and > 5 m high).

Species	BC Act	EPBC Act	Species Presence	Umwelt Comment
powerful owl ***Ninox strenua***	V	-	Yes (no breeding detected)	One individual was heard calling offsite during spotlighting in May 2019. No evidence of nesting / breeding was detected in the Development Footprint, however there are many suitable hollows present (> 20 cm diameter and > 5 m high).
masked owl ***Tyto tenebricosa***	V	-	Yes (GHD 2018 – no breeding detected)	No roosting or breeding habitat present
sooty owl ***Tyto tenebricosa***	V	-	Yes (no breeding detected)	One individual responded to call playback and was sighted during nocturnal surveys in August 2018. No evidence of nesting/ breeding was detected in the Development Footprint, however there are many suitable hollows present (> 20 cm diameter and > 5 m high).



Legend

- Development Footprint
- Watercourses
- Main Northern Railway

Umwelt Threatened Species Observations

- Charmhaven Apple (*Angophora inopina*)
- Black-eyed Susan (*Tetratheca juncea*)
- Sooty Owl (*Tyto tenebricosa*)
- Barking Owl (*Ninox connivens*)
- Powerful Owl (*Ninox strenua*)
- Varied Sittella (*Daphoenositta chrysoptera*)

FIGURE 3.2

Threatened Species

Image Source: Nearmap (May 2019); Open Street Map (2019) Data source: NSW LPI (2019); Eco Logical Australia (2012)

3.2.2 Species-credit Species

A list of the species-credit species predicted to occur by the BAM Calculator and/or the literature review and a discussion on their inclusion or exclusion from the calculator assessment is provided in **Section 2.1**.

Two species- credit species, Charmhaven apple (*Angophora inopina*) and black-eyed Susan (*Tetratheca juncea*), were detected in the Development Footprint by Umwelt during surveys in 2018 as shown in **Table 3.3** , with their associated species- credit species polygons detailed on **Figure 3.3**. Squirrel glider habitat mapping completed by GHD (2018) was updated by Umwelt and is also shown on **Figure 3.3**. In addition to this, GHD (2018) recorded habitat for Bynoe's wattle (*Acacia bynoeana*) and wallum froglet (*Crinia tinnula*) as detailed on **Figure 3.3**.

A further seven species-credit species were targeted during Umwelt surveys and are provided in **Table 3.4** however credits were not generated due to the absence of suitable habitat or no evidence of breeding detected. Potential breeding habitat for large forest owls was identified within the Development Footprint and a detailed targeted survey strategy devised and undertaken, including call playback, spotlighting and stag- watching over multiple nights. Whilst single barking owl, powerful owl, sooty owl and masked owl individuals were recorded in the Development Footprint, no evidence of breeding according to the TBDC (OEH 2019b) was recorded, which includes the presence of a male and female pair, pairs calling to each other (duetting) or presence of a nest, as detailed in **Table 3.4** below.

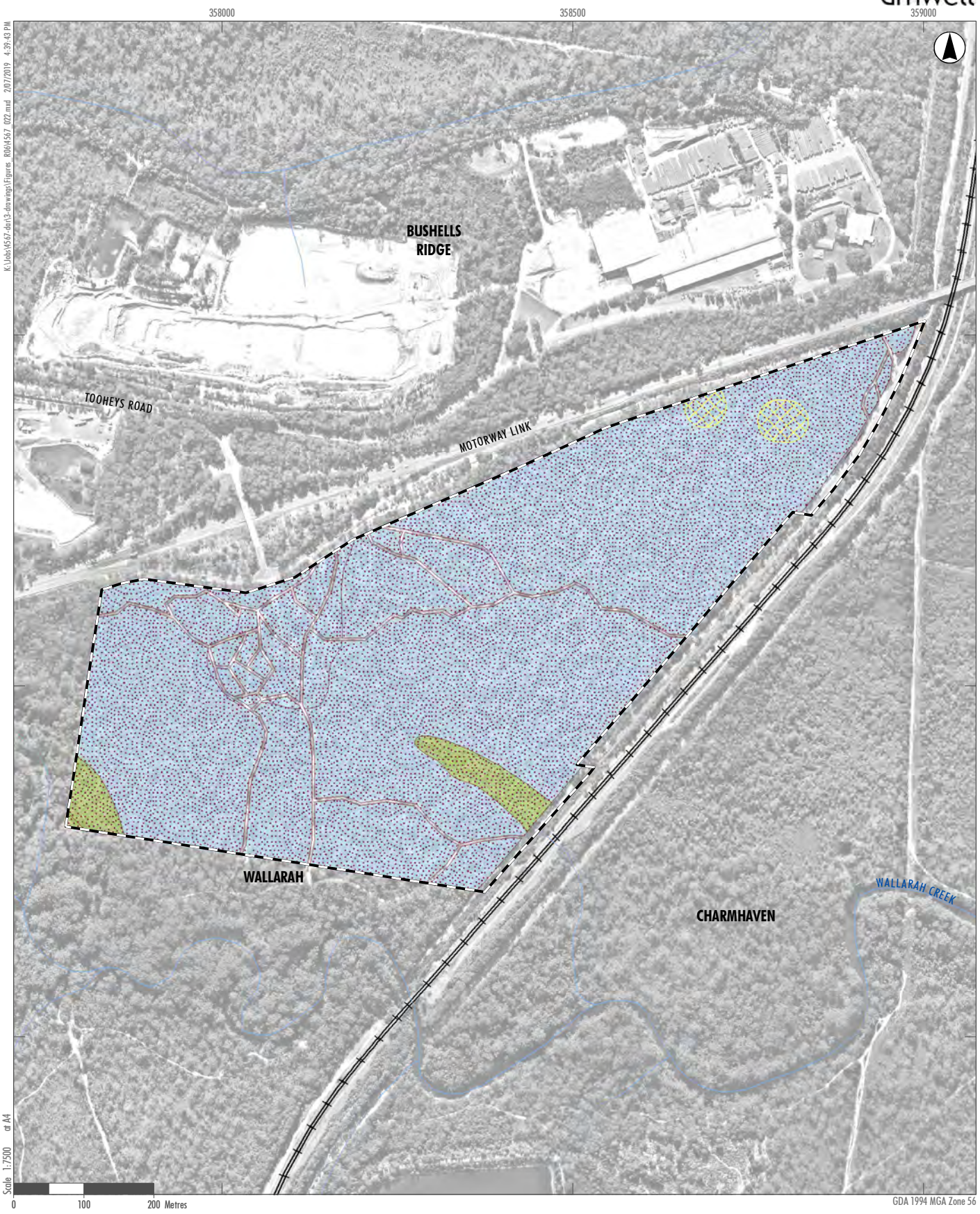
Table 3.3 Species-credit Species Recorded within the Development Footprint

Species	BC Act	EPBC Act	Species Presence	Comment
Bynoe's wattle *Acacia bynoeana*	E	V	Yes (detected by ELA 2012 and reported by GHD 2018)	13 individuals recorded by EcoLogical during targeted surveys in 2010-2012. Species habitat polygon generated by GHD (2018) and reproduced on **Figure 3.3** (0.6 ha within PCT 1636).
Charmhaven apple *Angophora inopina*	V	V	Yes	Species recorded during September 2018 across much of the Development Footprint. Species polygon aligns with PCT 1636 (41.4 ha) and is shown on **Figure 3.3**.
wallum froglet *Crinia tinnula*	V	-	Yes (detected by ELA 2012 and reported by GHD 2018)	Recorded by EcoLogical during targeted surveys in 2010-2012. Species polygon aligned with PCT 1649 (1.4 ha) and shown on **Figure 3.3**.
squirrel glider *Petaurus norfolcensis*	V	-	Yes (GHD 2018)	GHD previously mapped the species polygon for squirrel glider as pertaining only to PCT 1636. However, Umwelt believes that this species is also likely to utilise PCT 1649, due to the presence of Eucalypts and *Melaleuca* in this community. As a result, Umwelt have altered the species polygon to encompass 42.8 ha (total area of PCT 1636 and 1649). Refer to **Figure 3.3**.
black- eyed Susan *Tetratheca juncea*	V	V	Yes	Species recorded during September 2018 across much of the Development Footprint. Species polygon aligns with both PCTs 1636 and 1649 (42.8 ha) and is shown on **Figure 3.3**. GHD originally mapped the species habitat polygon for this species as aligning to only a small portion of the site (0.28 ha). However, a review of the distribution of this species across the Development Footprint, it is clear that it has been recorded by both GHD and Umwelt across the area in a range of habitat types. Therefore the Development Footprint is being mapped as a *Tetratheca juncea* habitat polygon.

Table 3.4 Species-credit Species Targeted by Umwelt within the Development Footprint

Species	BC Act	EPBC Act	Species Presence	Comment
glossy black- cockatoo *Callocephalon fimbriatum* (breeding habitat)	V	-	No	Species not previously surveyed for by GHD. Suitable hollows were watched for activity and inspected for signs of occupation. Species not detected during any surveys
gang- gang cockatoo *Calyptorhynchus lathami* (breeding habitat)	V	-	No	Species not previously surveyed for by GHD. Suitable hollows were watched for activity and inspected for signs of occupation. Species not detected during any surveys
Littlejohn's tree frog *Litoria littlejohni*	V	V	No	Species not previously surveyed for by GHD. Habitat assessments undertaken for this species Umwelt. Considered unlikely to occur given this species has not been recorded within 10 km according to NSW Atlas records and is not associated with the PCTs within the Development Footprint according to the TBDC.
barking owl *Ninox connivens* (breeding habitat)	V	-	Yes (no breeding habitat detected)	Species not previously surveyed for by GHD. One individual observed in the development footprint, however no evidence of breeding detected as part of call playback, spotlighting or stag- watching. According to the TBDC (OEH 2019b) '*Breeding can be identified by suitable habitat AND 1. presence of male and female or 2. calling to each other (duetting) or 3. find nest or 4. existing breeding habitat identified*'. None of these were identified as part of targeted surveys.
powerful owl *Ninox strenua* (breeding habitat)	V	-	Yes (no breeding habitat detected)	Species not previously surveyed for by GHD. One individual heard calling off site, however no evidence of breeding detected within the development footprint as part of call playback, spotlighting or stag-watching According to the TBDC (OEH 2019b) '*breeding can be identified by suitable habitat AND 1. presence of male and female or 2. calling to each other (duetting) or 3. find nest or 4. existing breeding habitat identified*'. None of these were identified as part of targeted surveys.

Species	BC Act	EPBC Act	Species Presence	Comment
sooty owl ***Tyto tenebricosa*** **(breeding habitat)**	V	-	Yes (no breeding habitat detected)	Species not previously surveyed for by GHD. One individual observed in the development footprint, however no evidence of breeding detected as part of call playback, spotlighting or stag-watching. According to the TBDC (OEH 2019b) species polygons for breeding habitat are required '*where a hollow bearing tree has been identified as a breeding site in accordance with the BAM*'. No evidence of breeding was detected within the Development Footprint.
masked owl ***Tyto novaehollandiae*** **(breeding habitat)**	V	-	Yes (GHD 2018)	Species reportedly responded to call playback by GHD (2018). No evidence of breeding detected by GHD or Umwelt within the development footprint. as part of call playback, spotlighting or stag-watching. According to the TBDC (OEH 2019b) species polygons for breeding habitat are required '*where a breeding site has been identified in accordance with the BAM*'. No evidence of breeding was detected within the Development Footprint.



Legend

- Development Footprint
- Watercourses
- Main Northern Railway
- *Acacia bynoeana* Habitat
- *Tetratheca juncea* and Squirrel Glider Habitat
- Wallum Froglet Habitat
- *Angophora inopina* Habitat

FIGURE 3.3

Species - Credit Species Polygons

Image Source: Nearmap (May 2019); Open Street Map (2019) Data source: NSW LPI (2019); GHD (May 2018)

4.0 Impact Assessment

Darkinjung have sought to avoid and minimise the potential impacts of the Project on ecological values primarily through site selection and through consideration of project design and scheduling of works. **Figure 4.1** below documents the final Development Footprint in relation to the biodiversity constraints that were considered by Darkinjung during the planning process.

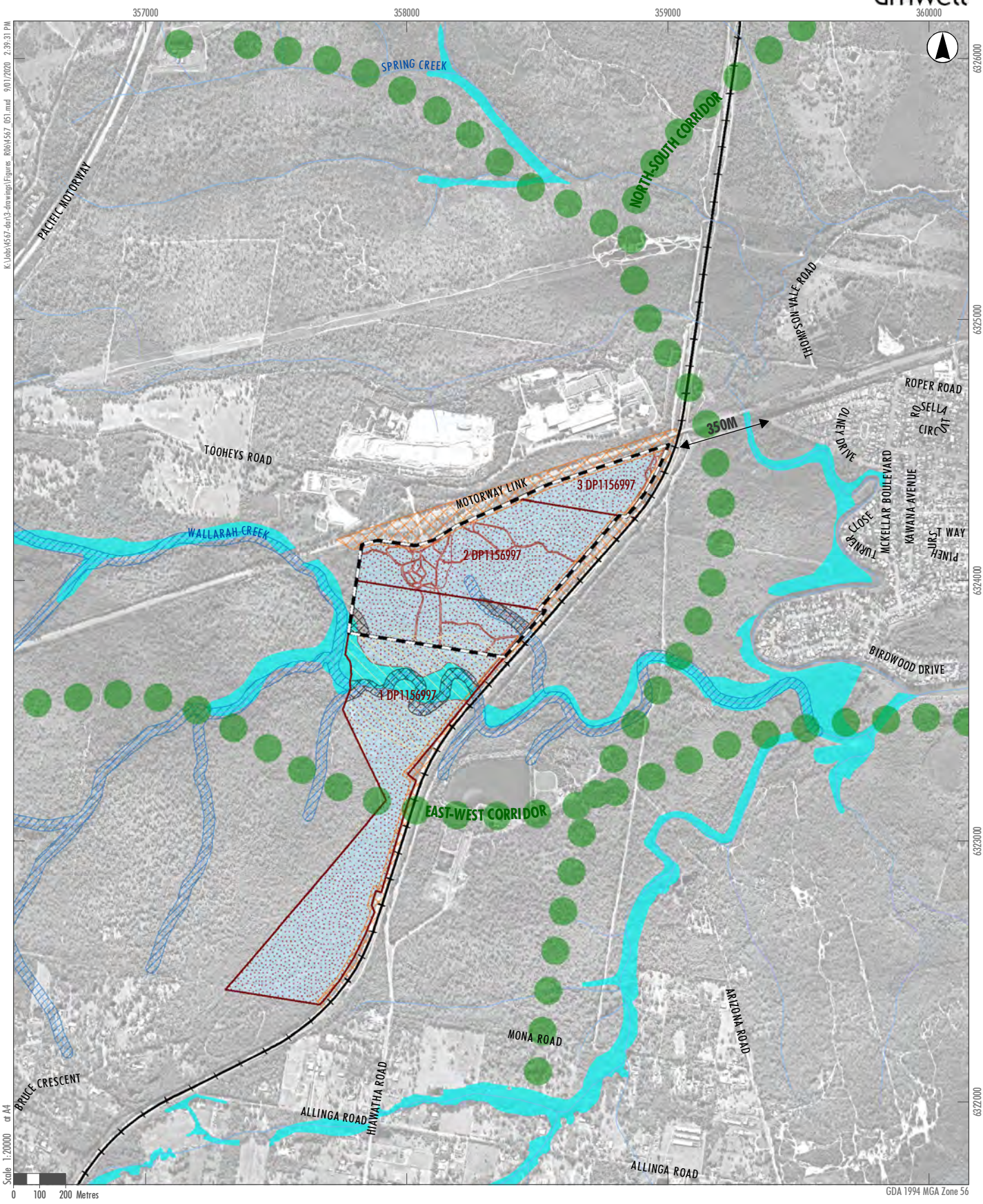
4.1 Impact Avoidance

Biodiversity surveys were initially conducted in the broader Wallarah land holding to identify biodiversity constraints and determine the most appropriate locations for future development. An Interim Ecological Inventory Report (EcoLogical 2012) was prepared to identify development opportunities and conservation outcomes on Darkinjung land holdings in relation to the North Wyong Structure Plan (Department of Planning 2010). EcoLogical (2012) identified the southern portion of the Wallarah land holding as a potential conservation area based on its ecological characteristics, while development was proposed for the northern portion of the site, adjacent to the Motorway Link road (EcoLogical 2012).

Subsequent survey and assessment of the site was undertaken by GHD (2018), conducting targeted survey and assessment in accordance with the BAM. The outcomes of the GHD and EcoLogical surveys were considered in development of the current planning proposal, to ensure that the most significant ecological values were avoided as part of the Project.

The Interim Ecological Inventory Report (EcoLogical 2012) and BCAR (GHD 2018) identified vegetation communities, including EECs, threatened flora species and threatened fauna species within the proposed development area and adjacent habitats within the Darkinjung Land holding to the south.

Following completion of field surveys further analysis of the most appropriate development footprint was undertaken with avoidance and minimisation of direct impacts on key biodiversity features a key consideration. The following sections detail the key decisions that relate to the avoidance and minimisation of impacts on biodiversity and the determination of the development footprint assessed by this biodiversity assessment and **Figure 4.1** shows the biodiversity values that were avoided as part of project design.



Legend

- Development Footprint
- Lots 1, 2 & 3 DP1156997
- Watercourses
- Main Northern Railway
- Vegetation Corridor Consideration
- Edge Effects Zone Considerations
- High HBT Zone Considerations
- Riparian Zone Considerations
- *Tetratheca juncea* and Squirrel Glider Habitat Considerations
- *Wallum froglet* Habitat Considerations
- *Angophora inopina* Habitat Considerations
- Swamp Sclerophyll Forest EEC (Bell 2009)

FIGURE 4.1

Biodiversity Constraints considered to inform Impact Avoidance and Mitigation Measures

Image Source: Nearmap (May 2019) Data source: Central Coast Regional Plan 2036 Biodiversity Corridors (NSW Government 2016); NSW LPI (2019)

A summary of the main points identified by GHD (2018) in former considerations of the biodiversity impacts of the Project has been provided in **Table 4.1**. Further project specific detail is provided in the sections below.

Table 4.1 Summary of Impact assessment as provided in Section 5.0 of GHD (2018)

Impact Assessment	Summary
Avoidance of Impacts	• Avoidance of impacts to areas of high conservation significance where possible • Concentration of the development footprint in the northern portion of the site immediately south of existing infrastructure • Use of existing road interchanges and frontage of Motorway Link Road
Minimisation of Impacts	• Construction Environmental Management Plan • Workers to be provided with an environmental induction • Vegetation clearing protocols and, pre- clearing assessments, soft- felling procedures and fencing around vegetation to be retained • Ecologist present during all vegetation clearing • Weed and pest species sub- management plan • Control of priority weeds • Erosion and sediment control plans and appropriate infrastructure implemented • Signposting • Water- sensitive urban design
Residual Impacts to be Offset	• Two native vegetation communities • Removal of habitat for five species-credit species
Prescribed Impacts	• No prescribed impacts anticipated (karst, caves, cliffs, other geological features of significance, human- made structures, or non- native vegetation). The only potential prescribed impact is to local and regional vegetation corridors, which is discussed in greater detail in **Sections 4.1.5** and **4.1.6** below. • No impacts on water quality or hydrological processes that sustain threatened species or threatened ecological communities are likely to occur.

4.1.1 Site Selection and Avoidance of Native Vegetation and Habitat

Whilst an alternative development footprint has not been provided, the placement of the current Development Footprint boundary has been developed to avoid and minimise direct, indirect and prescribed biodiversity impacts. Prescribed impacts set out in the BAM (OEH 2017) have been completely avoided by the Project.

Following the completion of the Interim Ecological Inventory Report (EcoLogical 2012) and BCAR (GHD 2018) a range of threatened flora and fauna species were identified within the proposed Development Footprint and on Darkinjung land holdings adjoining the site to the south. Key threatened species and threatened species habitat avoided include:

- Wallum froglet (*Crinia tinnula*)- listed as Vulnerable under the BC Act
- *Angophora inopina* - listed as Vulnerable under the BC Act and EPBC Act
- *Tetratheca juncea* - listed as Vulnerable under the BC Act and EPBC Act
- *Maundia triglochinoides* – listed as Vulnerable under the BC Act

- Black bittern (*Ixobrychus flavicollis*) – listed as Vulnerable under the BC Act
- Little lorikeet (*Glossopsitta pusilla*) – listed as Vulnerable under the BC Act
- Squirrel glider (*Petaurus norfolcensis*) - listed as Vulnerable under the BC Act
- Foraging and likely breeding habitat for the four large forest owls occurring in the Central Coast LGA - listed as Vulnerable under the BC Act

While not all of the threatened species and ecological communities could be wholly avoided by the proposed development, concentration of the proposed development impacts in the north of the site ensures that approximately 50% of the site is avoided.

4.1.2 Size

The Development Footprint is approximately 45 ha in area and represents approximately 50% of the total area of Lots 1, 2 and 3 DP 1156997. Darkinjung, during their planning process, have actively avoided direct biodiversity impacts to approximately 42 ha of vegetated land in Lots 2 and 3 DP 1156997 which contains habitat for a range of listed flora and fauna species including, but not limited to, those occurring in the Development Footprint (see above).

4.1.3 Location

The Development Footprint is proposed to be located immediately adjacent to Motorway Link road, in areas more likely to be already subject to significant edge effects and indirect impacts from existing surrounding development. Edge effects noted during surveys include weed incursions, access tracks and rubbish dumping including numerous car bodies (refer to **Figure 4.1**). The land in the northern portion of the land holding shows evidence of four wheel drive activity which continues to degrade the condition of the vegetation in that area. The bushland to the south of the development footprint will remain relatively intact, with little incursion into these areas.

The concentration of development impacts in the north of the has been designed to reduce the impact of edge effects elsewhere in the in site in order to avoid impacts on identified biodiversity values.

4.1.4 Project Design

Whilst detailed design plans aren't available at this stage, Darkinjung will consider the biodiversity values of the land when preparing the development plans at the DA stage of the Project to further avoid impacts of the proposed development on biodiversity values. Section 5.0 of the GHD BCAR (2018) provides the impact assessment in detail.

4.1.5 Local Biodiversity Corridor Functionality

The development footprint is located within and in proximity to an indicative green corridor and local conservation links identified in the North Wyong Shire Structure Plan (DPI 2012). The vegetation corridors shown on **Figure 4.1** broadly follows the corridor paths in the North Wyong Shire Structure Plan (DPI 2012). Impacts on connectivity for this planning proposal were identified in the Interim Ecological Inventory Report (EcoLogical 2012) and BCAR (GHD 2018) and was a key consideration in the design of the proposed development. The proposed development has been designed to avoid impacts on the functionality of the connectivity and biodiversity corridors in the locality and region. As a result of the placement of the development footprint, existing connectivity values between the north and south will be retained and the functionality of corridors will be preserved through the appropriate siting of the proposed development.

A ‘wildlife corridor’ generally describes a strip of vegetation that differs from the surrounding vegetation and connects otherwise separate areas of habitat (Gleeson and Gleeson 2012). Corridors may include large expanses of intact native landscapes, river systems and floodplains, networks of habitat patches or scattered paddock trees. Connectivity is a critical function of wildlife corridors. These corridors may help to reduce or moderate some of the adverse effects of habitat fragmentation by facilitating dispersal of individuals between substantive patches of remaining habitat. Corridors are not necessarily continuous, as currently fragmented or cleared areas can also contribute to overall landscape connectivity (Scotts 2003).

Maximising the widths of corridors is one of the most effective ways of increasing corridor effectiveness by reducing the impacts of edge effects, increasing diversity and providing habitat for species with larger home ranges (Bennett 2003). There is limited information for the minimum requirements for maintaining or creating effective natural habitat linkages for species in Australia (Gleeson and Gleeson 2012). Although no minimum benchmark has been identified, widths of 500 metres for regional corridors and 300 metres for sub-regional corridors were applied in the preparation of the Key Habitats and Corridors for Forest Fauna (Scotts 2003) and in the Fauna Corridors for Climate Change Report for the Hunter Central Rivers Catchment Management Authority (HCRCMA) (DECC 2007).

The key local corridors relevant to the development site include north-south linkages located between the rail line to the west and the suburb of Blue Haven to the east. The north-south local corridor is currently approximately 350 metres wide at its narrowest point near the Doyalson Link Road (refer to Figure 4.1). Due to the existing location of the industrial site along Tooheys Road and the rail line, the location of the development footprint has been carefully placed to ensure the width of this ‘pinch point’ is unaffected by the proposal.

Additionally, local east-west connectivity is associated with Wallarah Creek and the surrounding intact vegetation south of the development site. Riparian corridors have an important role in corridor function generally, and specifically in the Central Coast context, where residential and other development has caused significant historical fragmentation. The east-west corridor is already subject to some severance due to the rail line, however connectivity is maintained along Wallarah Creek. Direct and indirect impacts on the riparian corridor of Wallarah Creek have been specifically avoided (refer to **Figure 4.1**).

Importantly, the functionality of the identified local corridors will remain intact. The potential for the area south of the proposal footprint to be conserved through a Stewardship Agreement would provide in perpetuity conservation of a similarly sized area of the identified corridor in the North Wyong Shire Structure Plan (DPI 2012) and the Central Coast Regional Plan 2036 (NSW DPE 2016) (refer to **Section 4.1.6** below).

4.1.6 Regional Connectivity and Cumulative Impacts

The development footprint is also located within an indicative biodiversity corridor identified in the Central Coast Regional Plan 2036 (NSW DPE 2016) as connecting the coast to the foothills and providing an inter-regional landscape break (refer **Figure 4.2**). This is part of a broader biodiversity corridor network that links to the Great Dividing Range, Hawkesbury River, Ku-ring-gai Chase National Park and Watagans National Park.

Darkinjung LALC currently has a range of planning proposals in progress for future development within the Central Coast LGA, but also have large landholdings that have the potential to become key conservation assets for the region (refer to **Section 5.1**). **Figure 4.2** shows the locations of the current planning proposals in relation to the biodiversity corridor identified in the Central Coast Regional Plan 2036 (NSW DPE 2016). The development footprint of these sites totals approximately 120 ha and are located along biodiversity corridor No. 4 (connecting the coast to the foothills) and No. 2 (connecting the central national parks and state forests) as outlined in the Central Coast Regional Plan 2036 (NSW DPE 2016). Other Darkinjung LALC land that has the potential to be secured into biodiversity conservation mechanisms includes over 1,000 ha across the region.

The development of this planning proposal is unlikely to result in any substantial cumulative impacts in relation to regional connectivity and the collective development of other Darkinjung proposed developments in the Central Coast LGA. It is acknowledged that the biodiversity corridors identified in the Central Coast Regional Plan 2036 (NSW DPE 2016) are broad and indicative and the more accurate scale of connectivity features assessed in **Section 4.1.5** concludes that there is no expected reduction in existing local biodiversity links. While the development footprint occurs within an area identified as a biodiversity corridor, the site is also located adjacent to an identified Regional Growth Area and the Warnervale Town Centre (NSW DPE 2012). The development footprint proposed represents a relatively small area in a regional context and the proposal is not likely to sever or affect the functionality of any important regional biodiversity corridors.

4.2 Impacts Not Requiring Assessment

Under the BAM, impacts to areas of land without native vegetation do not require further assessment. The Development Footprint contains 2.2 ha of tracks and cleared areas that are not subject to assessment.

4.3 Impacts Requiring Offset

Two PCTs and five species-credit species are considered to require offsetting in accordance with the BAM (OEH 2017). **Table 4.2** summarises this outcome.

Table 4.2 Impacts Requiring Offset

Veg Zone	PCT/Species-credit	Vegetation Integrity Score			Area (ha)	Credits Required
		Current	Future	Change		
1	PCT1636 Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodlands on lowlands of the Central Coast (good condition)	61.5	0	-61.5	41.4	**1114**
2	PCT1649 Smooth- barked Apple – Red Mahogany – Swamp Mahogany – *Melaleuca sieberi* heathy swamp woodland of coastal lowlands (good condition).	60.9	0	-60.9	1.4	**43**
-	Bynoe's wattle *Acacia bynoeana*	-	-	-	0.6	**18**
-	Charmhaven apple *Angophora inopina*	-	-	-	41.4	**636**
-	wallum froglet *Crinia tinnula*	-	-	-	1.4	**32**
-	squirrel glider *Petaurus norfolcensis*	-	-	-	42.8	**1316**
-	black- eyed Susan *Tetratheca juncea*	-	-	-	42.8	**1316**

Legend

- Darkinjung Planning Proposal Footprints
- Central Coast Local Government Area
- Inter-regional Road and Interchange

Biodiversity Corridor

- 1 - Linking to Mountains and National Parks to the West
- 2 - Connecting the Central National Parks & State Forests
- 3 - Linking Coastal Hills with valleys and Foreshores
- 4 - Connecting the Coast to the Foothills and Providing an Inter-Regional Landscape Break

FIGURE 4.2

Darkinjung Planning Proposals in Relation to Central Coast Regional Plan 2036 Biodiversity Corridors (NSW Government 2016)

Image Source: Central Coast Regional Plan 2036 Biodiversity Corridors (NSW Government 2016) Data source: NSW LPI (2019)

5.0 Preliminary Biodiversity Offset Strategy

Only part of Lot 1 DP 1156997 380 Motorway Link, Wallarah is proposed for development. The area located immediately south of the Development Footprint in Lot 1 DP 1156997 (refer to **Figure 1.1**) will provide some of the required biodiversity credits to offset the impacts of the Project through the establishment of a Biodiversity Stewardship site.

While the southern portion of Lot 1 DP 1156997 is proposed to be rezoned to E2 Environmental Conservation for the purposes of the planning proposal, the area is intended to be established as a formal offset under a Stewardship Site agreement. The E2 zoning is not intended to be an existing conservation obligation under the BAM and therefore the calculation of credits at this Stewardship Site will be determined using the existing land zone (i.e. RU6 Transition).

Darkinjung is committed to delivering a Biodiversity Offset Strategy that appropriately compensates for the unavoidable loss of biodiversity values as a result of the Project under the BC Act and *Biodiversity Conservation Regulation 2017*. Firstly, Darkinjung has, where possible, altered the Project to avoid and minimise biodiversity impacts in the Project planning stage, and a range of impact mitigation strategies to mitigate the impact on ecological values (refer to Section 5.0 of GHD 2018) prior to the consideration of offsetting requirements.

Fulfilling offset requirements under the *BC Act 2016* can be undertaken using one or a combination of the following offset strategies:

- In-perpetuity conservation through the establishment of a Stewardship site achieved and the retirement of credits.
- Securing required credits through the open credit market and/or
- Payments to the Biodiversity Conservation Fund.

5.1 Potential Darkinjung LALC Stewardship Site Options

Darkinjung LALC currently has a range of landholdings that have the potential to become key conservation assets for the Central Coast region.

Table 5.1 outlines the extent of potentially suitable offset areas on Darkinjung LALC land within Lot 1 DP1156997 (i.e. immediately south of the development footprint) and in the wider Central Coast LGA. For PCTs, the location of potential offset areas has been determined using PCTs in the like-for-like offset trading groups. For species-credit species, areas have been calculated using the associated PCTs in the TBDC published by the Biodiversity Conservation Division (BCD) of the NSW Department of Environment Energy and Science (formerly OEH).

While land-based offsetting options can provide substantial conservation gains in the Central Coast region, Darkinjung LALC also acknowledge that a range of valuable offsetting options are available under the BC Act, as outlined above.

Table 5.1 Potential Darkinjung Stewardship Site Options

PCT/Species-credit	Impact Area (ha)	Area of Potential Offsets on Darkinjung Land	
		Remaining Lot 1 DP1156997	Central Coast LGA
PCT1636 Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodlands on lowlands of the Central Coast	41.4	23.9 ha	514 ha
PCT1649 Smooth- barked Apple – Red Mahogany – Swamp Mahogany – *Melaleuca sieberi* heathy swamp woodland of coastal lowlands	1.4	0.0 ha	155 ha
Bynoe's wattle *Acacia bynoeana*	0.6	36.1 ha	781 ha Confirmed records
Charmhaven apple *Angophora inopina*	41.4	36.1 ha Confirmed records	820 ha Confirmed records
wallum froglet *Crinia tinnula*	1.4	36.1 ha Confirmed records	788 ha Confirmed records
squirrel glider *Petaurus norfolcensis*	42.8	41.7 ha	849 ha Confirmed records
black- eyed Susan *Tetratheca juncea*	42.8	41.7 ha Confirmed records	839 ha Confirmed records

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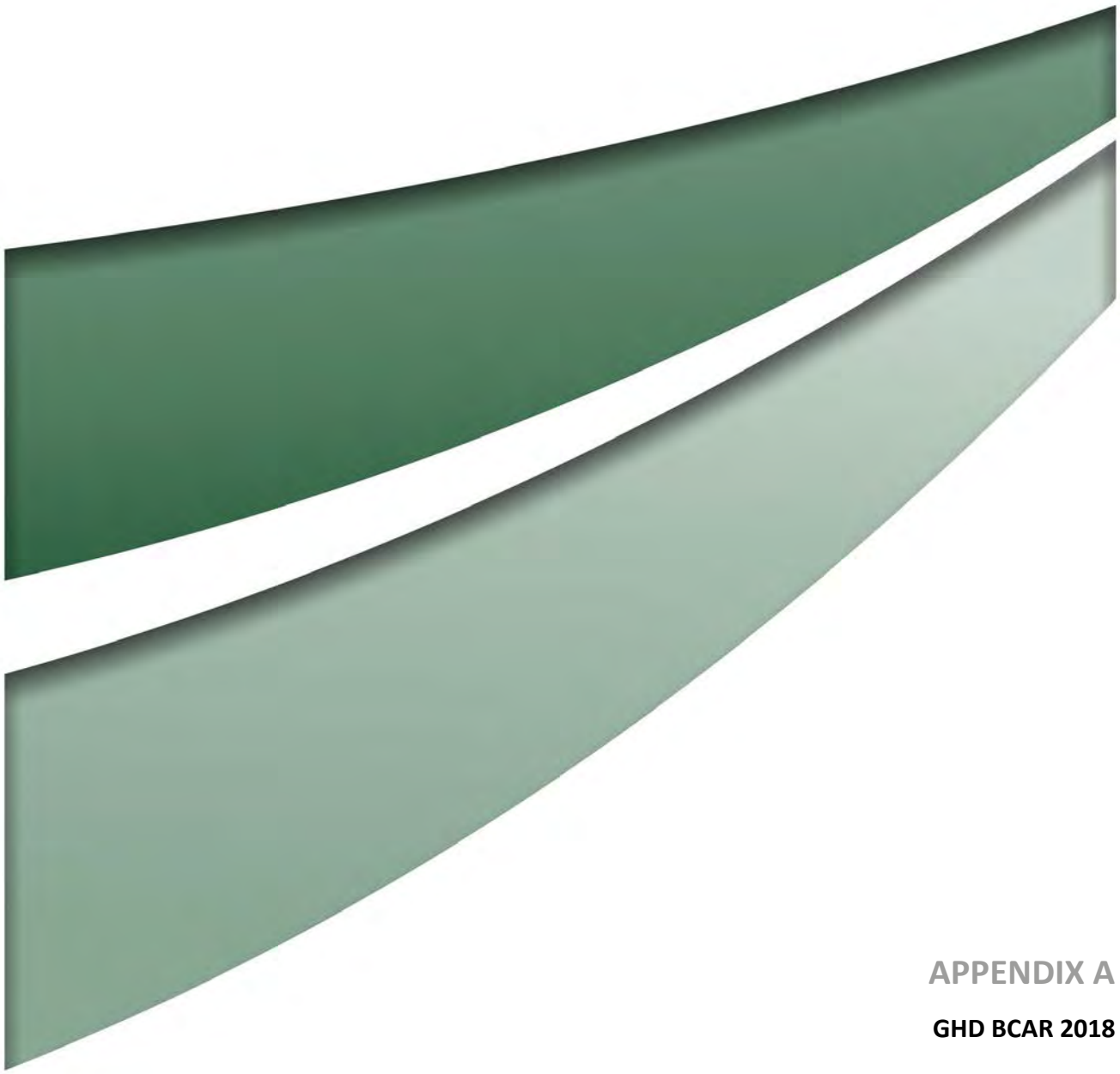

APPENDIX A

GHD BCAR 2018

Darkinjung Local Aboriginal Land Council

Motorway Link Industrial Subdivision

Biodiversity Certification Assessment Report

May 2018

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Appendices

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1. Introduction

1.1 Overview

GHD Pty Ltd (GHD) has been engaged by Darkinjung Local Aboriginal Land Council (Darkinjung LALC) to prepare a Biodiversity Certification Assessment Report (BCAR) to address the potential biodiversity impacts from the proposed conferral of biodiversity certification of an industrial rezoning and associated subdivision at Lots 1, 2 and 3 DP 1156997 380 Motorway Link, Wallarah, New South Wales (NSW).

Darkinjung LALC is seeking to have the proposed site rezoned from RU6 –Transition to IN1- General Industry and as part of the rezoning are applying for conferral of biodiversity certification under the Part 8 of the NSW *Biodiversity Conservation Act 2016* (BC Act).

This BCAR is a specialist study to support the planning proposal for the project. This report describes the ecological values at the site, with particular emphasis on, Plant Community Types (PCT's) present, threatened ecological communities, populations and species. It assesses the impact of the proposal on biodiversity values of conferring biodiversity certification, contains measures to avoid and minimise impacts to biodiversity values, describes and quantifies the biodiversity credits required to offset the residual impacts of conferral of biodiversity certification on biodiversity values.

Proposed conservation measures to offset the impacts of the development and to demonstrate that biodiversity values are being improved and maintained are briefly discussed in Section 7. Biodiversity values and credits generated from a proposed conservation area adjacent to the site and would be described in detail in a separate Biodiversity Stewardship Site Assessment Report (BSAR).

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1.2 Project description

The project involves the rezoning of 45 hectares of land from RU6 –Transition to IN1- General Industry and construction of a 72 Lot industrial subdivision, which would be developed for industrial/employment land purposes.

The proposed rezoning will facilitate increased economic activity and potentially 900 jobs to assist in meeting the employment targets set in the Central Coast Regional Plan.

As a result of the identified need for employment in the Wyong area, Darkinjung LALC undertook a review of their lands within the North Wyong Structure Plan area, which identified a number of sites considered as having potential for industrial or employment uses.

In June 2014, Darkinjung LALC lodged a multi-site planning proposal, in which the subject site formed development site 5. The site received a Gateway Determination from The Department of Planning and Infrastructure on 19th February 2015.

The proposal includes construction of road and infrastructure services associated with the subdivision in accordance with relevant standards to service the allotments.

The project will be undertaken as a staged development, with stages to be determined at a later date as part of development application for the project.

The final design layout takes into consideration the biodiversity values of the site and aims to achieve an appropriate balance between development and conservation.

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1.3 Purpose of this report

This BCAR has been prepared to assess the potential biodiversity impacts of the proposal and determine suitable offsets. Specifically, the objectives of this assessment are to:

- Outline the methods used in the biodiversity assessment.
- Describe the existing environment of the proposed biocertificaton area (referred to herein as the subject site) in terms of its biodiversity values, including type and condition of PCT's and terrestrial and aquatic habitats.
- Identify flora and fauna species and PCTs within the subject site that have the potential to be impacted by the proposal.
- Describe the conservation significance of the subject site in terms of threatened biota known or predicted to occur within the subject site.
- Provide a description of the proposal, including potential impacts on biodiversity values.
- Identify measures undertaken to avoid and minimise impact to biodiversity values.
- Present the data used to perform the Biodiversity Assessment Method (BAM) assessment and credit calculations for the proposal.
- Calculate the number and type of biodiversity credits using the BAM that would be required to offset impacts of the proposal.
- Discuss conservation measures proposed to offset the residual impact of the proposal.

This biodiversity assessment and credit calculations were conducted by Arien Quin (accredited assessor number BAAS17089) in accordance with the BAM. A technical review of the report was undertaken by Dan Williams (accredited assessor number BAAS17025).

1.4 Location and subject site

The proposed biocertification area is located at Lots 1, 2, and 3 DP 1156997, 380 Motorway Link, Wallarah, NSW. The site is bound to the south-west by the Doyalson Link, Road, to the north-west by the Sydney-Newcastle railway, and is located approximately three kilometres west of Bluehaven, within the Wyong Local Government Area (LGA).

The subject site is approximately 45 hectares in size and contains relatively intact native vegetation as well as several disturbed areas and tracks (refer to Figure 1-1).

1.5 Information sources

Information sources used in the preparation of this report include:

- Office of Environment and Heritage (OEH) BioNet Atlas (licensed) for records of threatened species, populations and endangered ecological communities listed under the BC Act that have been recorded within the locality of the proposal (OEH, 2018a).
- OEH threatened biota profiles for descriptions of the distribution and habitat requirements of threatened biota (OEH, 2018b). This resource was used to identify the suite of threatened ecological communities (TECs) that could potentially be affected by the proposal and to inform habitat assessments.
- The Commonwealth Department of the Environment and Energy (DoEE) Protected Matters Search Tool (PMST), for Matters of National Environmental Significance (MNES) known or predicted to occur in the locality (DoEE, 2018a).
- DoEE online species profiles and threats database (DoEE, 2018b).

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- The NSW BioNet database to identify Plant Community Types (PCTs) that occur in the subject site as required by the BAM (OEH, 2018c).
- Department of Primary Industries (DPI) freshwater threatened species distribution maps. For distribution of threatened aquatic species that may occur in the locality (DPI, 2018a).
- Groundwater Dependent Ecosystem Atlas (BOM 2018a).
- The list of species credit-type species identified by the BAM Credit Calculator based on the initial credit calculations.
- Previous ecological assessments completed for the site (Ecological 2012).
- Wyong Local Government Area (LGA) vegetation mapping (Bell 2002).
- Lower Hunter Central Coast Regional Environmental Mapping Survey 'LHCCREMS' Vegetation Mapping (Hunter Councils (2002).
- Aerial photographs and satellite imagery of the subject site and buffer area.

1.6 Glossary of terms and acronyms

Term	Definition
AOBV	Areas of Outstanding Biodiversity Value
BCAR	Biodiversity Certification Assessment Report
BC Act	Biodiversity Conservation Act 2016
Biodiversity Assessment Method (BAM)	The rules of BioBanking established under the BC Act that determine credits created, credits required and the circumstances that improve or maintain biodiversity values.
Biodiversity credit report	Specifies the number and type of biodiversity credits: required to offset the impacts of a development to obtain a Biodiversity Certification Agreement; or that would be generated through conservation and management of a Stewardship site under a Stewardship Site agreement.
BCT	Biodiversity Conservation Trust
Biodiversity credit	A unit of biodiversity value to measure specific development impacts or conservation gains in accordance with the BAM. Includes ecosystem credits or species credits.
Biodiversity offsets	Specific measures that are put in place to compensate for impacts on biodiversity values.
Biodiversity values	The composition, structure and function of ecosystems, including threatened species, populations and ecological communities, and their habitats.
BOS	Biodiversity Offset Scheme
CEEC	Critically Endangered Ecological Community
DoEE	Department of the Environment and Energy
DPI	Department of Primary Industries
Ecosystem credit	A credit that relates to a vegetation type and the threatened species that are reliably predicted by that vegetation type (as a habitat surrogate).
EEC	Endangered Ecological Community
CEMP	Construction Environmental Management Plan
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
FFMP	Flora and Fauna Management Plan
IBRA	Interim Biogeographic Regionalisation for Australia
MNES	Matters of National Environmental Significance
LEP	Local Environment Plan
LGA	Local Government Area

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Term	Definition
Locality	The area within a 10 km radius of the subject site.
Migratory Species	Species listed under listed under international agreements (I.e Ramsar, JAMBA and CAMBA conventions) to which Australia is a party
OEH	Office of Environment and Heritage
PCT	Plant Community Type
SAII	Serious and Irreversible Impacts
SEPP	State Environment Planning Policy
Species Credit	A credit that relates to an individual threatened species that cannot be reliably predicted based on habitat surrogates. Threatened species that require species credits are identified in the Threatened Biodiversity Data Collection
Study area	The area that was subject to a site survey and assessed for direct or indirect impacts arising from construction and operation of the proposal.
Subject site	The area that would be directly impacted by construction and operation of the proposal.
TEC	Threatened Ecological Community
Threatened biota	Threatened species, populations or ecological communities listed under the BC Act and/or the EPBC Act.

1.7 Definitions

The following terms are used in this report:

- The 'proposal' refers to the proposed subdivision works, which are discussed in Section 1.2
- The 'subject site' refers to the area that would be directly impacted by the proposal
- The 'study area' refers to the area that was subject to field survey and assessed for direct or indirect impacts that may arise from the proposal
- The 'locality' refers to the area within a 10 km radius of the subject site

1.8 Assumptions and accredited assessor judgments

This report has been prepared based on the proposal description and engineering drawings provided by the proponent. A 'proposal footprint' polygon (i.e. disturbance footprint) was prepared for the biodiversity assessment based on these inputs and confirmed in consultation with the proponent. It is assumed that the description and spatial data accurately represent the extent of direct impacts arising from the proposal and so these data have been used to calculate the extent of removal of vegetation and habitat arising from the proposal using GIS. These calculations have in turn been relied upon in the BAM calculations and the determination of key thresholds such as whether the proposal would have a direct impact on a threatened species, whether biodiversity offsets are required for a particular impact and whether a particular impact is likely to be significant. The assessment conclusions may change as a result of the provision of an updated proposal design and/or spatial data.

Tetratheca juncea is a sprawling shrub that sends out multiple stems connected through underground rootstock. This growth habitat makes it difficult to assess whether a plant is an individual or part of a nearby plant. Due to the rhizomatous nature of the plant, this survey counted 'clumps' rather than individual plant stems. This method of surveying is supported by the NSW Environmental Impact Assessment Guidelines (NPWS 2000) and Commonwealth Referral Guidelines (DSEWPaC 2011) for this species.

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The majority of the subject site is mapped within the “Sydney-Newcastle Coastal Alluvial Plains” Mitchell Landscape, with the southern portion of the site mapped within the “Gosford-Cooranbong Coastal Slopes’ Mitchell Landscape. The description of the “Sydney-Newcastle Coastal Alluvial Plains” Mitchell landscape appears to be the best match for the site and was therefore selected within the BAM calculator as the most appropriate landscape.

1.9 Scope and limitations

This report: has been prepared by GHD for Darkinjung Local Aboriginal Land Council and may only be used and relied on by Darkinjung Local Aboriginal Land Council for the purpose agreed between GHD and the Darkinjung Local Aboriginal Land Council as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Darkinjung Local Aboriginal Land Council arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

GHD has prepared this report on the basis of information provided by Darkinjung Local Aboriginal Land Council and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 1.8. of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

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Paper Size A4

0 35 70 140 210 280

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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LEGEND

- Proposed subdivision
- Biocertification area
- Cadastre
- Watercourse

Mitchell Landscapes

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

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Darkinjung Local Aboriginal Land Council
Motorway Link Residential Subdivision
Biodiversity Certification Assessment Report

Job Number 22-18652
Revision A
Date 19 Apr 2018

Site map

Figure 1-1

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

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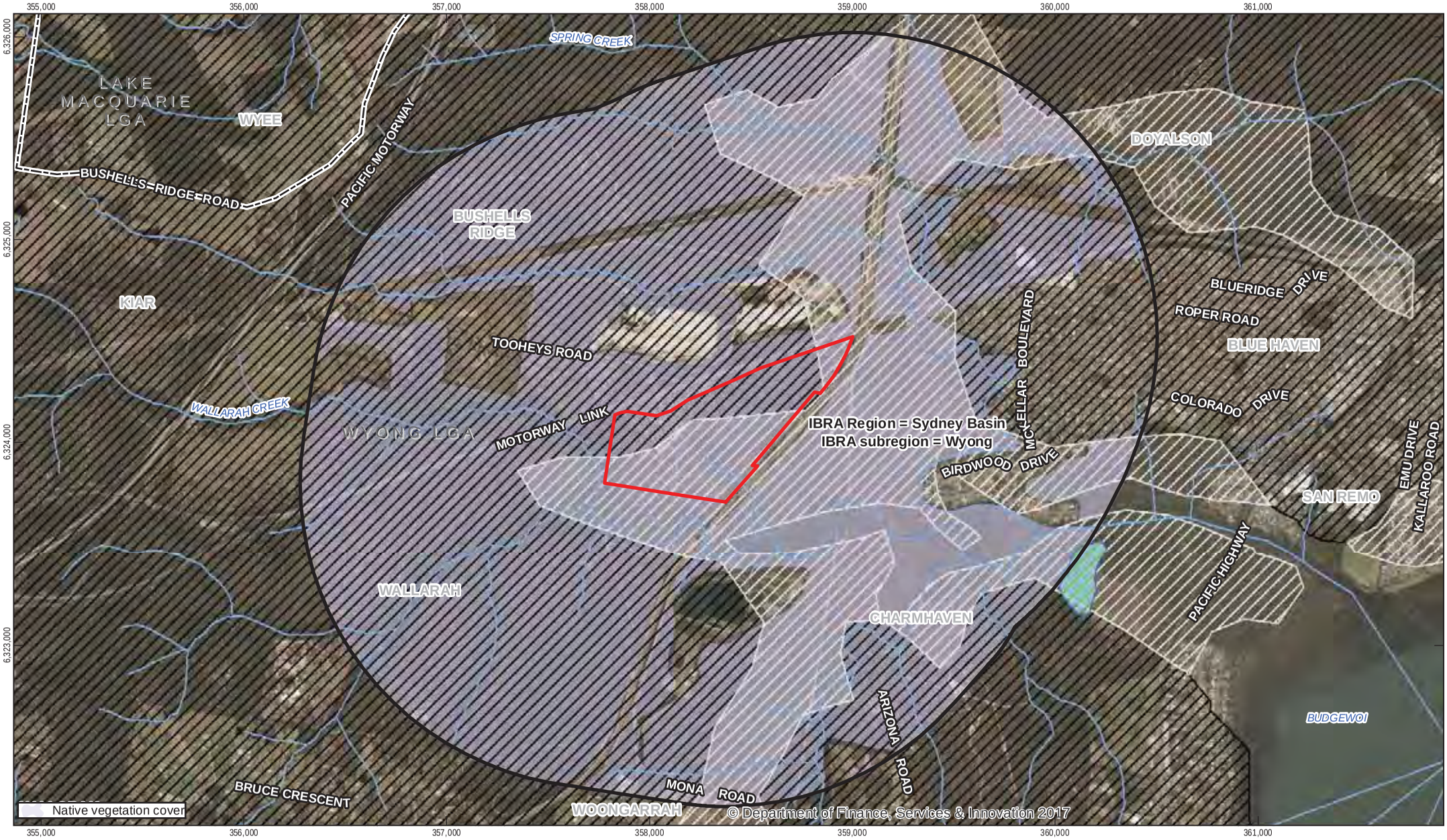
Data source: ADW Johnson: Subdivision layout, 2017; LPI: DTDB / DCDB, 2012, Aerial Imagery, 2016; DSEWPaC: IBRA Bioregions, 2013; DECCW: Mitchell landscapes, 2008, DPE: SEPP 14, 2016. Created by: fmackay



Paper Size A4

0 90 180 360 540 720

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

0

LEGEND

- Biocertification area
- Landscape Assessment (1500m buffer)
- IBRA bioregion boundary
- Local Government Area boundary
- SEPP14 - Coastal wetland
- Watercourse
- Native vegetation cover

Mitchell Landscape

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

DRAFT

Darkinjung Local Aboriginal Land Council
Motorway Link Residential Subdivision
Biodiversity Certification Assessment Report

Job Number 22-18652
Revision A
Date 02 May 2018

Location map

Figure 1-2

G:\22\18652\GIS\Maps\Deliverables\BCAR\2218652_BCAR002_LocationMap_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

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Data source: LPI: DTDB / DCDB, 2012, Aerial Imagery, 2016; DSEWPaC: IBRA Bioregions, 2013; DECCW: Mitchell landscapes, 2008, DPE: SEPP 14, 2016; CMA: LHCCREMS Vegetation, 2003. Created by: fmackay

2. Methodology

2.1 Biodiversity offset scheme and biodiversity assessment methodology

The BC Act, together with the *Biodiversity Conservation Regulations 2018***,** provides a mechanism to address impacts on biodiversity from land clearing associated with development. Under this legislation, there are provisions for a Biodiversity Offsets Scheme (BOS), which includes a framework to avoid, minimise and offset impacts of development on biodiversity.

The aim of the BOS is to provide a transparent, consistent and scientifically based approach to biodiversity assessment and offsetting. It also allows for the establishment of biodiversity stewardship agreements, which are in-perpetuity agreements entered into by landholders, to secure offset sites and generate biodiversity credits, which can be used to offset impacts of development. The aim of the BOS is to ensure that the impacts of development, clearing or biodiversity certification will result in no net loss of biodiversity.

The Biodiversity Assessment Method (BAM) was established by the NSW Office of Environment and Heritage (OEH) as a standard method to address the loss of biodiversity and threatened species. The scheme creates a market framework for the conservation of biodiversity values and the offsetting of development impacts. It also provides the mechanisms to offset impacts of development, clearing or biodiversity certification such that there is no loss of biodiversity values.

The BAM sets out how biodiversity values will be assessed, proscribes requirements to avoid and minimise impacts, establishes rules for calculating the number and class of credits required for unavoidable impacts, and determines the trading rules that will apply. The methodology includes a software package known as the Biodiversity Assessment Method Calculator (the credit calculator) which processes site survey and assessment data. The credit calculator specifies the type and extent of surveys required for a Biodiversity assessment and then processes survey data to calculate the number and type of biodiversity credits that are either required at a development site or will be generated at a stewardship site. The BAM must be applied by a person accredited under the BC Act.

The Biodiversity Conservation Trust Fund ensures that landowners have the funds needed to carry out the management actions required each year and provides a financial incentive to landowners to carry out those actions. The scheme is administered by OEH and ensures accountability and compliance through legislation, regular reporting requirements and financial measures.

2.2 Biodiversity certification

Biodiversity certification provides for a streamlined biodiversity assessment process for strategic or large developments.

Provisions to apply for biodiversity certification are contained within Section 8 of the BC Act.

Steps involved in biodiversity certification include:

- Planning and design of the development, including identifying the specific area that will be subject to the biodiversity certification application.
- Consultation with OEH and relevant local council.

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- Preparation of a formal application. This involves an accredited assessor applying the BAM to the area subject to the biodiversity certification proposal and preparation of a BCAR (this report) to assess the impacts on biodiversity values of conferring biocertification at the subject site and to quantify and describe the biodiversity credits required to offset the impacts of conferral of biocertification on biodiversity values.
- Public consultation and notification of the proposal and response to any submissions.
- Determination of the application by the Minister for the Environment.
- Ongoing review and auditing of compliance activities.

After biodiversity certification is conferred on an area of land, development may proceed without the usual requirement under the *Environmental Planning and Assessment Act 1979* for site-by-site threatened species assessment and no further assessments of threatened biota listed under the BC Act are required to accompany future Development Applications (DAs).

Biodiversity certification may only be conferred by the Minister if they are satisfied that the approved conservation measures adequately address the likely impacts of the proposal.

Parties to biodiversity certification are responsible for the implementation of the proposed conservation measures for the duration of the certification. Formal approval of the project cannot be granted until the offset requirements are met.

2.3 Approach

This BCAR has been prepared to describe the impacts of the conferral of biodiversity certification on biodiversity values using the BAM (OEH, 2018d).

The main components of the methodology for the biodiversity assessment include:

- Desktop assessment to describe the existing environment and landscape features of the study area and to identify the suite of threatened biota potentially affected by the proposal.
- Field survey in accordance with the BAM to describe the biodiversity values of the subject site and surrounding study area and determine the likelihood of threatened biota and their habitats occurring in the proposal site or being affected by the proposal.
- Determining reasonable actions to avoid and minimise impacts to biodiversity values.
- Completing calculations using the BAM calculator version 1.2.1 to quantify the residual biodiversity impacts of the proposed conferral of biodiversity certification and to determine the ecosystem and species credits that would require retirement to offset these impacts.

The biodiversity assessment and biodiversity credit calculations were performed by Arien Quin in accordance with the BAM (accredited assessor number BAAS17098). A technical peer review was completed by Dan Williams (accredited assessor number BAAS17025).

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2.4 Desktop assessment

2.4.1 Literature and database review

A desktop database review was undertaken to identify threatened flora and fauna species, populations and ecological communities (biota) listed under the BC Act, FM Act, and EPBC Act, that could be expected to occur in the locality, based on previous records, known distribution ranges, and habitats present. These were also used to obtain the necessary site data to perform BAM calculations. Biodiversity resources pertaining to the subject site and locality (i.e. within a 10 km radius of the site) that were reviewed prior to conducting field investigations included:

- The Commonwealth Department of the Environment and Energy (DoEE) Protected Matters Search Tool (PMST), for Matters of National Environmental Significance (MNES) known or predicted to occur in the locality (DoEE, 2018a).
- DotE online species profiles and threats database (DoE, 2018b).
- Office of Environment and Heritage (OEH) BioNet Atlas (licensed) for records of threatened species, populations and endangered ecological communities listed under the BC Act that have been recorded within the locality of the proposal (OEH, 2018a).
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- Wyong Local Government Area (LGA) vegetation mapping (Bell 2002).
- Lower Hunter Central Coast Regional Environmental Mapping Survey 'LHCCREMS' Vegetation Mapping, (Hunter Councils 2002).
- Aerial photographs and satellite imagery of the subject site and buffer area.

The threatened and migratory species identified in the desktop assessment are presented in Appendix A. Following collation of database records and threatened species and community profiles, a 'likelihood of occurrence' assessment was prepared for threatened and migratory species and ecological communities with reference to the broad vegetation types and habitats contained within the study area. This was further refined following field surveys and verification of vegetation types and identification and assessment of habitat present within the subject site. A likelihood of occurrence ranking was attributed to these biota based on this information.

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2.5 Site survey

2.5.1 Survey effort and timing

Staged surveys of the subject site were conducted with reference to the BAM and appropriate threatened species survey guidelines for targeted species. Site surveys included:

- Preliminary investigation of biodiversity values (survey completed from 2010-2012 by Ecological)
- Initial site stratification and vegetation mapping
- BAM plot surveys
- Incidental threatened flora surveys
- Fauna habitat assessment
- Opportunistic fauna surveys
- Targeted surveys for threatened flora
- Targeted surveys for threatened fauna

Survey effort that has directly contributed to this BCAR is summarised in Table 2-1 and is described in detail below.

Table 2-1 Survey effort associated with project impacts

Stage	Date	Survey Technique
Preliminary investigation of biodiversity values	October 2010-2012 (EcoLogical 2012)	Vegetation mapping Biometric plots Targeted threatened flora surveys Targeted threatened fauna surveys (including hair tubes, pitfall trapping, ultrasonic bat call recording, stag watching, call play back, bird surveys)
Targeted threatened flora survey	27-28 October 2016	Targeted *Tetratheca juncea*, *Acacia bynoeana, Genoplesium insigne* and *Thelymitra adorata* surveys
Targeted threatened flora survey	4 and 5 December	Targeted survey *Cryptostylis hunteriana and Genoplesium insigne*
Targeted threatened fauna surveys	22-26 January 2018	Arboreal Elliot Traps Spotlighting Call Playback Stag Watching Harp Trapping Ultrasonic call recording Active searches for scats and signs Camera traps Habitat assessment
BAM plot surveys	12 April 2018	Six BBAM plot surveys; targeted threatened flora surveys, opportunistic fauna observations; fauna habitat assessment.

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2.5.2 Vegetation mapping

Vegetation mapping completed by EcoLogical in 2012 was ground-truthed in the field via systematic walked transects across the entire subject site and by walking the boundary of vegetation units. Necessary adjustments were made by hand on aerial photographs of the subject site. The site was divided into relatively homogenous or discrete zones for assessment based on observed vegetation structure, species composition, soil type, landscape position and condition. Native vegetation was divided into vegetation zones which represented a distinct PCT and broad condition state.

2.5.3 Vegetation integrity survey plots

Plot surveys were conducted on site in accordance with the BAM to obtain vegetation integrity data for the calculation of biodiversity credits. The site value was determined by assessing ten attributes used to assess function, composition and structure of vegetation within a 50 metre X 20 metre plot. These attributes were then assessed against benchmark values. Benchmarks are quantitative measures of the range of variability in condition in vegetation with relatively little evidence of alteration, disturbance or modification by humans since European settlement (DECC, 2009). Attributes assessed within each plot are listed in Table 2-2. All flora species within a 20 metre by 20 metre quadrat nestled within the 50 m by 20 m plot were identified according to the nomenclature of the Royal Botanic Gardens and Domain Trust (2018). Each species identified was allocated a growth form group and designated as either native, exotic or high threat exotic in accordance to the lists provided in the BAM calculator.

Plots were located randomly within each of the vegetation zones by walking a random distance into the vegetation zone and then locating the plot on a randomly generated compass bearing, this was then repeated for subsequent plots within the vegetation zone.

Plots were purposely not located near ecotones, tracks and their edges or other disturbed areas. Plots were distributed between vegetation zones (i.e. NSW vegetation types and condition classes identified in the preliminary survey) according to the minimum number of plots required by Table 4 in the BAM (OEH 2018d) (refer to table below). Six plots were sampled within the study area. The location of survey plots is shown on Figure 2-1.

The overall condition of vegetation was assessed through general observation and comparison against the PCT condition benchmark data as well as using parameters such as species diversity, history of disturbance, weed invasion and canopy health.

Table 2-2 Site data collected within each plot

Attribute	Area assessed
Native plant species richness	20 X 20 metre plot
Percentage foliage cover for each species	20 X 20 metre plot
Estimated number of individuals for each species	20 X 20 metre plot
Number of large trees	50 X 20 metre plot
Tree regeneration (presence/absence)	50 X 20 metre plot
Tree stem size class	50 X 20 metre plot
Total length of fallen logs	50 X 20 metre plot
Litter cover	5 times 1 X 1 metre plot
High threat exotic vegetation cover	50 X 20 metre plot
Hollow bearing trees	50 X 20 metre plot

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Table 2-3 Minimum plot survey requirements

Vegetation zone	Area (hectares)	Minimum plot number required	Number of plots surveyed
PCT 1636 Scribbly Gum-Red Bloodwood-*Angophora inopina* heathy woodland on lowlands of the Central Coast	43.50	4	4
PCT 1649 Smooth Barked Apple-Red Mahogany- Swamp Mahogany-Melaleuca sieberi heathy swamp woodland of coastal lowlands	1.50	1	2
Total	**45.0**	**5**	**6**

2.5.4 Targeted threatened flora surveys

Targeted surveys for threatened flora species were completed by EcoLogical between 2010 and 2012. These surveys were undertaken as part of a larger study of Darkinjung (LALC) land holdings within the North Wyong Area (EcoLogical 2012). Targeted threatened flora surveys involved random meanders in areas of suitable habitat in September and December 2012 (EcoLogical 2012).

Targeted surveys were undertaken for threatened flora species that were either predicted to occur at the site by the BAM calculator or identified during the desktop review as having potential to occur within the study area given known distributions, previous records in the locality and habitat requirements for each species (refer to Appendix A). Surveys for conspicuous species that are readily detectable when present included random meander transects across the entire development site, according to the methods of Cropper (1993). Targeted searches for more cryptic species such as the threatened orchid species *Cryptostylis hunteriana* (Leafless Tounge Orchid), *Diuris praecox* (Rough Doubletail) and *Genoplesium insigne* (Variable Midge Orchid) as well as *Tetratheca juncea* (Black-eyed Susan) and *Tetratheca glandulosa* were completed by walking parallel transects spaced 5-10 metres apart across the entire study area. These surveys were focused in areas of proposed impact in potentially suitable habitat and within immediately adjoining vegetation.

Targeted threatened species surveys were undertaken in spring (27-28 October 2016) and winter (4 -5 December 2018) which, according to the BAM calculator, is a suitable time of the year for identifying all of the candidate threatened flora species identified as having potential to occur, except *Diuris praecox* (Rough Doubletail) (for which targeted surveys would be completed during the 2018 flowering season). Targeted surveys for threatened orchid species were completed during known flowering times of local population, with nearby reference populations confirmed to be in flower prior to surveys being completed.

Candidate threatened flora species that were targeted during these surveys and the appropriate survey period specified in the BAM calculator are listed in Table 2-4.

Further detail regarding candidate threatened flora species targeted during surveys are provided in Section 4.1.2.

Table 2-4 Threatened flora species targeted during surveys

Species name	Common Name	Appropriate survey period
Acacia bynoeana	Bynon's Wattle	September-March
Angophora inopina	Charmhaven Apple	All year
Astrotricha crassifolia	Thick-leaf Star Hair	All year
Callistemon linearifolius	Netted Bottle-brush	September-March
Cryptostylis hunteriana	Leafless Tongue Orchid	November-February

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Species name	Common Name	Appropriate survey period
Diuris praecox	**Rough Doubletail**	**July-August**
Eucalyptus camfieldii	Camfield's Stringybark	All year
Eucalyptus parramattensis subsp.*decadens*	Parramatta Red-gum	All year
Genoplesium insigne	Variable midge Orchid	September-October
Grevillea parviflora subsp. *parviflora*	Small Flowered Grevillea	All year
Melaleuca biconvexa	Biconvex paperbark	All year
Melaleuca groveana	Grove's Paperbark	All year
Persicaria elatior	Tall Knotweed	December-May
Prostanthera askania	Tranquility Mintbush	September-December
Rutidosis heterogama	Heath Wrinklewort	All year
Tetratheca glandulosa		July-November
Tetratheca juncea	Black-eyed Susan	July-December

Groundwater dependent ecosystems

The NSW Groundwater Dependent Ecosystem (GDE) Policy defines GDEs as ecosystems, which have their species composition, and their natural ecological processes determined by groundwater (DLWC 2002). The Policy defines groundwater as the water beneath the earth's surface that has filtered down to the zone where the earth or rocks are fully saturated (DLWC 2002). Ecosystems vary dramatically in the degree of dependency of groundwater, from having no apparent dependence through to being entirely dependent on it (DLWC 2002).

The Australian Government Atlas of Groundwater Dependent Ecosystems was used to identify any previously mapped GDEs that occur in or near the subject site. This atlas identifies GDEs reliant on surface groundwater (rivers, springs and wetlands) and subsurface groundwater (vegetation). The Atlas was reviewed to ascertain whether any GDEs are likely to occur in the subject site.

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2.5.5 Terrestrial fauna survey

Terrestrial fauna surveys were completed within the subject site over a period of 4 days / 4 nights from 22-26 January 2018.

A variety of techniques were used to target threatened fauna species and to assess habitat values within the subject site. Detailed descriptions of survey techniques are provided below and summarised in Table 2-5 . All fauna observations were recorded on proforma field data sheets. Fauna survey locations are shown on Figure 2-1.

Table 2-5 Summary of survey effort

Survey type	Effort
Arboreal trap lines	A total of six transects consisting of ten traps (five Elliott A and five Elliot B) over 4 day/nights. 60 trap nights/ night. Total effort = 240 trap nights
Spotlighting	Four consecutive nights of spotlighting (4 x person hours each night) were conducted between the hours of 8:30 – 10:30 PM. During which survey effort included call playback and walked transects. Total effort = 16 person hours
Call Playback	Conducted over four consecutive nights in four different locations targeting Koala, Squirrel Glider, Yellow-bellied Glider, Masked Owl and Barking Owl.
Daytime traverses	Undertook targeted searches in identified preferred habitat for 2 person hours x four days.

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Survey type	Effort
Active reptile/amphibian searches Active searches for scats and signs	Total effort = 8 person hours Included dedicated searches for any signs of fauna occupation. Included searching for evidence of feeding (e.g. Allocasuarina chewed cones which are signs of Glossy Black-cockatoo (*Calyptorhynchus lathami*) in dense stands of Allocasuarinas), foraging and signs of birds presence (such as pellets, whitewash, nests etc.) and other biota (scats, scratchings, diggings, nests etc.). Active searches of woody debris and other ground litter were conducted throughout the subject site targeting threatened frogs and reptiles.
Harp Traps	5 x harp traps positioned around the subject site for a total of four nights. Total effort = 20 Trap Nights
Ultasonic call recording	A total of 9 x ANABATS positioned in different flyways within the site over three nights (12 hours each/per night) Total effort = 324 hours
Camera Traps	10 x baited motion activated camera traps active for three nights, positioned around the site in suitable habitat.
Diurnal bird surveys	4 person hours x 4 days in suitable habitat throughout site. Total effort = 16 person hours

Candidate threatened fauna species that were targeted during these surveys and the appropriate survey period as specified in the BAM calculator are listed in Table 2-6. The targeted fauna survey was not completed at an appropriate time of year to adequately survey all species identified during the desktop assessment as having potential to occur within the subject site. These species are highlighted in bold text in Table 2-6 and will be surveyed for later in the year.

Further detail regarding candidate fauna species targeted during surveys is provided in Section 4.1.2.

Table 2-6 Threatened fauna species targeted during surveys

Species name	Common Name	Appropriate survey period	Comment	Survey Method/s
Anthochaera phrygia	Regent Honeyeater	Sept-Dec	***Further targeted surveys required for this species***	Diurnal bird surveys (22-26 January 2018)
Burhinus grallarius	Bush Stone-curlew	All Year	Surveyed at appropriate time	Spotlighting (22-26 January 2018) Camera traps (22-26 January 2018)
Callocephalon fimbriatum	Gang-gang Cockatoo	Oct-Jan	Surveyed at appropriate time	Diurnal bird surveys (22-26 January 2018)
Calyptorhynchus lathami	Glossy Black-cockatoo	May-August	***Further targeted surveys required for this species May***	Habitat assessment Diurnal bird surveys (22-26 January 2018)
Cercartetus nanus	Eastern Pygmy-possum	Oct-March	Surveyed at appropriate time	Arboreal elliot traps (22-26 January 2018) Spotlighting (22-26 January 2018)

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Species name	Common Name	Appropriate survey period	Comment	Survey Method/s
Chalinolobus dwyeri	Large-eared Pied Bat	Sept-March	Surveyed at appropriate time	Ultrasonic call detection (22-26 January 2018) Harp trapping (22-26 January 2018)
Crinia tinnula	Wallum Froglet	All Year	Surveyed at appropriate time	Spotlighting (22-26 January 2018) Nocturnal amphibian surveys (22-26 January 2018)
Haliaeetus leucogaster	White-bellied Sea-eagle	July-Dec	***Further targeted surveys required for this species***	Diurnal bird surveys (22-26 January 2018)
Heleioporus australiacus	Giant Burrowing Frog	Sept-May	Surveyed at appropriate time	Habitat assessment Spotlighting (22-26 January 2018) Nocturnal amphibian surveys (22-26 January 2018)
Hieraaetus morphnoides	Little Eagle	Aug-Oct	***Further targeted surveys required for this species in August***	Habitat assessment
Hoplocephalus bitorquatus	Pale-headed Snake	Nov-March	Surveyed at appropriate time	Spotlighting (22-26 January 2018)
Lathamus discolor	Swift Parrot	May-Aug	***Further targeted surveys to be completed in May***	Habitat assessment
Litoria aurea	Green and Golden Bell Frog	Nov-March	Surveyed at appropriate time	Spotlighting (22-26 January 2018) Nocturnal amphibian surveys (22-26 January 2018)
Litoria brevipalmata	Green-thighed Frog	Oct-March	Surveyed at appropriate time	Habitat assessment Spotlighting (22-26 January 2018) Nocturnal amphibian surveys (22-26 January 2018)
Lophoictinia isura	Square-tailed Kite	Sept-Jan	Surveyed at appropriate time	Diurnal bird surveys (22-26 January 2018)
Miniopterus australis	Little Bentwing-bat	Dec-Feb	Surveyed at appropriate time	Ultrasonic call detection (22-26 January 2018) Harp trapping (22-26 January 2018)

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Species name	Common Name	Appropriate survey period	Comment	Survey Method/s
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat (Breeding)	Nov-Feb	Surveyed at appropriate time	Ultrasonic call detection (22-26 January 2018) Harp trapping (22-26 January 2018)
Myotis macropus	Large-footed Myotis	Nov-March	Surveyed at appropriate time	Ultrasonic call detection (22-26 January 2018) Harp trapping (22-26 January 2018)
Ninox connivens	Barking Owl	May-Dec	***Further targeted surveys required for this species***	Call Playback (22-26 January 2018) Spotlighting (22-26 January 2018)
Ninox strenua	Powerful Owl	May-Aug	***Further targeted surveys required for this species***	Habitat assessment (22-26 January 2018)
Pandion cristatus	Eastern Osprey	April-Nov	***Further targeted surveys required for this species***	Habitat assessment (22-26 January 2018)
Petalura gigantea	Giant Dragonfly	Dec-Jan	Surveyed at appropriate time	Habitat assessment (22-26 January 2016)
Petaurus norfolcensis	Squirrel Glider	All Year	Surveyed at appropriate time	Arboreal elliot traps (22-26 January 2018) Call Playback (22-26 January 2018) Spotlighting (22-26 January 2018)
Petrogale penicillata	Brush-tailed Rock wallaby	All Year	Surveyed at appropriate time	Spotlighting (22-26 January 2018) Camera traps (22-26 January 2018)
Phascogale tapoatafa	Brush-tailed Phascogale	All Year	Surveyed at appropriate time	Arboreal elliot traps (22-26 January 2018) Camera traps (22-26 January 2018)
Phascolarctos cinereus	Koala	All Year	Surveyed at appropriate time	Spotlighting (22-26 January 2018) Camera traps (22-26 January 2018) Searches for scats and signs (22-26 January 2018)
Planigale maculata	Common Planigale	All Year	Surveyed at appropriate time	Arboreal elliot traps (22-26 January 2018) Camera traps (22-26 January 2018)

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Species name	Common Name	Appropriate survey period	Comment	Survey Method/s
Pteropus poliocephalus	Grey-headed Flying-fox	Oct-Dec	***Further targeted surveys required for this species***	Spotlighting (22-26 January 2018)
Tyto novaehollandiae	Masked Owl	May-August	***Further targeted surveys required for this species***	Habitat assessment (22-26 January 2018) Call playback (22-26 January 2018)
Tyto tenebriscosa	Sooty Owl	May-Aug	***Further targeted surveys required for this species***	Habitat assessment (22-26 January 2018)
Uperoleia mahonyi	Mahony's Toadlet	Oct-March	Surveyed at appropriate time	Habitat assessment (22-26 January 2018) Nocturnal amphibian surveys (22-26 January 2018) Spotlighting (22-26 January 2018)

Fauna habitat assessment

General fauna habitat assessments were undertaken throughout the subject site, including active searches for potential shelter, basking, roosting, nesting and/or foraging sites. Specific habitat features and resources such as water bodies, food trees, the density of understorey vegetation, the composition of ground cover, the soil type, presence of hollow-bearing trees, leaf litter and ground debris were noted.

Indicative habitat criteria for targeted threatened species (i.e. those determined as having the potential to occur within the subject site following the desktop review) were identified prior to fieldwork. Habitat criteria were based on information provided in OEH and DoEE threatened species profiles, field guides, and the knowledge and experience of GHD field ecologists.

Habitat assessments included active searches for the following:

- Trees with bird nests or other potential fauna roosts
- Rock outcrops or overhangs providing potential shelter sites for fauna
- Burrows, dens and warrens
- Distinctive scats or latrine sites (of particular relevance for the Spotted-tailed Quoll), owl white wash and regurgitated pellets under roost sites
- Tracks or animal remains
- Evidence of activity such as feeding scars, scratches and diggings
- Specific food trees and evidence of foraging (chewed Allocasuarina cones)

The locations and quantitative descriptions of significant habitat features were captured with a handheld GPS unit and photographed where appropriate.

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Arboreal Elliot Trapping

Trapping targeted threatened arboreal mammals was completed were completed within the subject site over a period of 4 days / 4 nights from 22-26 January 2018.

Species targeted include Squirrel Glider (*Petaurus norfolkensis*), Eastern Pygmy-possum (*Cercartetus nanus*) and Brush-tailed Phascogale (*Pascogale tapoatafa*).

A total of six transects consisting of ten traps (five Elliott A and five Elliot B) were established within the subject site. All traps were opened in the late afternoon and checked each morning, closed and then reopened in the afternoon for four consecutive days. The total trapping effort amounted to 240 trap-nights.

Diurnal bird surveys

Targeted surveys for diurnal birds were undertaken throughout the subject site within two hours of dawn over a three-day period. Surveys followed the area search method, and birds were identified by observation with binoculars and/or call identification. Diurnal bird surveys also included searches for signs indicative of particular threatened species, including searching for evidence of feeding (e.g. *Allocasuarina* chewed cones which are signs of Glossy Black-cockatoo (*Calyptorhynchus lathami*) foraging and signs of bird presence, such as pellets, whitewash, nests etc.)

Nocturnal amphibian surveys

Active searches for frogs were performed within the subject site focussing on areas of suitable habitat, including swampy areas, pools of standing water and drainage lines. Frogs were identified by sight and call.

Microchiropteran bat survey

Stationary Anabat recordings were undertaken in nine locations (three on each night over a total of three nights) within the subject site as shown on Figure 2-1. Recording commenced at least half an hour before dusk and continued until the following morning.

Calls recorded during the field survey were identified using zero-crossing analysis and AnalookW software (version 3.8m, Chris Corben 2010) by visually comparing call traits. No reference calls were collected during the survey. Pennay *et al*. (2004) was used as a guide to call analysis. Due to the high level of variability and overlap in call characteristics, a conservative approach was taken when analysing calls.

A call (pass) was defined as a sequence of three or more consecutive pulses of similar frequency. Pulses separated from another sequence by a period of five seconds were considered to be separate passes. Scattered sequences, where intermittent pulses were not separated by more than five seconds, were recognised as a sing.

Where constant activity was recorded, a single pass was defined as 15 seconds (i.e. one full display screen comprising as Anabat sequence file). Although this method underestimates the number of bat passes when there is continuous activity, the standard unit of time remains consistent (Law *et al*. 1998; Law *et al*. 1999).

Five harp traps were set up within the subject site over a period of 4 days / 4 nights. The traps were set in potential flyways within the Scribbly Gum- Red Bloodwood-*Angophora inopina* heathy woodland and checked twice daily, towards the conclusion of nocturnal surveys (9-10 pm) and just before dawn (5.30-6 am). All trapped bats were identified, weighted, measures, checked for health and released at point of capture.

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Spotlighting

Spotlight searches were undertaken throughout the subject site for nocturnally active mammals, birds and frogs, including dedicated listening periods for fauna vocalisations. Mammals and nocturnal birds were identified by observation under spotlight or by vocalisations heard whilst spotlighting. Transects were conducted on foot over survey period for four consecutive nights. Transects were walked for a period of 4 person-hours each night between the hours of 8:30-10:30 pm. Species targeted during spotlighting surveys included the Bush Stone Curlew (*Burhinus grallirius*), Pygmy Possum (*Cercartetus nanus*), Barking Owl, (*Ninox connivens*), Squirrel Glider (*Petaurus norfolcensis)*, Brush-tailed Phascogale (*Petrogale pinnicillata*), Brush-tailed Rock Wallaby (*Petrogale penicillata*), Koala (*Phascolarctos cinereus)*, Grey-headed Flying Fox (*Pteropus poliocephalus*), Wallum Froglet (*Crinia tinnula*), Green and Golden Bell Frog (Litoria aurea) and Pale Headed Snake (*Hoplocephalus bitorquatus*).

Call playback

Nocturnal call playback surveys were conducted over four consecutive nights during the survey period. Species targeted included Koala (*Phascolarctos cinereus),* Barking Owl (*Ninox connivens*), Squirrel Glider (*Petaurus norfolcensis*). Surveys involved an initial listening period of five minutes, followed by call playing for three minutes, followed by a listening period of five minutes (undertaken separately for each species), with a final listening period of approximately 10 minutes. Calls were played through a portable MP3 player connected to a 45-watt megaphone. All potential roost sites in the immediate area were then scanned for 10 minutes using spotlights.

Call playback was not used to target other species of forest owls (other than Barking Owl and Masked Owl) as the survey was not completed at an appropriate time for surveying these species. Additional targeted surveys for breeding habitat for forest owls will be conducted in an appropriate time latter in 2018.

Active searches

Active searches of woody debris and other ground litter were conducted throughout the subject site during the survey period targeting threatened frogs and reptiles. Fallen timber and other potential shelter sites such as corrugated iron sheets and rock piles were carefully turned and inspected.

Opportunistic observations

Opportunistic and incidental observations of fauna species were recorded at all times during field surveys. This included a conscious focus on suitable areas of habitat during flora surveys, for instance fallen timber was scanned and/or turned for reptiles and mature trees and stags were scanned for roosting birds.

Camera Traps

Ten baited infra-red motion cameras were set up across the subject site for the survey period. These cameras were used to target Bush Stone Curlew (*Burhinus grallirius*), Brush-tailed Phascogale (*Petrogale pinnicillata*), Brush-tailed Rock Wallaby (*Petrogale penicillata*), Koala (*Phascolarctos cinereus)* and Common Planigale (*Planigale maculata).*

Aquatic habitat survey

No permanent aquatic habitat occurs within the subject site. There is a small ephemeral drainage line located on the eastern side of the site. The nature and condition of this drainage line was assessed for fauna habitat values. No aquatic fauna was observed on site during the survey period.

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Paper Size A4

0 25 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

LEGEND

- Biocertification area
- Cadastre
- Watercourse
- Arboreal trap line
- BAM plot surveys
- Anabat
- Call playback
- Harp trap

DRAFT

Darkinjung Local Aboriginal Land Council
Motorway Link Residential Subdivision
Biodiversity Certification Assessment Report

Job Number 22-18652
Revision A
Date 19 Apr 2018

Survey locations

Figure 2-1

G:\22\18652\GIS\Maps\Deliverables\BCAR\2218652_BCAR009_FaunaSurveys_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

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Data source: LPI: DTDB / DCDB, 2012, Aerial Imagery, 2016. Created by: fmackay

2.6 Survey conditions

The field surveys were undertaken in early summer. Conditions were generally warm to hot and humid. No rain fell during the survey period and 23.6 mm of rainfall was recorded at Norah Head weather station in the fortnight preceding the survey. Temperatures throughout the survey period were favourable for the detection of both diurnal and nocturnal reptiles potentially present at the site. Wind during bird surveys was light to moderate and so would not have hampered the detection of bird species.

Bureau of Meteorology (BOM) records for survey dates are outlined in Table 2-7. These records were taken at Norah Head weather station located approximately 12 kilometres southeast of the subject site (BOM 2018b).

Table 2-7 Daily weather observations at Norah Head during the survey periods (BOM 2018b)

Date	Minimum temp (Deg Celsius)	Max temp (Deg Celsius)	Rainfall (mm)
22 January 2018	20.5	29.7	0
23 January 2018	21.4	27.8	0
24 January 2018	21.3	30.3	0
25 January 2018	21.3	29.7	0
26 January 2018	22.2	29.4	0

2.7 Geographical Information System (GIS) analysis

GIS analysis is an integral part of the BAM. GIS was used to plot the subject site on a high resolution aerial photo base and to map vegetation types and biodiversity values across the site. GIS analysis was used to calculate the extent of native vegetation to be impacted as well as the extent of native vegetation within the buffer area.

GIS analysis was used to accurately determine the relevant IBRA bioregion, IBRA subregion and Mitchell Landscape for the site.

Additional GIS analysis was used to plot a 1,500 metre buffer area surrounding the site in which site context components were calculated. Native vegetation cover, extent and connectivity were assessed using aerial photography and NSW Interim Vegetation Extent remote sensing imagery (DECCW 2010). Air photo interpretation was used to identify and record distinct vegetation patches, determine the broad condition state of vegetation types and the location and extent of vegetated habitat corridors. The buffer area and GIS area calculations were used to enter information about landscape value and to determine the change in Landscape Value score by assessing the impact of the development on native vegetation cover and connectivity as well as the patch size.

2.8 BAM calculations

The proposal was assessed according to the methodology presented in the BAM (OEH, 2018d), and the *Biodiversity Assessment Methods Calculator Users Guide* (OEH 2018e). The credit calculator is a software application that is used to apply the BAM. Data is entered into the credit calculator based on information collected in the desktop assessment, site surveys and from using GIS mapping software.

The BAM credit calculations were performed by Arien Quin using credit calculator version 1.2.1. The biodiversity credit report is included as Appendix D.

The data and assumptions used to perform the BAM credit calculations are summarised in Section 5.

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2.9 Staff qualifications

Field surveys were conducted by Gilbert Whyte, Arien Quin, Gary Leonard, Bridie Halse, Emily Rindfliesh and Ben Lewis. Anabat analysis was completed by Craig Grabham. Credit calculations and reporting was performed by Arien Quin and peer reviewed by Dan Williams. Staff qualifications are presented in Table 2-8.

Table 2-8 Staff qualifications

Name	Position / Project Role	Qualifications	Relevant Experience
Dan Williams	Principal ecologist, credit calculations and report review	B. App. Sc. Cons Tech BAM Assessor Accreditation	17+ years
Arien Quin	Senior ecologist / BAM plots / vegetation mapping /credit calculations / reporting	BA, BSc BAM Assessor Accreditation	11+ years
Gilbert Whyte	Senior ecologist / targeted threatened species surveys	BEnvSc PHD BA, BSc BAM Assessor Accreditation	10+ years
Ben Lewis	Ecologist / targeted threatened fauna surveys	BSc (Hons)	22+ years
Gary Leonard	Targeted threatened species surveys	Masters of Science, DipEd, Dip Horticulture	40 + years
Bridie Halse	Ecologist / assistant for targeted flora surveys	BEnvSc	2+ years
Emily Rindfleish	Ecologist/assistant for targeted flora and fauna surveys	BEnvSc	2+ years
Craig Grabham	Senior ecologist/ Bat call analysis	BSc (Parks, Recreation and Heritage) Wildlife Accoustic's Song Meter and SongScope training – Faunatech/Austbat Anabat system training course – Titley Scientific	18 years

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3. Existing environment

3.1 Landscape features

The BAM requires the assessment of landscape features to help describe the biodiversity values of the proposed biodiversity certification area and assess the impacts of the project. Landscape features relevant to the BAM calculations are shown on Figure 1-2, are discussed below and summarised in Table 3-1.

3.1.1 Location and land uses

The subject site is located approximately three kilometres north of Blue Haven within the Central Coast (formally Wyong) Local Government Area (LGA) as shown on Figure 1-1. It falls within the Sydney Basin IBRA bioregion and Wyong IBRA subregion.

The subject site includes an area of 45 hectares, located across Lots 1, 2 and 3 DP 1156977, 380 Motorway Link, Wallarah, NSW. It is bound to the northwest by the Motorway Link site, to the southeast by the Sydney- Newcastle Railway and to the south-west by a large contiguous patch of native vegetation. To the southeast on the other side of the railway are extensive areas of native vegetation that extends to Lake Budgewoi.

The entire subject site is currently zoned RU6 (Transition) under the *Wyong Local Environment Plan 2013*.

There are a number of cleared tracks and areas of disturbed lands throughout the site.

3.1.2 Bioregion and IBRA subregion

The subject site occurs within the Wyong IBRA (Interim Biogeographic Regionalisation for Australia) subregion of the Sydney Basin IBRA bioregion (refer to Figure 1-2). The Sydney Basin IBRA bioregion lies on the central east coast of NSW and covers an area of about 3,624,008 hectares which includes about 4.53 per cent of NSW. The region extends from north of Batemans Bay to Nelson Bay and West to Mudgee and includes a significant proportion of the catchments of the Hawkesbury-Nepean, Hunter and Shoalhaven river systems.

3.1.3 NSW landscape region (Mitchell Landscapes)

The site is mapped within both the “Sydney-Newcastle Coastal Alluvial Plains” and “Gosford-Cooranbong Coastal Slopes’ Mitchell Landscapes (refer to Figure 1-2) (DECC, 2008).

The Sydney-Newcastle Coastal Alluvial Plains is described by Mitchell (2008) as occurring on undulating plains and low rises on Quaternary sands or Permian/Triassic sandstone or shale with swampy valley floors. The general elevation is 0 to 80 m, with a local relief of 20 m and siliceous uniform sands, patches of deep podsol and yellow or brown texture-contrast soils on bedrock. Vegetation varies with soil and drainage. On the sands and podsols Coast Banksia, *Banksia aemula*, Red Bloodwood (*Corymbia gummifera*) and Smooth-barked Apple (*Angophora costata*) are common. In areas of bedrock Forest Oak (*Allocasuarina torulosa*), Grey Gum *(Eucalyptus punctata*), Forest red gum *(Eucalyptus tereticornis*), and Scribbly Gum *(Eucalyptus haemastoma*), with a shrubby understorey are common. Swampy areas within this landscape are typically surrounded by Broad-leaved Paperbark (*Melaleuca quinquenervia*), Coast Banksia (*Banksia integrifolia*), Swamp Oak (*Casuarina glauca*) and Swamp Mahogany *(Eucalyptus robusta*) with Spike Rushes (*Eleocharis* sp.) and Tall Swamp Sedge (*Gahnia* sp.) also common. Areas of open water tend to supportsa variety of aquatic plants including; Common Reed (*Phragmites australis*), Floating Pondweed (*Potamogeton tricarinatus*), Water Primrose (*Ludwigia peploides*) Duckweed (*Lemna* sp.), Water Buttons (*Cotula coronopifolia*) and Red Azolla (*Azolla filiculoides*).

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The Gosford-Cooranbong Coastal Slopes is described by Mitchell (2008) as being located on the coastal fall of the Sydney Basin on rolling hills and sandstone plateau outliers of Triassic Narrabeen sandstones with extensive rock outcrop and low cliffs along ridge margins. Elevations within the landscape are generally 0 to 75 m. Soils are comprised of texture-contrast soils on lithic sandstones and shales with loamy sand alluvium along creeks and organic sand and mud in lagoons and swamps. Vegetation comprises open forest and woodland of Smooth-barked Apple (*Angophora costata*), Red Bloodwood (*Corymbia gummifera*), Brown Stringybark *(Eucalyptus capitellata*), Sydney Peppermint *(Eucalyptus piperita*), Spotted Gum *(Corymbia maculata*), Bastard Mahogany *(Eucalyptus carnea*), Grey Ironbark *(Eucalyptus siderophloia*) and Grey Gum *(Eucalyptus punctata*) on hills and slopes. Small areas of closed forest with; Turpentine (*Syncarpia glomulifera*), Lilly Pilly (*Acmena smithii*), Mountain Cedar Wattle (*Acacia elata*), Coachwood (*Ceratopetalum apetalum*), Sassafras (*Doryphora sassafras*) and Water Gum (*Tristaniopsis laurina*) in gullies under high escarpments Prickly-leaved Tea-tree (*Melaleuca styphelioides*) and other shrubs with Swamp Mahogany *(Eucalyptus robusta*), Swamp oak (*Casuarina glauca*), Sedges and Common Reed (*Phragmites australis*) on swampy creek flats.

3.1.4 Climate

The site has a sub-tropical to temperate climate. Based on data from the Norah Head weather station the site has a mean annual rainfall of 1152 mm, falling predominantly in summer and autumn. The mean daily maximum temperature of 22.3 degrees and mean daily minimum temperature of 15.2 degrees Celsius (BOM, 2018b).

3.1.5 Soils and Geology

Soil landscapes

The Soil Landscapes of the Gosford-Lake Macquarie 1:100 000 mapping indicates that the entire subject site is covered by the one soil landscape (Gorokan) (Murphy 1992). The Gorokan Soil Landscape (9131 Gk).generally consist of undulating hills and rises on lithic sandstones of the Tugggerah Formation with slope gradients of less than 15 percent and local relief to 30 metres. Soils consist of moderately deep (50-150 cm), Yellow Podzolic Soils and Soloths on ridges and crests, Yellow Podzolic Soils, Soloths and Grey-brown Podzolic soils on slopes with Gleyed Podozolic Soils along drainage lines.

The soils are highly erosional and are hardsetting and of low fertility due to high acidity and seasonal waterlogging (Murphy 1992).

Soil hazards

Soil landscapes for the subject site and surrounding buffer area indicate that the soils are highly erosional. Some soils to the south / southeast of the site along Wallarah creek are also mapped as having high acid sulphate potential (refer to Figure 3-1) (Murphy 2002).

Areas of geological significance

There are no karst, caves, crevices, cliffs or other areas of geological significance located within the subject site or buffer area surrounding the site.

3.1.6 Hydrology

The subject site includes one small ephemeral drainage line which drains south into Wallarah Creek, which in turn drains into Budgewoi Lake, located approximately two kilometres southeast of the subject site (refer to Figure 1-2). There is also a low-lying swampy area located in the southwest corner of the site which is associated with the fringing riparian vegetation along Wallarah Creek (refer to Figure 3-2).

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3.1.7 Wetlands

No wetlands occur within or immediately adjacent to the subject site. There is a small coastal wetland located on Wallarah creek, approximately 1.5 kilometres downstream of the subject site. This wetland is located just outside the buffer area for the proposal. This wetland is mapped as a coastal wetland under the State Environment Planning Policy (SEPP) (Coastal Management) 2018 (refer to Figure 1-2).

3.1.8 Patch size and connectivity features

Vegetation that would be disturbed within the site is part of a much larger remnant patch that extends to the north, and west of the site. The size of this patch is greater than 1,500 hectares. This patch also extends to the east/southeast of the subject site although the Sydney-Newcastle railway dissects it along the southeastern boundary of the site. More mobile fauna species would readily traverse the gap created by the railway, for these species the patch size would therefore be in excess of 2,000 hectares.

Within the subject site and surrounding 1,500 metre buffer area native vegetation comprises approximately 80 percent of the area.

Drainage lines through the site link to Wallarah Creek, which flows into Budgewoi Lake, to the southeast of site. Swamp forest vegetation along these drainage lines provides a contiguous vegetated link to the aquatic and riparian habitats along Wallarah Creek.

Table 3-1 Summary of landscape features present within the subject site

Landscape feature	Subject site
Method applied for site context components	Site-based
Interim Biogeographic regionalisation of Australia (IBRA) bioregion	Sydney Basin
IBRA subregion	Wyong
Predominant Mitchell landscape	Sydney-Newcastle Coastal Alluvial Plains
% native vegetation extent within buffer area	79.8 percent
Rivers, streams and estuaries	The subject site contains a number of small unnamed drainage lines that connect to a second order stream, Wallarah Creek that runs adjacent to the site to the southwest and to the west of the site.
Wetlands	None within or adjacent to the site. Small Coastal Management SEPP located approximately 1.5 kilometres to the west of the site.
Connectivity features	The site is connected to extensive areas of vegetation to the north and west of the site. It is also connected to riparian and aquatic corridors of Wallarah Creek located to the southwest and to the west of the site (although dissected by the Sydney-Newcastle rail to the east of the site).
Areas of geological significance or soil hazard features	Soil landscapes for the subject site and surrounding buffer area indicate that the soils are highly erosional and have high acid sulphate potential
Other landscape features	Nil
Current percent native vegetation cover buffer area	79.8 percent
The future percent native vegetation cover buffer area	76.2 percent

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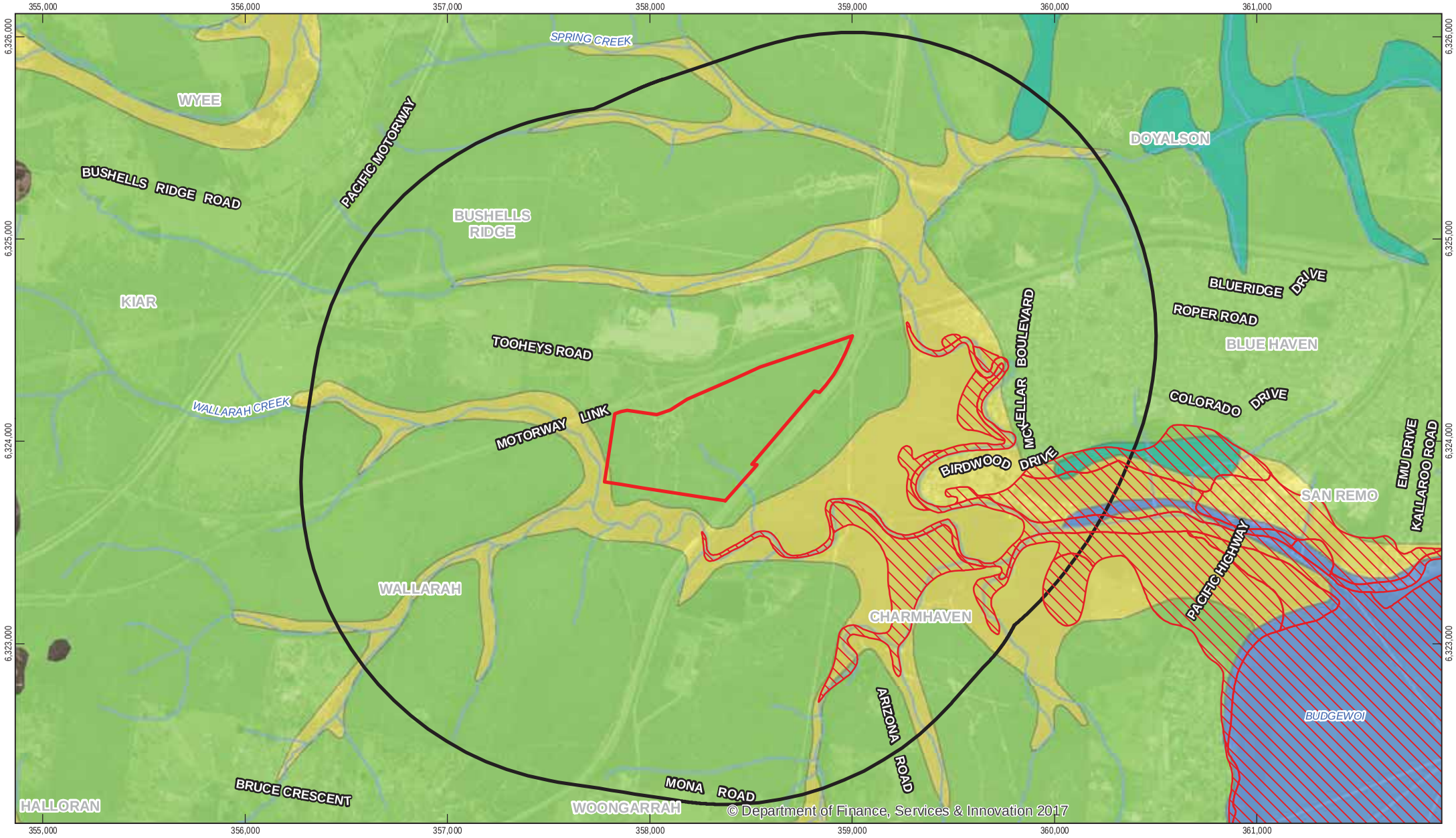

Paper Size A4

0 90 180 360 540 720

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

0

LEGEND

- Biocertification area
- Landscape Assessment (1500m buffer)
- Watercourse

Soil landscapes

- Alluvial
- Erosional
- Swamp

- Water

Acid Sulfate Soil Risk

- High probability of occurrence

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Darkinjung Local Aboriginal Land Council
Motorway Link Residential Subdivision
Biodiversity Certification Assessment Report

Job Number 22-18652
Revision A
Date 19 Apr 2018

Soil landscapes and hazards

Figure 3-1

G:\22\18652\GIS\Maps\Deliverables\BCAR\2218652_BCAR003_SoilHazards_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

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Data source: LPI: DTDB / DCDB, 2012, Aerial Imagery, 2016; DPI: Soil landscapes, 2008; OEH: ASS Risk, 2016. Created by: fmackay

3.2 Native vegetation

3.2.1 Flora species

A total of 85 flora species from 25 families were recorded within the subject site, comprising 80 native and five exotic species. The Myrtaceae (16 species, all native), Poaceae (13 species, 8 native) and Fabaceae (10 species, all native) were the most diverse families recorded. Two threatened flora species were recorded within the subject site (see Section 4.2.1). A full list of flora species recorded is provided in Appendix B. Common species recorded are discussed below in relation to the vegetation zones occurring within the subject site.

3.2.2 Plant Community Types

Overview

To determine the appropriate PCTs for the site the following data was collected in the field and then compared against PCTs outlined in the BioNet Vegetation Classification Database (OEH 2018c).

- Soil type
- Landscape position
- Floristics data and structural composition

Other things considered when determining the PCT types included

- Regional Vegetation Mapping (Hunter Council 2002)
- Site disturbance history (i.e. fire history)

Field surveys confirmed the presence of two PCTs within the subject site. Both of these vegetation types are in moderate/good - high condition yielding two vegetation zones, which are shown on Figure 3-2, summarised in Table 3-2 and described below.

The majority of the site is dominated by Scribbly Gum- Red Bloodwood-*Angophora inopina* heathy woodland on lowlands of the Central Coast (PCT 1636). This community occurs on coastal flats and low rises in the Wyong, Gosford, Lake Macquarie, Cessnock and Newcastle LGAs. There is also two low-lying swampy areas in the southeast and south western corner of the site that are contagious with vegetation along the edges of Wallarah creek that support small areas of Smooth Barked Apple- Red Mahogany- Swamp Mahogany- Melaleuca sieberi heathy swamp woodland of coastal lowlands (PCT 1649).

Mature and hollow-bearing trees are scattered across the site and there is regeneration occurring of all canopy species within the site. There are several disturbed tracks throughout the site as well as a small cleared area off the main access track in the southwest of the site, which contains small patches of exotic grasses and exposed soil. This area has been subject to rubbish dumping, including household refuse and building waste.

The majority of vegetation within the site is in high condition with few weeds present. However there are several patches of *Andropogon virginicus* (Whisky Grass), *Setaria sphacelata* (Pigeon Grass), *Paspalum urvillei* (Vasey Grass), *Cortaderia selloana* (Pampas Grass) and *Chloris gayana* (Rhode's Grass) along road verges and disturbed areas throughout the site.

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Table 3-2 Vegetation zones within the subject site

Plant Community Type (OEH, 2018a)	PCT ID	Condition	Area (ha)	Patch size (ha)	Vegetation integrity score	Conservation significance
Scribbly Gum-Red Bloodwood-Angophora inopina heathy woodland on lowlands of the Central Coast	1636	Moderate/good – high	43.5	> 100	61.5	Not listed as an EEC
Smooth Barked Apple-Red Mahogany-Swamp Mahogany-Melaleuca sieberi heathy swamp woodland of coastal lowlands	1649	Moderate/good – high	1.5	> 100	58.4	Swamp Sclerophyll Swamp Forest Endangered Ecological Community (EEC)
		Total area	**45.0**			

Vegetation zones

The structure, species composition and condition of each of the vegetation zones within the subject site are described below. Plant species lists are provided in Appendix B. Plot data is provided in Appendix C along with benchmark values for each vegetation type.

Table 3-3 Zone 1 - Scribbly Gum- Red Bloodwood-*Angophora inopina* heathy woodland on lowlands of the Central Coast

Scribbly Gum- Red Bloodwood-*Angophora inopina* heathy woodland on lowlands of the Central Coast		
PCT (OEH, 2018c)	Scribbly Gum- Red Bloodwood-Angophora inopina heathy woodland on lowlands of the Central Coast	
PCT ID	1636	
Survey effort	Plots 1, 3, 5 and 6	
Conservation significance	Not listed as an EEC	

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Scribbly Gum- Red Bloodwood-*Angophora inopina* heathy woodland on lowlands of the Central Coast	
Estimated percentage cleared (OEH 2018c)	58 percent
Patch size	> 100 hectares
Condition	Plot data confirms that this vegetation is in moderate/good – high condition, with benchmark or near-benchmark values for native plant species richness and most vegetation cover attributes although percentage of shrub cover is substantially lower than benchmark values. A relatively high number of hollow-bearing trees were recorded within plot in this zone, in particular in Scribbly Gums. There is a relatively low amount of fallen logs and leaf litter present, possibly as a result of the recent fire at the site. Exotic plant cover is very low with no exotic species being recorded in any of the plots. All of the native canopy species present in the vegetation zone were observed regenerating.
Vegetation integrity score	61.5
Landscape position	This community occurs on coastal lowlands from northern Tuggerah Lake to the northern end of Lake Macquarie, on a substrate of sandstone with moist sandy soils with an elevation usually under 100 metres.
Structure	Open Forest or woodland
Over storey	This open woodland occurs on a sandy substrate and is dominated by *Eucalyptus haemastoma* (Scribbly Gum) in association with *Angophora costata* (Smooth Barked Apple), *Corymbia gummifera* (Bloodwood) and occasional *Eucalyptus capitulata* (Brown Stringybark) and *Allocasuarina littoralis* (Black She-Oak) (to 20 metres).
Mid storey	The mid storey consists of low shrubs and trees, including *Banksia oblongifolia* (Fern-leaved Banksia), *Banksia spinulosa* (Hairpin Banksia), *Angophora inopina* (Charmhaven Apple) *Hakea dactyloides* (Finger Hakea), *Lambertia formosa* (Mountain Devil), *Petrophila pulchella* (Conesticks), *Isopogon anemonifolius* (Broad-leaf Drumsticks), *Pultenaea retusa* (Notched Bush-pea) and *Epacris pulchella* (Wallum Heath)
Groundcover	The groundcover is grassy and is typically characterised by *Entolasia stricta* (Wiry Panic), *Xanthorrhoea latifolia*, *Lepyrodia scariosa*, *Themeda australis* (Kangaroo Grass), *Anisopogon avenaceus* (Oat Grass) and *Lepidosperma laterale*. Common herbaceous species include *Ptilothrix deusta*, *Platysace linearifolia*, *Hibbertia riparia*, *Pultenaea tuberculata, Lomandra obliqua*, *Mirbelia rubiifolia* (Mirbelia), and *Gonocarpus tetragynus* (Raspwort). Scrambling climbers such as *Glycine clandestina* and *Cassytha glabella* are also common within the community.
Exotic species	No exotic species were recorded within any of the plots surveys within this PCT.

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Table 3-4 Zone 2- Smooth Barked Apple- Red Mahogany- Swamp Mahogany- Melaleuca sieberi heathy swamp woodland of coastal lowlands

Zone 2 – Smooth Barked Apple- Red Mahogany- Swamp Mahogany- Melaleuca sieberi heathy swamp woodland of coastal lowlands (PCT 1649)		
PCT (OEH, 2018c)	Smooth Barked Apple- Red Mahogany- Swamp Mahogany- Melaleuca sieberi heathy swamp woodland of coastal lowlands.	
PCT ID	1649.	
Survey effort	Plot 5 & 9.	
Conservation significance	Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions, Endangered Ecological Community (EEC) listed under the BC Act.	
Estimated percentage cleared (OEH 2018c)	58.4 percent	
Patch Size	> 100 hectares.	
Condition	Plot/transect data confirms that this vegetation is in moderate/good – high condition, with benchmark or near-benchmark values for native plant species richness and most vegetation cover attributes. There is a relatively low amount of fallen logs and leaf litter present, possibly as a result of recent fire at the site. All of the native canopy species present in the vegetation zone were also observed to be regenerating. No exotic species were recorded within this vegetation zone.	
-Vegetation integrity Score	54.3.	
Landscape position	This community is common on coastal floodplains on poorly drained lowlands from the Broadwater to Failford. It mainly occurs on unconsolidated sediments at elevations below 50 metres.	
Structure	Open forest or woodland.	
Over storey	The canopy of this community is dominated by *Melaleuca sieberi* to 15 metres tall with occasional *Eucalyptus robusta (*Swamp Mahogany), *Eucalyptus resinifera (*Red Mahogany), *Allocasuarina littoralis* (Black She-Oak) and *Melaleuca nodosa* (Prickly-leaved Paperbark).	
Mid storey	The mid storey is characterised by a dense layer of shrubs, including *Acacia longifolia* subsp *longifolia*, *Acacia suaveolens* (Sweet Wattle) *Leptospermum polygalifolium* (Tantoon), *Banksia oblongifolia* (Fern-leaf Banksia) and *Leptospermum trinervium* (Slender Tea-tree).	
Groundcover	The groundlayer is dominated by water loving grasses, sedges and rushes, including *Baumea rubiginosa, Gahnia clarkei* (Tall Saw-sedge),*Ptilothrix deusta, Empodisma minus* (Spreading Rope Rush), *Lomandra longifolia* (Spiny-headed Mat-rush), *Schoenus brevifolius* (Zig-zag Bog-rush), *Themeda australis* (Kangaroo Grass) and *Leptocarpus tenax.*	
Exotic species	No exotic species were recorded within any of the plots surveys within this PCT.	

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3.2.3 Justification of evidence used to identify Plant Community Types within subject site

A number of PCTs were considered when classifying the dry sclerophyll forest within the subject site. These included:

- PCT 1636- Scribbly Gum- Red Bloodwood-Angophora inopina heathy woodland on lowlands of the Central Coast
- PCT 1638 – Smooth-barked Apple-Red Bloodwood-Scribbly Gum grass-shrub woodland on lowlands of the Central Coast
- PCT 1642 –Scribbly Gum- Red Bloodwood-Old Man Banksia heathy woodland of southern Central Coast
- PCT 1137 Scribbly Gum –Red Bloodwood heathy woodland on the coastal plains of the Central coast
- PCT 1619 - Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands

PCT 1636 is considered the best fit for the dry sclerophyll vegetation at the site as it has a good floristic match, with 13 of the 14 species identified in the BioNet vegetation classification database recorded in this community within the site. This PCT also closely aligns to the site description, geology and topography of the site as it is described as occurring on sandstone with sandy moist soils on coastal lowlands from Northern Tuggerah Lake to the northern end of Lake Macquarie.

PCT 1638 was also considered a good fit for this vegetation type with the majority of the species identified on the BioNet classification database recorded at the site. The general description provided in the BioNet database also closely matches the sites location, geology and landscape position. The dominant mid-strata and ground-storey species that occur within the subject site however appear to be slightly more aligned with PCT 1636 (i.e. midstorey is dominated by *Banksia oblongifolia, Hakea dactyloides, Xanthorrhoea* spp and *Lambertia formosa*, which are listed as characteristic species of the midstorey in PCT 1636. The groundlayer is characterised by *Lepyrodia scariosa, Petrophila pulchella, Epacris pulchella* and *Ptilothrix deusta* which also aligns more closely with PCT 1636 (although *Entolasia stricta* also dominates in some areas, which is listed as a key species in PCT 1638). Furthermore, the presence of *Angophora inopina* (Charmhaven Apple) throughout the site also suggests that the PCT more closely aligns to PCT 1636 than it does to 1638.

PCT 1642 does not represent a good floristic match for the site as only five of the 15 species listed in the BioNet vegetation database for PCT recorded within the site. Furthermore, PCT 1642 is described as occurring on dissected sandstone hills of the southern central coast hinterland, which doesn't align with the landscape position of the site.

PCT 1137 was discounted as a potential PCT for the site as despite having a relatively good floristic match, this community has been decommissioned due to its classification having a very low confidence level.

The BioNet description of PCT 1619 has some floristic commonalities with the site with 13 of the 18 species described as occurring within this PCT recorded within the subject site. This community was discounted however as it does not contain *Eucalyptus haemastoma (*Scribbly Gum), which is a characteristic species within the subject site.

When classifying the swamp forest within the site PCTs that were considered included:

- PCT 1649 –Smooth Barked Apple- Red Mahogany- Swamp Mahogany- Melaleuca sieberi heathy swamp woodland of coastal lowlands.

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- PCT 926 – Melaleuca sieberi-Tall Saw-sedge closed shrubland in drainage lines on the Central Coast, Sydney Basin Bioregion.
- PCT 1717 -Broad-leaved Paperbark - Swamp Mahogany - Swamp Oak - Saw Sedge swamp forest of the Central Coast and Lower North Coast.
- PCT 1231 -Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion.
- PCT 1730 – Swamp Paperbark –Baumea juncea swamp shrubland on coastal lowlands of the Central Coast and Lower North Coast.

None of the above PCTs represents an ideal match for the vegetation on site. PCT 1649 was identified as the best fit as 10 of the 15 (67 percent) species identified in the BioNet vegetation classification database for this PCT were recorded within the site (opposed to 42 percent for PCT 926, 36 percent for both PCT 1717 and 1231 and only 30 percent for PCT 1730).

Furthermore, the BioNet Vegetation Classification database describes PCT 1646 as occurring on low poorly drained sands from Tumbi Umbi to Crowdy Head, which is consistent with the general landscape and geographic position of the subject site (OEH 2018c). Whereas PCT 1717 occurs on coastal floodplains and poorly drained lowlands from the Broadwater to Failford.

3.2.4 Other vegetation on the subject site

There are a large number of narrow cleared and partially cleared tracks through the subject site. These trails are relatively narrow and have been included in the assessment through their incorporation into the adjacent vegetation zone.

3.2.5 Threatened ecological communities

Areas mapped as PCT 1649 –Smooth Barked Apple- Red Mahogany- Swamp Mahogany- Melaleuca sieberi heathy swamp woodland of coastal lowlands are commensurate with the Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions EEC listed under the BC Act.

3.2.6 Groundwater dependent ecosystems

The *NSW State Groundwater Dependent Ecosystems Policy* defines groundwater dependent ecosystems (GDEs) as ecosystems, which have their species composition, and their natural ecological processes determined by groundwater (DLWC 2002). Ecosystems vary dramatically in the degree of dependency of groundwater, from having no apparent dependence through to being entirely dependent on it (DLWC 2002).

Dependence (or interaction) of the vegetation communities identified within the subject site on groundwater was determined by searching the Atlas of GDEs (BOM 2018a). This Atlas predicts the occurrence of groundwater dependent ecosystems and ecosystems that potentially use groundwater. It shows ecosystems that interact with the subsurface expression of groundwater (including vegetation ecosystems) or the surface expression of groundwater (such as rivers and wetlands. The Atlas also shows the likelihood that landscapes are accessing water in addition to rainfall, such as soil water, surface water or groundwater. Native vegetation within the subject site is mapped as vegetation that has high potential for being reliant on subsurface groundwater. PCT 1649 is considered to have high potential to be a terrestrial GDE and PCT 1636 is mapped as having moderate potential to be groundwater dependant and is likely to be intermittently dependent on groundwater (BOM 2018a).

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3.2.7 Habitat resources

The subject site is predominantly dry open forest/woodland situated within a tract of relatively contiguous vegetated land to the north of Wallarah Creek. Dominant overstorey trees include Scribbly Gum (*Eucalyptus haemastoma*), Red Bloodwood (*Corymbia gummifera*), Smooth-barked Apple (*Angophora costata*) and Brown Stringybark (*Eucalyptus capitellata*). The presence of both smooth and rough-barked trees makes it particularly suitable for birds which forage beneath the bark of trees, particularly White-throated Treecreeper (*Cormobates leucophaea*) and the threatened Varied Sittella (*Daphoenositta chrysoptera*) which was recorded foraging within the site. Most of the overstorey species provide suitable almost year round foraging resources for nectivorous fauna including honeyeaters, lorikeets including the threatened Little Lorikeet (*Glossopsitta pusilla*) and marsupial gliders, in particular the threatened Squirrel Glider (*Petaurus norfolcensis*). The southern half of the site becomes progressively more suitable for the threatened Yellow-bellied Glider (*Petaurus australis*).

The overstorey contains numerous hollow bearing trees estimated at densities of 8-14 hollow bearing trees per hectare. Hollow sizes range from small (<50 mm aperture) limb and trunk hollows through to large (>150 mm aperture) and occasionally some very large hollows exceeding 250 mm aperture. Together, they provide roosting, refuge and breeding habitat for a range of fauna including small scansorial mammals (i.e. Antechinus), micro bats, arboreal herpetofauna (tree frogs, monitor lizards; python), gliders (Sugar and Squirrel), birds (parrots, tree creeper, lorikeets) and possums (i.e. brushtail and ringtail). The density of trees hollows are such that the Common Ringtail Possum (*Pseudocheirus peregrinus*) preferentially uses hollows at this site as opposed to constructing dreys. From a threatened species perspective, Squirrel Glider almost certainly uses hollows across the site as would a number of hollow dependant bats including the Eastern Free-tail Bat (*Mormopterus norfolkensis*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*). A number of threatened birds may also utilise these hollows, particularly the Little Lorikeet given the regularity with which it was recorded using the site. The larger hollows are suitable for a number of large forest owls, particularly the Masked Owl (*Tyto novaehollandiae*) which was recorded on site and Barking Owl (*Ninox connivens*) which is known from the area. Closer to Wallarah Creek, the larger hollows located in the taller forest appear particularly suitable for Powerful Owl (*Ninox strenua*). Some threatened herpetofauna species including the Stephens Banded Snake may inhabit the southern part of the site given the density of hollows and the availability of prey.

The mid storey is generally comprised of regenerating overstorey species along with Black She-oak (*Allocasuarina littoralis*) and occasionally Prickly-leaved Paperbark (*Melaleuca nodosa*), *Melaleuca sieberi* and Broad-leaved Paperbark (*Melaleuca quinquenervia*) in areas more prone to inundation. The Melaleuca's provide an important foraging resource, particularly at the end of summer and into autumn for marsupial gliders. The *Allocasuarina* provides a confirmed foraging resource for the threatened Glossy Black Cockatoo, particularly in the southern part of the site where most patches show some form of prior use.

The under storey consists of low shrubs including *Banksia oblongifolia* (Fern-leaved Banksia), *Banksia spinulosa* (Hairpin Banksia), *Hakea dactyloides* (Finger Hakea), *Lambertia formosa* (Mountain Devil), *Petrophila pulchella* (Conesticks), *Isopogon anemonifolius* (Broad-leaf Drumsticks) *Leptospermum trinervium (*Slender Tea-tree), *Pultenaea retusa* (Notched Bush-pea), *Micromyrtus ciliata* (Fringed Heath-myrtle) and *Epacris pulchella* (Wallum Heath). Apart from it providing habitat for cover dependant fauna such as bandicoots, Swamp Rat (*Rattus lutreolus*) and Swamp Wallaby (*Wallabia bicolor*) some threatened fauna may forage in this community, particularly Eastern Pygmy Possum (*Cercartetus nanus*) and seasonally gliders may also access some of the flowering Banksia and Lambertia.

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In general the groundcover is composed of 5-8% log cover, 2-4% rock cover, 5-8% litter, around 8% bare ground and the remainder (i.e. approximately 70-75%) vegetation. This broad composite of resources is suitable for a range of ground dwelling mammals, myobatrachid (i.e. ground dwelling) frogs and reptiles. The vegetation is generally characterised by *Entolasia stricta* (Wiry Panic), *Xanthorrhoea latifolia*, *Lepyrodia scariosa*, *Themeda australis* (Kangaroo Grass), *Anisopogon avenaceus* (Oat Grass) and *Lepidosperma laterale*. Common herbaceous species include *Ptilothrix deusta*, *Platysace linearifolia*, *Hibbertia riparia*, *Pultenaea tuberculata, Lomandra obliqua*, *Mirbelia rubiifolia* (Mirbelia), and *Gonocarpus tetragynus* (Raspwort). Scrambling climbers such as *Glycine clandestina* and *Cassytha glabella* are also common within the community. Together, they provide both foraging and refuge resource for ground dwelling and herbivorous fauna (i.e. rodents, macropods). In wetter areas, sedges and rushes tend to dominate and include *Baumea rubiginosa* (Jointed Twigrush)*, Gahnia clarkei* (Tall Saw-sedge), *Ptilothrix deusta, Empodisma minus* (Spreading Rope Rush), *Lomandra longifolia* (Spiny-headed Mat-rush), *Schoenus brevifolius* (Zig-zag Bog-rush) and *Leptocarpus tenax.* It is these locations which provide habitat for the threatened Wallum Froglet (*Crinia tinnula*). There was however, no obvious permanent wetlands or streams to suggest the site provides habitat for other threatened frog fauna such as the Green and Golden Bell Frog (*Litoria aurea*) and Giant Burrowing Frog (*Heleioporus australiacus*).

The BAM assessment of habitat resources at the subject site was completed with reference to the above observations. The following specific geographic and habitat features were identified within the site and indicate the potential presence of threatened species that contribute to the credit calculations:

- Fallen/standing dead timber including logs
- Semi-permanent/ephemeral wet areas
- Land within 1 km of wet areas/swamps
- Land containing swamps
- Swamp margins or creek edges
- Hollow bearing trees
- Land within 500 meters of swamps

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Plate 1 Scribbly Gum- Red Bloodwood-*Angophora inopina* heathy woodland on lowlands of the Central Coast (PCT 1636)

Plate 2 Scribbly Gum- Red Bloodwood-*Angophora inopina* heathy woodland on lowlands of the Central Coast (PCT 1636)

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Plate 3 Smooth Barked Apple- Red Mahogany- Swamp Mahogany- Melaleuca sieberi heathy swamp woodland of coastal lowlands (PCT 1649)

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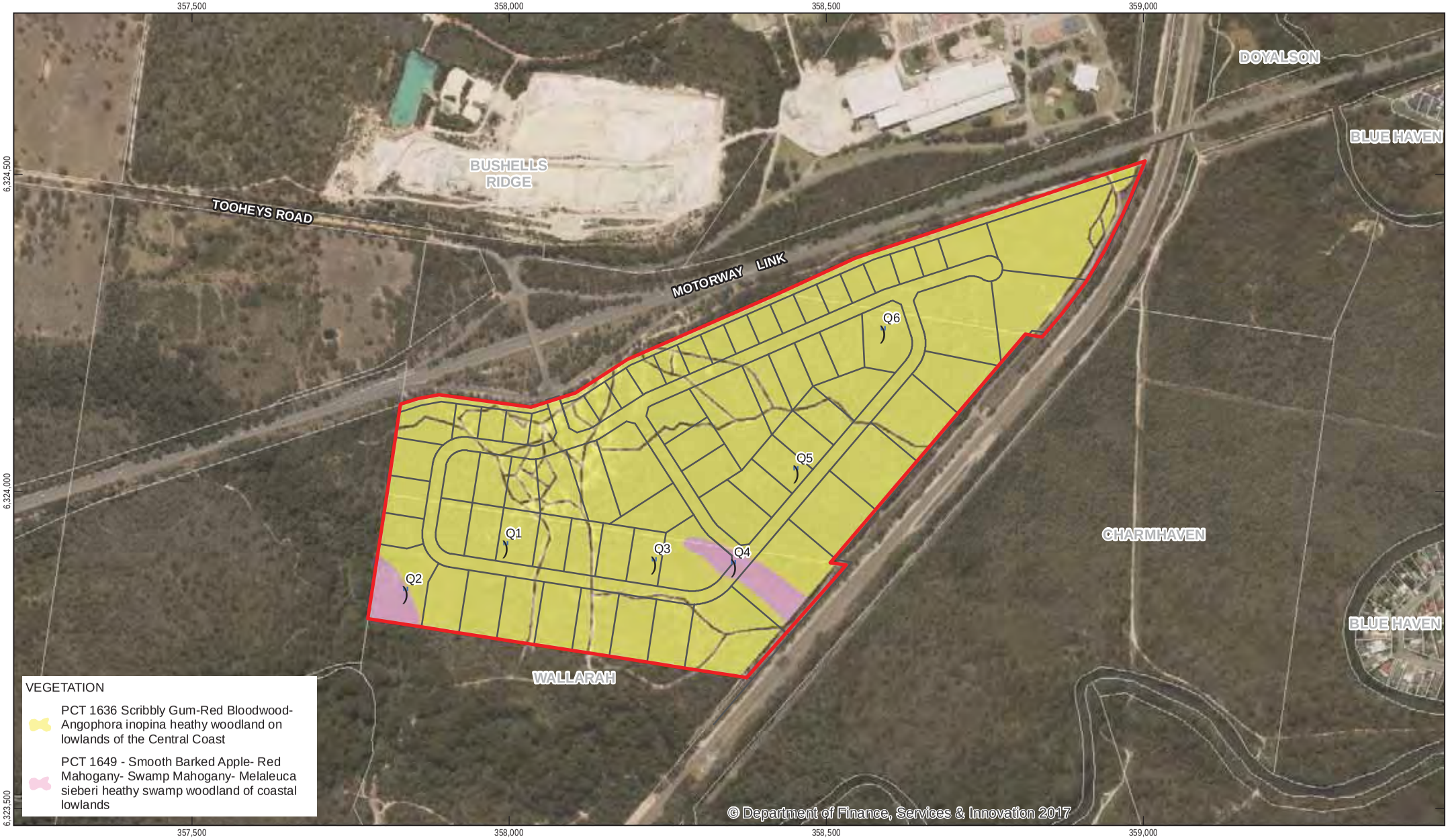

Paper Size A4

0 25 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Biocertification area
- Proposed subdivision
- Cadastre
- BAM plot surveys

DRAFT

Darkinjung Local Aboriginal Land Council
Motorway Link Residential Subdivision
Biodiversity Certification Assessment Report

Job Number 22-18652
Revision A
Date 19 Apr 2018

Plant community and BAM plots

Figure 3-2

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

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Data source: LPI: DTDB / DCDB, 2012, Aerial Imagery, 2016; EcoLogical: Vegetation mapping, 2016. Created by: fmackay

4. Conservation significance

4.1 Identification of threatened species under the BAM

4.1.1 Predicted threatened species

Based on the vegetation types and habitat resources present within the site, the BAM calculator generates a list of threatened fauna species that are predicted to utilise the subject site. The suite of threatened species associated with ecosystem credits required for the subject site are listed in Table 4-1. For each predicted threatened species a sensitivity class rating and vegetation zones they are predicted to be associated with are also provided. Targeted surveys are not required for these species.

Five of these species (Little Bent-wing Bat (*Miniopterus australis*), Eastern Free-tail Bat (*Mormopterus norfolkensis*), Grey-headed Flying-fox (*Pteropus poliocephalus)*, Varied Sittella (*Daphoenositta chrysoptera*) and Little Lorikeet (*Glossopsitta pusilla*)) were recorded within the subject site during fauna surveys completed at the site.

Table 4-1 Predicted threatened species (ecosystem species)

Common name	Scientific name	Sensitivity class[1]	Vegetation zone predicted to occur in	Habitat present
Barking Owl[2]	*Ninox connivens*	High	1636 1649	Yes
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis* subsp. *gularis*	Moderate	1636	Yes
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus* subsp. *victoriae*	High	1636	Yes
Eastern Bentwing-bat[2]	*Miniopterus schreibersii oceanensis*	High	1636 1649	Yes
Eastern Chestnut Mouse	*Pseudomys gracilicaudatus*	High	1636 1649	Yes
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	High	1636 1649	Yes
Eastern Freetail-bat[2]	*Mormopterus norfolkensis*	High	1636 1649	Yes
Eastern Osprey[2]	*Pandion cristatus*	Moderate	1636 1649	Yes
Gang-gang Cockatoo[2]	*Callocephalon fimbriatum*	Moderate	1636 1649	Yes

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Common name	Scientific name	Sensitivity class[1]	Vegetation zone predicted to occur in	Habitat present
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	High	1636 1649	Yes
Golden-tipped Bat	*Kevivoula papuensis*	High	1636 1649	Yes
Greater Broad-nosed Bat	*Scoteanax rueppellii*	High	1636 1649	Yes
Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis* subsp. *temporalis*	Moderate	1636	Yes
Grey-headed Flying-fox [2]	*Pteropus poliocephalus*	High	1636 1649	Yes
Koala[2]	*Phascolarctos cinereus*	High	1636 1649	Yes
Little Bentwing-bat[2]	*Miniopterus australis*	High	1636 1649	Yes
Little Eagle[2]	*Hieraaetus morphnoides*	Moderate	1636 1649	Yes
Little Lorikeet	*Glossopsitta pusilla*	High	1636 1649	Yes
Long-nosed Potoroo	*Potorous tridactylus*	High	1636 1649	Yes
Masked Owl[2]	*Tyto novaehollandiae*	High	1636	Yes
Painted Honeyeater	*Grantiella picta*	High	1636	Yes
Powerful Owl[2]	*Ninox strenua*	High	1636	Yes
Regent Honeyeater	*Anthochaera phrygia*	High	1649	Yes
Scarlet Robin	*Petroica boodang*	High	1636	Yes
Speckled Warbler	*Chthonicola sagittata*	High	1636	Yes
Spotted-tailed Quoll	*Dasyurus maculatus*	High	1636 1649	Yes
Square-tailed Kite[2]	*Lophoictinia isura*	Moderate	1636	Yes
Swift Parrot[2]	*Lathamus discolor*	Moderate	1636 1649	Yes

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Common name	Scientific name	Sensitivity class[1]	Vegetation zone predicted to occur in	Habitat present
Turquoise Parrot	*Neophema pulchella*	High	1636	Yes
Varied Sittella	*Daphoenositta chrysoptera*	Moderate	1636 1649	Yes
White-bellied Sea-eagle[2]	*Haliaeetus leucogaster*	High	1636 1649	Yes
Yellow-bellied Glider	*Petaurus australis*	High	1636 1649	Yes
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	High	1636 1649	Yes

[1] Sensitivity to gain class – High = high sensitivity to potential gain, Moderate = moderate sensitivity to potential gain.

[2] These species are predicted ecosystem credit species due to foraging habitat within the site (they may also be species credit species if known breeding habitat occurs within the site).

4.1.2 Species credit species

Threatened species that cannot reliably be predicted to occur on a development site based on PCT, distribution and habitat criteria are identified by the Threatened Biodiversity Data Collection as 'species credit species'. In some circumstances, the particular habitat components of species assessed for ecosystem credit species, such as the breeding habitat of a cave roosting bat or forest owls, are also assessed for species credits. The credit calculator references geographic, vegetation and habitat data for the proposal footprint to generate a list of the species credit-type threatened species predicted to occur and requiring targeted survey. Searches of threatened species databases were also completed to determine any additional species to those generated by the credit calculator that are known or predicted to occur in the locality (refer to likelihood of occurrence table in Appendix A). These results were reviewed giving consideration to the relevant habitats available on site, to determine the candidate species credit species that may potentially occur onsite. These species are identified in Table 4-2. Surveys were conducted in the appropriate season for the majority of species credit-type species (see Table 4-2). Further targeted surveys are required for some species credit species. These surveys will be completed at the appropriate time of year to target these species (refer to species highlighted in Table 4-2).

Five species credit species were recorded during targeted surveys completed by GHD and EcoLogical within the subject site:

- *Tetratheca juncea* (Black Eyed-Susan)
- *Angophora inopina* (Charmhaven Apple)
- *Acacia bynoeana* (Bynone's Wattle)
- *Petaurus norfolcensis* (Squirrel Glider)
- *Crinia tinnula* (Wallum Froglet) (recorded during EcoLogical surveys completed within the subject site during 2010 - 2012)

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Table 4-2 Candidate species credit species with potential to occur within subject site

Common name	Scientific name	Habitat present within the site	Recorded within subject site	Survey adequacy (recommended survey period)
Barking Owl (Breeding)	*Ninox connivens*	Yes	No	***Further targeted surveys required for this species (May-Dec***
Biconvex Paperbark	*Melaleuca biconvexa*	Yes	No	Adequate: surveyed 12 April and 27-28 October (All year)
Black-eyed Susan	*Tetratheca juncea*	Yes	**Yes**	Adequate: surveyed 27-28 October (July-Dec)
Brush-tailed Phascogale	*Phascogale tapoatafa*	Yes	No	Adequate: surveyed 22-26 January (All year)
Brush-tailed Rock wallaby	*Petrogale penicillata*	No (no rocky outcrops, cliffs or escarpments within subject site)	No	Adequate: surveyed 22-26 January (All year)
Bush Stone-curlew	*Burhinus grallarius*	Yes	No	Adequate: surveyed 22-26 January (All year)
Bynoe's Wattle	*Acacia bynoeana*	Yes	**Yes**	Adequate: 27-28 October (Sept-March)
Camfield's Stringybark	*Eucalyptus camfieldii*	Yes	No	Adequate: surveyed 12 April and 27-28 October (All year)
Charmhaven Apple	*Angophora inopina*	Yes	**Yes**	Adequate: surveyed 12 April and 27-28 October (All year)
Common Planigale	*Planigale maculata*	Yes	No	Adequate: surveyed 22-26 January (All year)
Eastern Bentwing-bat (Breeding)	*Miniopterus schreibersii oceanensis*	Yes	No	Adequate: surveyed 22-26 January (Nov-Feb)
Eastern Osprey (Breeding habitat)	*Pandion cristatus*	Yes	No	***Further targeted surveys required for this species (April-Nov)***
Eastern Pygmy-possum	*Cercartetus nanus*	Yes	No	Adequate: surveyed 22-26 January (Oct-March)
Eucalyptus parramattensis subsp. decadens	*Eucalyptus parramattensis subsp. decadens*	Yes	No	Adequate: surveyed 12 April and 27-28 October (All year)
Gang-gang Cockatoo (Breeding)	*Callocephalon fimbriatum*	Yes	No	Adequate: surveyed 22-26 January (Oct-Jan)
Giant Burrowing Frog	*Heleioporus australiacus*	Yes	No	Adequate: surveyed 22-26 January (Sept-May)

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Common name	Scientific name	Habitat present within the site	Recorded within subject site	Survey adequacy (recommended survey period)
Giant Drangonfly	*Petalura gigantea*	Yes	No	Adequate: surveyed 22-26 January (Dec-Jan)
Glossy Black-cockatoo	*Calyptorhynchus lathami*	Yes	No	***Further targeted surveys required for this species (March-August)***
Green and Golden Bell Frog	*Litoria aurea*	Yes (marginal)	No	Adequate: surveyed 22-26 January (Nov-March)
Green-thighed Frog	*Litoria brevipalmata*	Yes	No	Adequate: surveyed 22-26 January (Oct-March)
Grey-headed Flying-fox (breeding habitat)	*Pteropus poliocephalus*	Yes	Yes – recorded flying over the site	***Not adequate: Further targeted surveys required for this species (Oct-Dec)***
Grove's Paperbark	*Melaleuca groveana*	Yes	No	Adequate: surveyed 12 April and 27-28 October (All year)
Heath Wrinklewort	*Rutidosis heterogama*	Yes	No	Adequate: surveyed 12 April and 27-28 October (All year)
Koala	*Phascolarctos cinereus*	Yes	No	Adequate: surveyed 22-26 January (All year)
Large-eared Pied Bat	*Chalinolobus dwyeri*	Yes	No	Adequate: surveyed 22-26 January (Sept-March)
Large-footed Myotis (Breeding habitat)	*Myotis macropus*	Yes	No	Adequate: surveyed 22-26 January (All year)
Leafless Tongue Orchid	*Cryptostylis hunteriana*	Yes	No	Adequate: surveyed 4-5 December 2018 (Nov-Feb)
Little Bentwing-bat (Breeding habitat)	*Miniopterus australis*	Yes	No	Adequate: surveyed 22-26 January (Dec-Feb)
Little Eagle (Breeding habitat)	*Hieraaetus morphnoides*	Yes	No	***Not adequate: Further targeted surveys required for this species (Aug-Oct)***
Mahony's Toadlet	*Uperoleia mahonyi*	Yes	No	Adequate: surveyed 22-26 January (Oct-March)
Masked Owl (Breeding)	*Tyto novaehollandiae*	Yes	No	***Not adequate: Further targeted surveys required for this species (May-August)***
Netted Bottlebrush	*Callistemon linearifolius*	Yes	No	Adequate: surveyed 27-28 October (Sep-Mar)

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Common name	Scientific name	Habitat present within the site	Recorded within subject site	Survey adequacy (recommended survey period)
Pale-headed Snake	*Hoplocephalus bitorquatus*	Yes	No	Adequate: surveyed 22-26 January (Nov-March)
Powerful Owl (Breeding habitat)	*Ninox strenua*	Yes	No	***Not adequate: Further targeted surveys required for this species (May-August)***
Regent Honeyeater (Breeding habitat)	*Anthochaera phrygia*	Yes	No	Adequate: surveyed December 12-16 (Sept-Dec)
Rough Double Tail	*Diuris praecox*	Yes	No	***Not adequate: Further targeted surveys required for this species (Jul-Aug)***
Small-flower Grevillea	*Grevillea parviflora* subsp. *parviflora*	Yes	No	Adequate surveyed 12 April and 27-28 October (All year)
Sooty Owl (Breeding habitat)	*Tyto novaehollandiae*	Yes	No	***Not adequate: Further targeted surveys required for this species (April-August)***
Square-tailed Kite	*Lophoictinia isura*	Yes	No	Adequate: surveyed 22-26 January (Sept-Jan)
Squirrel Glider	*Petaurus norfolcensis*	Yes	No	Adequate: surveyed 22-26 January (All year)
Swift Parrot (Breeding habitat)	*Lathamus discolor*	Yes	No	***Not adequate: Further targeted surveys required for this species (May-August)***
Tetratheca glandulosa	*Tetratheca glandulosa*	Yes	No	Adequate: surveyed 27-28 October (Jul-Nov)
Thick-leaf Star-hair	*Astrotricha crassifolia*	Yes	No	Adequate: surveyed 12 April and 27-28 October (All year)
Tranquillity Mint-bush	*Prostanthera askania*	Yes	No	Adequate: surveyed 27-28 October (Sept-Dec)
Variable Midge Orchid	*Genoplesium insignis*	Yes	No	Adequate: surveyed 27-28 October (Sep-Oct)
Wallum Froglet	*Crinia tinnula*	Yes	**Yes (EcoLogical 2012)**	Adequate: surveyed 22-26 January (All year)
White-bellied Sea-eagle (Breeding habitat)	*Haliaeetus leucogaster*	Yes	No	***Not adequate: Further targeted surveys required for this species (July-Dec)***

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4.2 Threatened survey results

4.2.1 Threatened flora

Two threatened flora species (*Tetratheca juncea* (Black-eyed Susan) and *Angophora inopina* (Charmhaven Apple) were recorded within the subject site during the BAM surveys. These species are both listed as a vulnerable species under both the BC Act and EPBC Act. Targeted searches for these species were completed on the 27-28 October 2018. During this survey 33 clumps of *Tetratheca juncea* were recorded within the subject site and *Angophora inopina* was recorded throughout PCT 1636 –Scribbly-Gum-Red Bloodwood –*Angophora inopina* heathy woodland within the site, there is 43.5 hectares of recorded habitat for this species within the site (refer to Figure 4-1).
Thirteen *Acacia bynoeana* (Bynone's Wattle) individuals were also recorded within the subject site during targeted surveys completed by EcoLogical in 2010-2012) (refer to Figure 4-1). These records however where not able to be confirmed/relocated during targeted surveys completed by GHD in 2017/2018.

4.2.2 Threatened fauna

A total of eight threatened fauna species were recorded within the subject site during surveys completed by GHD and EcoLogical these include:

- *Petaurus norfolcensis* (Squirrel Glider)
- *Glossopsitta pusilla* (Little Lorikeet)
- *Tyto novaehollandiae* (Masked Owl)
- *Daphoenositta chrysoptera* (Varied Sittella)
- *Pteropus poliocephalus* (Grey-headed Flying-fox)
- *Mormopterus norfolkensis* (East-coast Free-tailed Bat)
- *Miniopterus australis* (Little Bent-wing Bat)
- *Crinia tinnula* (Wallum Froglet) (recorded during EcoLogical surveys 2012)

All of these species are listed as vulnerable species under the BC Act. Grey-headed Flying-fox is also listed as a vulnerable species under the EPBC Act.

Little Lorikeets were frequently observed foraging within areas of Scribbly-Gum-Red Bloodwood –*Angophora inopina* heathy woodland throughout the subject site during the survey period. While numerous Grey-headed Flying-fox were observed flying over the subject site. This species is likely to utilise the site intermittently for foraging when eucalyptus are in flower.

Six Squirrel Glider individuals were captured in Elliot traps within areas of Scribbly-Gum-Red Bloodwood –*Angophora inopina* heathy woodland.

During call play back surveys one Masked Owl responded to played calls.

Anabat analysis detected *Mormopterus norfolkensis* (East-coast Free-tailed Bat) and *Miniopterus australis* (Little Bent-wing Bat) at multiple locations across the subject site over the four night survey period. In addition to the above *Miniopterus schreibersii oceanensis* (Eastern Bent-wing Bat) was identified as probably occurring within the site.

Ten additional threatened fauna species will require targeted survey at an appropriate time of year. These species are listed in Table 4-3 below. Surveys for these species would be completed later in 2018.

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Table 4-3 Threatened species that require further assessment

Common Name	Scientific name	Habitat type	Recommended survey period
Barking Owl	Ninox connivens	Breeding	May-Dec
Eastern Osprey	*Pandion cristatus*	Breeding	April- November
Glossy Black-cockatoo	*Calyptorhynchus lathami*	Breeding	May-August
Grey-headed Flying-fox	*Pteropus poliocephalus*	Breeding	October-December
Little Eagle	*Hieraaetus morphnoides*	Breeding	August-October
Masked Owl	*Tyto novaehollandiae*	Breeding	May-August
Powerful Owl	*Ninox strenua*	Breeding	May-August
Sooty Owl	*Tyto novaehollandiae*	Breeding	May-August
Swift Parrot	*Lathamus discolor*	Breeding	May-August
White-bellied Sea-eagle	*Haliaeetus leucogaster*	Breeding	July-December

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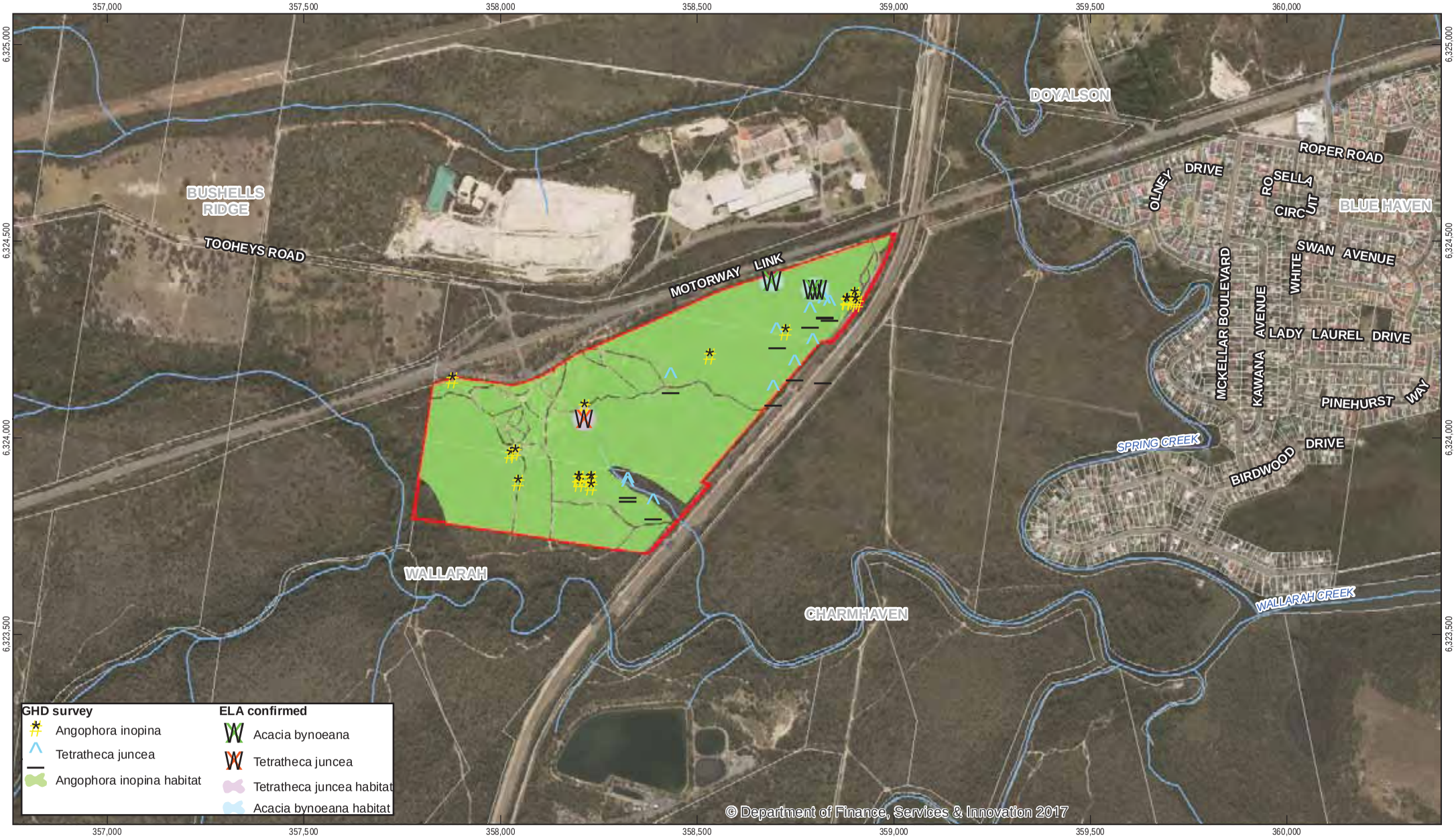

Paper Size A4

0 45 90 180 270 360

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

LEGEND
Biocertification area
Cadastre
Watercourse

DRAFT

Darkinjung Local Aboriginal Land Council
Motorway Link Residential Subdivision
Biodiversity Certification Assessment Report

Job Number 22-18652
Revision A
Date 19 Apr 2018

Threatened flora

Figure 4-1

G:\22\18652\GIS\Maps\Deliverables\BCAR\2218652_BCAR005_ThreatSpecies_Flora_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

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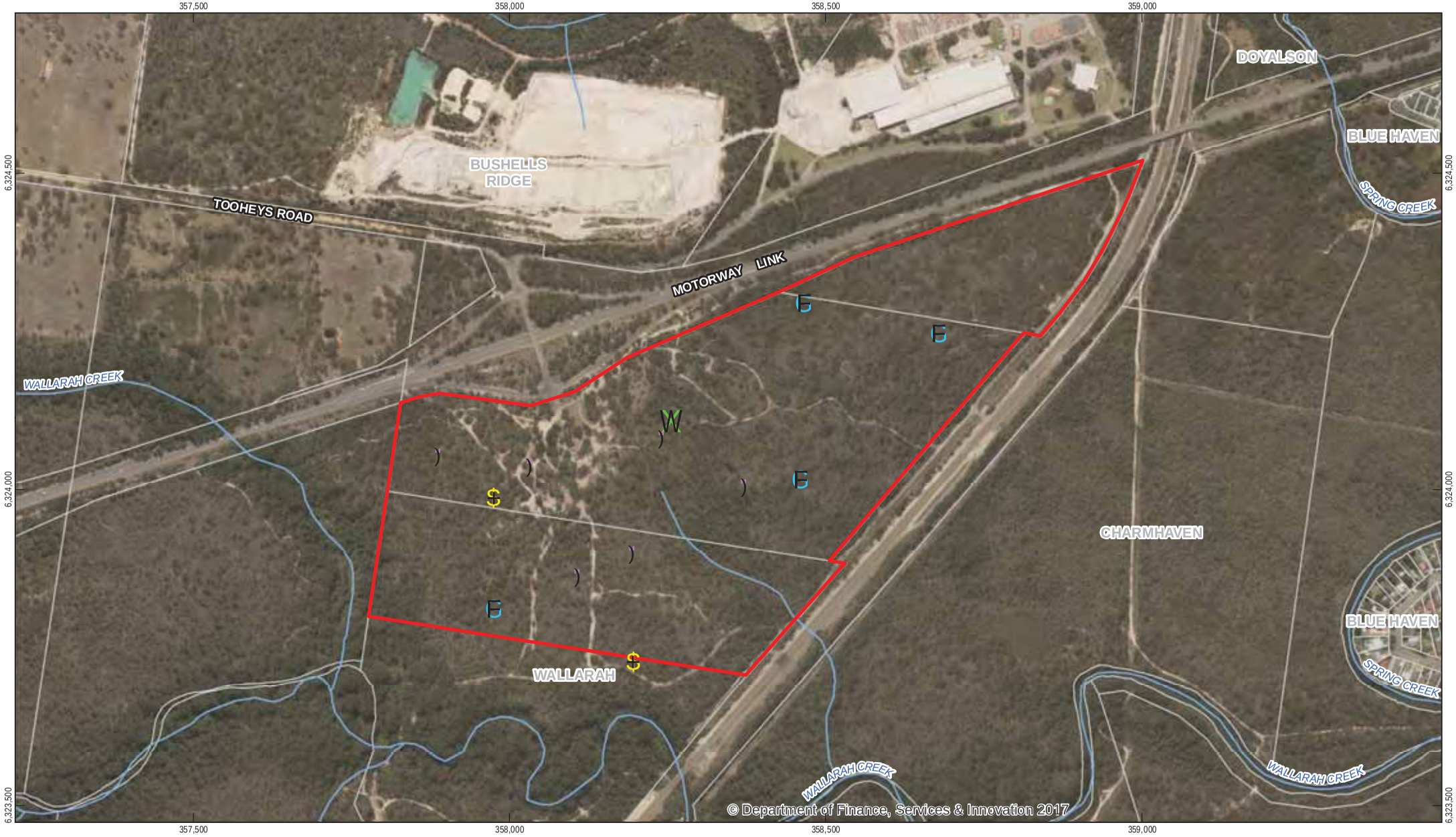
Data source: LPI: DTDB / DCDB, 2012, Aerial Imagery, 2016. Created by: fmackay



Paper Size A4

0 25 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

LEGEND

- Biocertification area
- Cadastre
- Watercourse
- Glossy black cockatoo
- Little Lorikeet
- Masked Owl
- Squirrel Glider

DRAFT

Darkinjung Local Aboriginal Land Council
Motorway Link Residential Subdivision
Biodiversity Certification Assessment Report

Job Number 22-18652
Revision A
Date 19 Apr 2018

Threatened fauna

Figure 4-2

G:\22\18652\GIS\Maps\Deliverables\BCAR\2218652_BCAR006_ThreatSpecies_Fauna_A.mxd

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Data source: LPI: DTDB / DCDB, 2012, Aerial Imagery, 2016. Created by: fmackay

5. Impact assessment

5.1 Introduction

The proposed conferral of biodiversity certification would result in direct impacts on native biota and their habitats within the subject site. There is also the potential for indirect impacts on retained areas of native vegetation adjacent to the subject site, both during construction and from the resulting operation of the industrial development.

Specific mitigation measures are recommended to minimise likely impacts on biodiversity values. These measures are presented according to the hierarchy of avoidance and mitigation of impacts, and the provision of offsets to counter residual impacts of the proposal that cannot be avoided or mitigated.

5.2 Avoidance of impacts

The proposal has avoided impact to areas of high conservation significance where possible given the constraints associate with the design of industrial subdivisions. These developments generally require:

- A mix of lot sizes, including large lots.
- The ability to utilise existing infrastructure. In the case of the Motorway Link site this includes using the existing road interchange and frontage associated with the Motorway Link Road, existing services etc.

These considerations have led to the development footprint being concentrated in the northern portion of the site immediately south of the Motorway Link Road and west of the train line. This approach has avoided impacts to large areas of Swamp Sclerophyll Floodplain Forest in the south and west of the site associated with the broader riparian zone of Wallarah Creek. The development has also been focussed on the portion of the site which has been subjected to human disturbance through activities such as motor bike riding and 4WD activities. This is evidenced by the large network of informal tracks leading south and east from the existing road interchange.

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5.3 Minimisation of impacts

5.3.1 Construction phase

Construction Environmental Management Plan

A Construction Environmental Management Plan (CEMP) would be required for the construction phase of the project, and would be prepared prior to issue of the Construction Certificate. The CEMP would include, as a minimum, industry-standard measures for the management of soil, surface water, weeds and pollutants, as well as site-specific measures, including the procedures outlined below. The proposed mitigation measures would include environmental safeguards for protection of neighbouring areas of native vegetation and waterways in accordance with relevant policy documentation and Government guidelines.

In order to address the potential impacts of the proposal on biodiversity as discussed in Section 5.4, the mitigation and management measures outlined in Table 5-1 would be implemented as part of the CEMP for the site.

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Table 5-1 Mitigation measures (construction)

Impact	Mitigation	Timing	Responsibility
General	All workers are to be provided with an environmental induction prior to starting work on site. This would include information on the ecological values of the site, protection measures to be implemented to protect biodiversity and penalties for breaches.	Prior to clearing/construction works.	Construction contractor
	Preparation of a flora and fauna management sub-plan as part of the CEMP, incorporating recommendations below, and expanding on specific details where necessary.	Prior to clearing/construction works.	Construction contractor
	Measures to suppress dust implemented during clearing and construction.	Throughout clearing and construction phases	Construction contractor
Vegetation clearing	Prior to the commencement of any work in or adjoining areas of native vegetation, a survey would be carried out to mark the construction impact boundary. The perimeter of this area will be fenced using high visibility fencing and clearly marked as the limits of clearing. All vegetation outside this fence line will be clearly delineated as an exclusion zone to avoid unnecessary vegetation and habitat removal. Fencing and signage must be maintained for the duration of the construction period. Fencing should be designed to allow fauna to exit the site during clearing activities.	Prior to clearing / Daily inspections of exclusion zones during works in area.	Construction contractor and qualified ecologist
	Stockpiles of fill or vegetation should be placed within existing cleared areas (and not within areas of adjoining native vegetation).	Prior to clearing/ construction works	Construction contractor
	Sediment fences would be installed to prevent transfer of sediments into adjacent vegetation.	Prior to clearing/ construction works	Construction contractor
Introduction of Weeds and Pathogens	A weed and pest species management sub-plan would be developed as part of project CEMP to manage weeds and pathogens during the construction and operational phase of the proposal.	Prior to clearing/ construction works	Construction contractor
	The location and extent of any priority and/or high threat environmental weeds within the site will be identified by a suitably qualified ecologist during pre-clearance surveys. The introduction and spread of weed species will be minimised by restricting access to areas of native vegetation and communicating the responsibilities of all Project personnel at site inductions and during regular toolbox meetings.	Prior to clearing/ construction works	Construction contractor and qualified ecologist

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Impact	Mitigation	Timing	Responsibility
	All priority weeds identified on the site will be controlled and removed in accordance with the requirements of the Biosecurity Act 2016 and Council's relevant Weed Control Manuals: Appropriate pesticides will be applied if required and a record of such application made in the pesticide application register. All noxious and environmental weeds will be cleared and stockpiled separately to all other vegetation, removed from site and disposed of at an appropriately licenced disposal facility. When transporting weed waste from the site to the waste facility, trucks must be covered to avoid the spread of weed-contaminated material. Disposal must be documented, and evidence of appropriate disposal must be kept.		
	All machinery entering the site must be appropriately washed down and disinfected prior to work on site to prevent the potential spread of weeds, Cinnamon Fungus (Phytophthora cinnamomi) and Myrtle Rust (Pucciniales fungi) in accordance with the national best practice guidelines for Phytophthora (O'Gara et al 2005) and the Myrtle Rust factsheet (DPI 2015b) for hygiene control.	Prior to any plant or machinery being brought onto the site	Construction contractor
	Incorporate control measures in the design of the proposal to limit the spread of weed propagules downstream of subject site. Sediment control devices, such as silt fences, would assist in reducing the potential for spreading weeds.	Prior to clearing/ throughout construction works	Construction contractor
Removal of fauna habitat	Protocols to prevent introduction or spread of chytrid fungus would be implemented following Office of Environment and Heritage Hygiene protocol for the control of disease in frogs (DECCW, 2008c).	Prior to clearing/ throughout construction works	Construction contractor
	A trained ecologist would be present during the clearing of native vegetation or removal of potential fauna habitat to avoid impacts on resident fauna and to salvage habitat resources as far as is practicable. Clearing surveys would include the following (as a minimum):	Prior to and during clearing works	Qualified ecologist
	Staged vegetation clearing, commencing with the most disturbed vegetation in the north of the site and progressing southwards to increase the opportunity for fauna to vacate the site and disperse into areas of adjoining habitat to evade injury. It is preferable for the clearing of hollow-bearing trees to occur outside of the breeding season of bats and other arboreal mammals known to occur at the site (typically during September-December), and periods when some species (microbats) are in torpor (typically during June-August).	During clearing phase	Construction contractor

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Impact	Mitigation	Timing	Responsibility
	• Pre-clearance fauna surveys, undertaken in accordance with the following procedure: • An initial pre-clearance survey of the site will be undertaken by a suitably qualified ecologist prior to the commencement of any clearing activities. During the initial survey all hollow-bearing trees and significant habitat features such as fallen logs, will be identified with a "H" in high visibility spray paint. Significant environmental or noxious weed infestations would also be identified and communicated to the contractor. • A daily pre-clearance fauna survey is also to be undertaken by a suitably qualified ecologist each day prior to the clearing of native vegetation: • Surrounding vegetation (i.e. non-hollowing bearing trees and understory plants) will be inspected by the ecologist for the presence of fauna. • If animals are found, procedures outlined in the protocol for capture and relocation (below) will be followed. Surrounding vegetation can then be cleared. • If no fauna are found, then surrounding non-hollow-bearing vegetation can be cleared. This process will be monitored by the ecologist in case fauna are found to be at risk; and • The ecologist will document the outcomes of this process (e.g. number and species encountered/rescued) • As discussed above clearing of hollow-bearing trees and logs is to take place outside the breeding and torpor periods for the majority of species that may potentially occur. As such it is unlikely that any breeding activity would be present	Prior to and during clearing works	Qualified ecologist
	A suitably qualified and appropriately licenced ecologist under the NSW National Parks and Wildlife Act 1974 is to be present during clearing of all native vegetation to ensure felling of trees is carried out in an appropriate manner, and that any fauna present can be rescued and relocated. All trees marked with an "H" are to be felled in accordance with the procedure detailed below: • When clearing within the approved construction area, all vegetation surrounding a hollow-bearing tree (excluding other hollow-bearing trees and logs) will be removed at least 24 hours prior to the hollow-bearing tree or log being removed. • At least 24 hours after the removal of surrounding (non "H" marked) vegetation, the hollow-bearing tree or log can be removed (in accordance with the technique outlined below). Appropriate fauna 'capture and release' techniques will be implemented (see procedure below).	During clearing phase	Qualified ecologist

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Impact	Mitigation	Timing	Responsibility
	• During the removal of any identified sensitive habitat or hollow-bearing trees: • A suitably qualified and experienced ecologist will be present, with appropriate animal-handling equipment and holding containers. **For hollow-bearing trees:** • Prior to felling or removal, clearing machinery will be used to gently shake or 'bang' the habitat tree for a period of 2-3 minutes (dependant on tree health and structural integrity) to encourage any resident fauna to vacate hollows. Sticks, poles or other similar hand-held objects will also be used to hit the trunk of the tree or log at various points, to encourage animals to vacate the tree. The tree will be observed for at least 5 minutes prior to completing this action. • After the observation period, trees will be gently lowered/felled using an excavator bucket or dozer blade for support if possible. The ecologist will observe the tree felling and ensure that any hollows are not blocked by being placed against the ground. • Once deemed safe by the plant operator, the ecologist will inspect each tree and hollows for fauna that may be present (uninjured, injured or deceased). Use of fibre-optic cameras to assist this process is recommended. The ecologist will document this process using the tree hollow inspection register. • Felled habitat trees with any occupied hollows will be left on the ground overnight or up to 24 hours to allow the animal to exit the hollow. Habitat trees can then be cut into appropriate sections according to the protocol for habitat salvage and relocation (described below) **For any all hollow logs:** • Gently knock the log with an excavator for a short time while the log is observed by the ecologists. • Any fauna leaving the log will be rescued by the ecologists according to the protocol for fauna capture and relocation (described below); and • If no fauna emerge after an appropriate time (>5 min), the ecologists will inspect the hollow and instruct the plant operator to salvage hollows or translocate the log in accordance with the protocol for habitat salvage and relocation (described below).		

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Impact	Mitigation	Timing	Responsibility
	Significant habitat features (fallen logs and tree hollows) removed from site would be salvaged and relocated within adjacent areas of vegetation. Prior to removal hollow logs should be knocked gently knocked with an excavator for a short time while the log is observed by a qualified ecologist. Any fauna leaving the log will be rescued by the ecologists according to the protocol for fauna capture and relocation into adjoining vegetation	Following clearing activities	Construction contractor and qualified ecologist
	A suitably qualified and appropriately licenced ecologist under the NSW National Parks and Wildlife Act 1974 will be present during the clearance of all native vegetation and/or fauna habitats. Animals that require handling must not be approached or handled until the ecologist is present, unless in an emergency (e.g. when there are both no authorised persons present and where the failure to immediately intervene would place the animal at significant risk). In such an emergency, the site manager may obtain over the phone instructions from the project ecologist to ameliorate the situation. A wildlife rescue organisation (e.g. WIRES) should be made aware of operations in case any injured fauna are found. All animals encountered will be treated humanely, ethically, and in accordance with relevant codes under the NSW Prevention of Cruelty to Animals Act 1979, including: Australian code of practice for the care of animals for scientific purposes (NHMRC 2004). Code of practice for the welfare of wildlife during rehabilitation (DPI 2001). Animal ethics considerations and protocols outlined in this document. If the project ecologist considers an animal is at risk of injury or undue stress, it is to be gently directed into secure adjoining habitat. Where deemed necessary by the project ecologist, the animal may be required to be captured and released. Capture and release operations will proceed via the following protocols: All construction activities that are considered by the project ecologist be likely to increase the risk of injury, mortality or stress to the animal will be halted until the animal has been removed, which will be enforced with the co-operation of the Contractor. Construction activities that do not contribute to the risk of injury, mortality or stress to the animal can continue (as determined by the project ecologist). Only qualified ecologists or wildlife carers are authorised to handle animals.	During clearing	Qualified ecologist

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Impact	Mitigation	Timing	Responsibility
	Animals will be captured (if required) by the project ecologist using a safe and ethical technique, as is appropriate for the particular species (see below). Native animals that are unable to depart of their own accord will be captured and held in a receptacle appropriate for that species until release. All captive-held animals will be provided with food, water and warmth as is appropriate for the species. Each receptacle will only hold one animal at a time and will be cleaned and disinfected between use to avoid the spread of disease. Details of any fauna relocated from hollows would be recorded on the tree hollow inspection register. Any other fauna relocated from trees, shrubs or other areas would also be recorded.		
	The construction contractor is to contact the Project ecologist for advice if any unexpected fauna are found during the construction period (i.e. following clearing of native vegetation when the Project ecologist is no longer on site).	During clearing	Construction contractor
	A post-clearing report will be prepared documenting all animals that are handled, or otherwise managed, within the site. Data to be recorded would include: • Date and time of the sighting and details of the observer • Species • Number of individuals recorded • Adult/juvenile • Condition of the animal (living/dead/injured/sick) • Management action undertaken (e.g. captured, handled, taken to vet) • Results of any management actions (e.g. released, placed in a nest box, euthanised, placed with carer) • An inventory of hollows and fallen timber salvaged and relocated will be maintained.	Post clearing	Construction contractor/ Qualified ecologist
Water Quality and aquatic habitats	Erosion and sediment control plans should be prepared in accordance with Volume 2D of Managing Urban Stormwater: Soils and Construction (DECC 2008d). The erosion and sediment control plans would be established prior to the commencement of construction and be updated and managed throughout as relevant to the activities during the construction phase.	Prior to construction commencing	Construction contractor
	Erosion and sediment control controls would be regularly inspected, particularly following rainfall events, to ensure their ongoing functionality.	Weekly during construction phase or after any significant rainfall event	Construction contractor

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Impact	Mitigation	Timing	Responsibility
	Stabilised surfaces should be reinstated as quickly as practicable after construction.	Immediately following clearing	Construction contractor
	Appropriate speeds are to be enforced to limit dust generation and minimise chances of fauna mortality through vehicle strike.	During construction	Construction contractor
	All stockpiled material should be stored in bunded areas and kept away from waterways to avoid sediment or contaminants entering the waterway.	During construction	Construction contractor
	Spill kits would be made available to construction vehicles. A management protocol for accidental spills would be put in place.	During construction	Construction contractor

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5.3.2 Operation phase

The following mitigation measures would be implemented during the operational phase of the proposed development

- Signposting and enforcement of appropriate speed limits along internal roads to reduce the likelihood of vehicle strike and mortality of native fauna.
- Appropriate management of bushfire asset protection zones (APZ) to prevent the spread of weeds or soil into adjacent areas of vegetation.
- Water Sensitive Urban Design infrastructure, perimeter roads and building setbacks would be included in APZ. These design features would act as a buffer between the built form and adjoining area of native vegetation.
- Use of perimeter roads where possible to maintain public line of sight to neighbouring vegetation to reduce dumping.
- Appropriate fencing to be erected at interface between industrial lots and adjoining native vegetation to restrict access to these areas.
- Enforcement of legal obligations to control priority weeds within industrial areas to prevent the spread of propagules into retained areas of native vegetation.
- Street lighting to be designed to direct light away from adjoining bushland areas and to limit the impacts of light spill on native fauna habitats.

5.4 Residual impacts to be offset

5.4.1 Construction phase

Direct impacts

Clearing of vegetation

Conferral of biodiversity certification would result in direct impacts on 45.0 hectares of native vegetation including 43.5 hectares of Scribbly Gum –Red Bloodwood –*Angophora inopina* heathy woodland (PCT 1636) and 1.5 hectares of Smooth Barked Apple- Red Mahogany- Swamp Mahogany- Melaleuca sieberi heathy swamp woodland (PCT 1649). This vegetation is in moderate/good condition with a relatively high species diversity and very few weed presents. The primary direct impacts on this vegetation are associated with clearing for industrial lots and construction of associated infrastructure (roads, services etc.).

The proposal would remove a small number (33 clumps) of the threatened flora species, *Tetratheca juncea* (Black-eyed Susan) which represents approximately 0.28 hectares of habitat for this species (based on a 30 metre buffer around each individual). In addition up to 43.5 hectares of habitat for *Angophora inopina* (Charmhaven Apple) and 0.58 hectares of habitat for *Acacia bynoeana* (Bynoe's Wattle) would be removed from the subject site. The proposal would also impact on non-threatened plant species including mature canopy trees and hollow bearing trees.

The proposed development would result in the total clearing of the site. The future values of the composition condition scores, structural condition score and function condition score would be 0 for each vegetation zone within the subject site.

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Table 5-2 Proposed removal of vegetation within the project site

Vegetation Community	PCT (OEH 2018)	Area within the project site (ha)
Scribbly Gum –Red Bloodwood –Angophora inopina heathy woodland of the Central Coast	1636	43.5
Smooth Barked Apple-Red Mahogany- Swamp Mahogany- Melaleuca sieberi heathy swamp woodland of coastal lowlands	1649	1.5
Total		**45.0**

Removal of habitat resources

The vegetation that would be removed provides habitat resources for native fauna species, including threatened species of fauna. The proposal would result in direct impacts on known local populations of eight threatened fauna species. These include:

- *Petaurus norfolcensis* (Squirrel Glider)
- *Glossopsitta pusilla* (Little Lorikeet)
- *Tyto novaehollandiae* (Masked Owl)
- *Daphoenositta chrysoptera* (Varied Sittella)
- *Pteropus poliocephalus* (Grey-headed Flying-fox)
- *Mormopterus norfolkensis* (East-coast Free-tailed Bat)
- *Miniopterus australis* (Little Bent-wing Bat)
- *Crinia tinnula* (Wallum Froglet)

The proposal would remove approximately 45.3 hectares of habitat resources for these species (except for *Crinia tinnula* (Wallum Froglet) for which the project would remove up to 1.5 hectares of habitat) and would also remove potential habitat for a variety of other threatened fauna that my utilise the site including:

- 43.5 hectares of potential foraging and nesting habitat for threatened woodland birds such as the Dusky Woodswallow (*Artamus cyanopterus*), Speckled Warbler (*Chthonicola sagittata*) and Scarlet Robin (*Petroica boodang*).
- 43.5 hectares of potential habitat, including potential roost trees for tree-roosting microbats such as the Eastern False Pipistrelle (*Falsistrellus tasmaniensis)*, Yellow Sheathtail Bat (*Saccolaimus flaviventris*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*).
- 43.5 hectares of potential foraging and roosting habitat, for forest owls such as the Barking Owl (*Ninox connivens*), and Powerful Owl (*Ninox strenua*).
- 43.5 hectares of potential foraging, shelter and nest or den sites for the Spotted-tailed Quoll (*Dasyurus maculatus*).
- 43.5 hectares of potential foraging and roosting habitat, for cockatoos such as the Gang-gang Cockatoo (*Callocephalon fimbriatum*) and Glossy Black Cockatoo (*Calyptorhynchus lathami).*

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- 43.5 hectares of potential foraging habitat for migratory nectarivorous species such as the Regent Honeyeater (*Anthochaera phrygia*), Swift Parrot (*Lathamus discolor*) and Grey-headed Flying-fox (*Pteropus poliocephalus*).
- Removal of 43.5 hectares of potential foraging and breeding habitat for Yellow-bellied Glider (*Petaurus australis*).
- 1.5 hectares of potential habitat for the Eastern Chestnut Mouse (*Pseudomys gracilicaudatus).*

The clearing of 45 hectares of native woodland and forest would include the removal of a large number of mature trees. Mature trees have value for fauna populations as sources of foraging resources such as leaves, nectar, sap or seed and substrate for invertebrate prey. In the context of the extensive areas of native vegetation surrounding the site, the proposal would remove a small proportion of available foraging resources for local populations of native fauna: 0.3% of the extent of vegetation map units likely to contain similar foraging habitat in the locality (around 13,906 hectares based on LHCCREMS, 2009 vegetation mapping).

The subject site includes a large number of identified habitat trees, including large hollow-bearing trees and stags. These trees would provide potential roost sites for forest owls, cockatoos and/or threatened gliders among other species. They may also be utilised as a roost or nest site by hollow-roosting microbats or smaller bird species. Plot data collected at the site indicates that there is approximately 22 hollow bearing trees per hectare (i.e. 13 hollow bearing trees were recorded within the six 0.1 hectare plots). Extrapolating this number over the 45 hectare impact area suggests an estimated impact on 990 hollow bearing trees across the entire subject site.

Fauna injury and mortality

As described above, the subject site provides a variety of habitat resources for native fauna species, including foraging, roosting and shelter resources for threatened species as well as common native fauna. Groundcover vegetation, leaf litter and woody debris would provide shelter and foraging substrate for reptiles, frogs and invertebrates. Construction is likely to result in the injury or mortality of some individuals of these less mobile fauna species and other small terrestrial fauna that may be sheltering in vegetation within the subject site during clearing activities. There are an estimated 990 hollow-bearing trees in the subject site (as per above extrapolation), and therefore there is a high potential risk of injury or mortality of arboreal mammals or hollow-nesting birds. The potential for impacts on fauna utilising hollows would be reduced through pre-clearance surveys of habitat trees. Alternative habitat resources and refuge from construction activities is available in retained native vegetation adjoining the site. More mobile native fauna such as native birds, bats, terrestrial and arboreal mammals that may be sheltering in vegetation in the subject site are likely to evade injury during construction activities.

Recommendations have been made in Section 5.3 above to minimise the risk of vegetation clearing activities resulting in the injury or mortality of resident fauna.

Fragmentation or isolation of habitat

Habitat fragmentation through the clearing of vegetation can increase the isolation of remnant vegetation and create barriers to the movements of small and sedentary fauna such as ground dwelling mammals, reptiles and amphibians. Furthermore, habitat fragmentation can create barriers to the movement of pollinator vectors, such as insects, and consequently affect the life cycle of both common and threatened flora.

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The project would require the removal of vegetation and habitat and would create or increase gaps in habitat that are the width of the project site. Remnant vegetation is present adjacent to the site to the west and south west. The removal vegetation would result in the fragmentation of a number of small areas of vegetation surrounding the subject site although it is unlikely that the project would create a barrier to the movement of pollinator and seed dispersal vectors, such as insects and birds and therefore would not completely isolate any areas of native vegetation.

Aquatic habitats

Aquatic habitats in the project site are limited. The project would remove small areas of low quality aquatic habitat associated with ephemeral drainage lines and small depressions. These are not classified as Key Fish Habitat and do not provide potential habitat for threatened fish. Aquatic habitats would provide breeding and shelter resources for common frog and reptile species as discussed above.

Indirect impacts

Weed invasion and edge effects

'Edge effects' can include increased noise and light or erosion and sedimentation at the interface of intact vegetation and cleared areas. Edge effects may result in impacts such as changes to vegetation type and structure, increased growth of exotic plants, increased predation of native fauna or avoidance of habitat by native fauna. Edge effects would result from construction activities and then continue to affect vegetation and habitats adjoining the project site.

Altered environmental conditions along new edges can allow invasion by pest animals specialising in edge habitats and/or change the behaviour of resident animals. Edge zones can be subject to higher levels of predation by introduced mammalian predators and native avian predators.

The proposal would result in new edges being established within areas of relatively intact native vegetation to the west and south west of the subject site. Vegetation within and adjoining the site is in relatively good condition with very few weed species present. There is therefore a high risk that construction activities may increase the degree of weed infestation through dispersal of weed propagules (seeds, stems and flowers) into areas of native vegetation via erosion (wind and water) and via workers shoes and clothing and through construction vehicles. The risk of introduction of weeds are likely to continue during operation of the proposal.

Management measures including the development of a weed management sub-plan as part of the project CEMP would be implemented to mitigate these potential impacts (refer to Section 5.3).

The creation of new edges within areas of native vegetation also has the potential to introduce impacts associated with noise and light into areas of adjacent vegetation. This could in turn result in disruptions to fauna utilising vegetation adjacent to the site (as described below).

The site however is already subject to a significant amount of noise impact due to its location between the Newcastle-Sydney rail line and the Motorway Link.

Other relevant mitigation measures to reduce the impacts of edge effects include the establishment of an APZ which would act as a buffer from development land, lighting design to minimise light spill as well as dust suppression and erosion and sediment measures during construction.

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Introduction and spread of weeds, pests and pathogens

Disturbance associated with vegetation clearing, vehicle traffic and general day to day operations of the proposal during construction and operation of the proposal would increase the potential for the spread, introduction and establishment of weed and pest species, and diseases and pathogens.

Weed species are effective competitors for food and habitat resources and have the potential to exclude native species and modify the composition and structure of vegetation communities.

Construction activities within the project site also have the potential to introduce or spread pathogens such as Phytophthora (*Phytophthora cinnamomi*), Myrtle Rust (*Uredo rangelii*) and Chytrid fungus (*Batrachochytrium dendrobatidis*) into adjacent native vegetation through vegetation disturbance and increased visitation. There is little available information about the distribution of these pathogens within the locality, and no evidence of these pathogens was observed during surveys. Phytophthora and Myrtle Rust may result in the dieback or modification of native vegetation and damage to fauna habitats. Chytrid fungus affects both tadpoles and adult frogs and can wipe out entire populations once introduced into an area.

The potential for impacts associated with these pathogens is high, given the relatively undisturbed nature of the subject site. Diseases and pathogens can be introduced or spread to site via dirt or organic material attached to machinery, vehicles, equipment and employees. To help mitigate the risk of pathogens being brought onto and/or spread through the site all machinery brought to site will be washed down and inspected to be free of soils, seeds and other organic material in accordance with Section 5.3.1.

Noise and light impacts on fauna

The majority of the proposed construction works would be undertaken during standard, daytime construction hours. Exemptions and approval for works outside of the above standard construction hours may be required during certain circumstances.

Construction noise would be temporary and generally confined to daylight hours. There would be a minor increase above existing background levels and that is unlikely to result in a significantly impact on fauna that occur in the subject site. Once the industrial development is in operation there may also be some indirect impacts from noise and light around the immediate periphery of the site. To help mitigate these impacts lighting within the development site will be designed to direct light inward to limit the light spill into adjoining vegetation.

Noise impacts associated with the proposal are not expected to exceed those already present at the site due to the adjacent Newcastle-Sydney rail line to the south east and the Motorway Link to the north.

Aquatic disturbance and impacts on fish habitat

The introduction of pollutants from the project into the surrounding environment, if uncontrolled, could potentially impact on water quality further downstream.

The potential for water quality impacts on Wallarah, are considered to be low to moderate given the distance of the project site from and defined drainage lines, the buffer of vegetated land and the use of mitigation measures during construction. Potential water quality impacts would be managed through the implementation of mitigation measures, including the provision of sedimentation basins, silt fences and other structures to intercept runoff.

No endangered aquatic communities, aquatic fauna or marine vegetation listed under the FM Act or EPBC Act occur in the subject site and no significant impacts on riparian vegetation or habitats downstream of the project site are anticipated as a result of the project. There would be no impact on Key Fish Habitat as a result of the project.

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5.4.2 Operation phase

Impacts on biodiversity values would be largely restricted to the construction phase of the project. There are however a number of potential impacts to surrounding vegetation that may occur as a result of the operation of the proposal these include:

- Generation of additional light and noise
- Erosion and sedimentation as a result of runoff from hard stand areas
- Introduction of weed propagules by vehicle and/or tenants
- Fauna mortality as a result of collision with vehicles
- Increased risk of fire
- Rubbish dumping

These potential impacts are linked to human occupation of the site and are likely to persist indefinitely. Mitigation measures to be implemented to minimise these potential impacts are discussed in Section 5.3.1.

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Paper Size A4

0 25 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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LEGEND

- Biocertification area
- Proposed subdivision
- Cadastre
- Watercourse

DRAFT

Darkinjung Local Aboriginal Land Council
Motorway Link Residential Subdivision
Biodiversity Certification Assessment Report

Job Number 22-18652
Revision A
Date 19 Apr 2018

Final project footprint

Figure 5-1

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Data source: LPI: DTDB / DCDB, 2012, Aerial Imagery, 2016; ADW Johnson: Subdivision layout, 2017. Created by: fmackay

6. Offset requirements

6.1 Assessment of impacts requiring offsetting

Impacts associated with the proposal that require offsetting include the removal of 45.0 hectares of native vegetation, comprising:

- 43.5 hectares of PCT 1636- Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland of the Central Coast
- 1.5 hectares of PCT-1649 -Smooth Barked Apple- Red Mahogany- Swamp Mahogany- Melaleuca sieberi heathy swamp woodland of coastal lowlands
- 43.5 hectares of known habitat for the threatened flora species *Angophora inopina* (Charmhaven Apple)
- 0.28 hectares of known habitat (containing 33 individuals) for the threatened flora species *Tetratheca juncea* (Black-eyed Susan)
- 0.58 hectares of known habitat (containing 13 individuals) for the threatened flora species *Acacia bynoeana* (Bynoe's Wattle)
- 43.5 hectares of known habitat for the threatened fauna species *Petaurus norfolcensis* (Squirrel Glider)
- 1.5 hectares of known habitat for the threatened fauna species *Crinia tinnula* (Wallum Froglet)

Impacts within the subject site requiring offsetting are shown on Figure 6-1.

6.2 Assessment of serious and irreversible impacts

The assessment of serious and irreversible impacts (SAII) is a central component of the BOS. The purpose of considering SAII is to protect threatened species and threatened ecological communities most at risk from extinction from potential development impacts or activities. It is the responsibility of approval authorities to determine whether or not an impact on biodiversity values is likely to be a SAII. Under the BC Act, a determination of whether an impact is serious and irreversible must be made in accordance with the principles set up in Section 6.7 of the BC Regulation.

The principles are aimed at capturing impacts which are likely to contribute significantly to the risk of extinction of a threatened species or ecological community in New South Wales. These include impacts that will:

- Cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline, or
- Further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size, or
- Impact on the habitat of a species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution, or
- Impact on a species or ecological community that is unlikely to respond to measures to improve habitat and vegetation integrity and is therefore irreplaceable.

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A set of criteria have been developed and are included in the *OEH Guidelines to assist a decision-maker to determine a SAII* (OEH 2018f). Threatened biota that meet the criteria under one or more of the above principles have been identified as potential SAII and are listed in the fore mentioned document. Each potential SAII entity has an impact threshold identified which can be used to help determine if a development will result in SAII.

No potential SAII species or ecological communities (as identified in OEH 2018f) would be impacted by the proposal.

6.3 Areas not requiring assessment

The entire subject site has been assessed as requiring offsetting therefore this section does ot apply Calculation of the offset requirement for ecosystem credits

The data from the fieldwork and mapping was entered into version 1.2.3 of the BAM credit calculator as a 'Biodiversity Certification' assessment to determine the number and type of biodiversity credits that would be required to offset impacts of the proposal. The Biodiversity credit report is included in Appendix D and summarised below.

A total of 1,214 ecosystem credits would be required to offset the impacts of the project as shown in Table 6-1.

Table 6-1 Ecosystem credits required to offset impacts of the project

Plant community type	Area (ha)	Current vegetation integrity score	Future vegetation integrity score	BC Act status	Ecosystem credits required
1636 -Scribbly Gum – Red Bloodwood – Angophora inopina heathy woodland on lowlands of the Central Coast	43.5	61.5	0		1,170
1649 -Smooth Barked Apple- Red Mahogany-Swamp Mahogany-Melaleuca sieberi heathy swamp woodland of coastal lowlands	1.5	58.4	0	EEC[1]	44
Total					**1,214**

Notes [1] Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

6.4 Calculation of the offset requirement for species credits

Species credits required to offset impacts on threatened species comprise:

- 669 species credits to offset impact to 43.5 hectares of Angophora inopina (Charmhaven Apple) habitat.
- Nine (9) species credits to offset impact to 0.28 hectares of known *Tetratheca juncea (*Black-eyed Susan) habitat.
- 18 species credits to offset impact to 0.58 hectares of known *Acacia bynoeana* (Bynoe's Wattle) habitat.

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- 1,337 species credits to offset impacts to 43.5 hectares of known *Petaurus norfolcensis* (Squirrel Glider) habitat.
- 33 species credits to offset impacts to 0.2 hectares of known Wallum Froglet (*Crinia tinnula*) habitat.

Species credit requirements are summarised in Table 6-2 below.

Table 6-2 Species Credits required to Offset Impacts of the Development

Species	Area of Habitat	Species Credits Required
Angophora inopina (Charmhaven Apple)	43.5	669
Tetratheca juncea (Black-eyed Susan)	0.28	9
Acacia bynoeana (Bynone's Wattle)	0.58	18
Crinia tinnula (Wallum Froglet)	1.5	33
Petaurus norfolcensis (Squirrel Glider)	43.5	1,337

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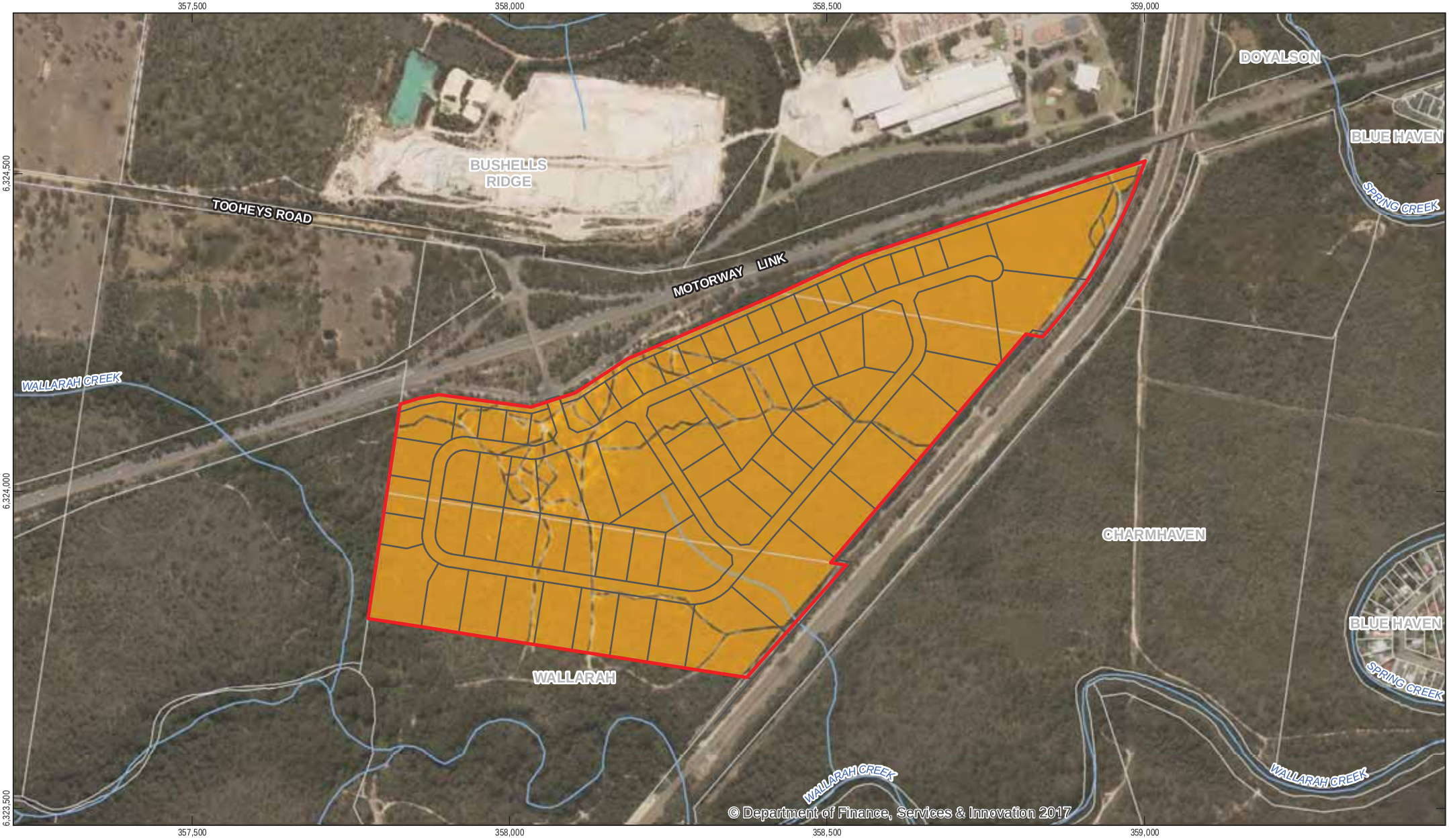

Paper Size A4

0 25 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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LEGEND

- Biocertification area
- Proposed subdivision
- Cadastre
- Watercourse
- Impacts requiring offsetting

DRAFT

Darkinjung Local Aboriginal Land Council
Motorway Link Residential Subdivision
Biodiversity Certification Assessment Report

Job Number 22-18652
Revision A
Date 19 Apr 2018

Impact summary

Figure 6-1

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7. Proposed conservation measures

7.1 Options to meet offset obligations

In accordance with the offset rules established by the *Biodiversity Conservation Regulation 2018* there are various means by which offset obligations described in Section 6.1 can be met. These include

- Retiring the appropriate credits from an established stewardship site
- Monitory payment directly into the Biodiversity Conservation Trust (BCT) or
- Funding an approved biodiversity action (note this mechanism is only available to actions listed in the ancillary rules for biodiversity conservation actions (OEH 2018g) and therefore is not relevant to this site)

7.2 Conservation measures proposed to offset impacts of development

Darkinjung LALC's preferred approach to offset the residual impacts of the proposed development is to secure and retire appropriate credits at a stewardship site located nearby to the subject site. This site would be assessed in accordance with the BAM and a separate Biodiversity Stewardship Site Assessment Report (BSAR) would be prepared that would describe the ecosystem and species credits generated at the site. Vegetation types at this site are similar to those at the subject site and it is anticipated that this site would provide habitat for a similar suite of threatened species and contain the appropriate credits to at least partially meet offset obligations for the proposal. Any residual credit shortfalls would be secured from additional stewardship sites that provide biodiversity credits that comply with the trading rules of the BOS including other nearby stewardship sites proposed on Darkinjung LALC lands within the Central Coast Council area.

A payment to the Biodiversity Conservation Trust would only be considered if a suitable number and type of biodiversity credits cannot be secured from stewardship sites owned by Darkinjung LALC and/or other third parties.

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8. Conclusion

Darkinjung Local Aboriginal Land Council (Darkinjung LALC) is proposing to rezone and develop a 72 Lot industrial subdivision at 380 Motorway Link, Wallarah NSW. This Biodiversity Certification Development Report (BCAR) has been prepared by GHD Pty Ltd to identify the potential impacts of the conferring biocertification on biodiversity values within the subject site. This assessment has been completed in accordance with the BAM and includes:

- Desktop assessment to describe the existing environment and landscape features of the subject site and to identify the suite of threatened biota potentially affected by the proposal.
- Field survey to describe the biodiversity values of the proposal footprint and surrounding subject site and determine the likelihood of threatened biota and their habitats occurring in the proposal footprint or being affected by the proposal.
- BAM calculations using the credit calculator version 1.2.3 to quantify the biodiversity impacts of the proposal following implementation of measures to avoid and minimise impacts and to determine the biodiversity credits that would be required to be retired to offset the residual impacts of the proposal.

The conferral of biodiversity certification would result in the following impacts:

- Removal of 43.5 hectares of Scribbly Gum- Red Bloodwood-*Angophora inopina* heathy woodland on lowlands of the Central Coast.
- Removal of 1.5 hectares of Smooth Barked Apple- Red Mahogany- Swamp Mahogany-Melaleuca sieberi heathy swamp woodland of coastal lowlands, which is listed as Swamp Sclerophyll Floodplain Forest Endangered Ecological Community under the *Biodiversity Conservation Act 2016* (BC Act).
- Removal of 0.28 hectares of known habitat for the the endangered plant Black-eyed Susan (*Tetratheca juncea*) (listed as a vulnerable species under the *BC Act* and the *EPBC Act*).
- Removal of 43.5 hectares of known habitat for the threatened flora species *Angophora inopina* (Charmhaven Apple) (listed as a vulnerable species under the *BC Act* and the *EPBC Act*).
- Removal of 43.5 hectares of known habitat for the threatened fauna species *Mormopterus norfolkensis* (Eastern Freetail-bat) (listed as a vulnerable species under the *BC Act*).
- Removal of 0.58 hectares of known habitat (containing 13 individuals) for the threatened flora species *Acacia bynoeana* (Bynoe's Wattle) (listed as an endangered species under the BC Act and a vulnerable species under the EPBC Act).
- Removal of 43.5 hectares of known habitat for the threatened fauna species *Miniopterus australis* (Little Bent-wing Bat) (listed as a vulnerable species under the *BC Act*).
- Removal of 1.5 hectares of known habitat for *Crinia tinnula* (Wallum Froglet) (listed as a vulnerable species under the *BC Act*).
- Removal of 43.5 hectares of known habitat for the threatened fauna species *Petaurus norfolcensis* (Squirrel Glider) (listed as a vulnerable species under the *BC Act*).
- Removal of 43.5 hectares of known foraging and potential breeding habitat for *Tyto novaehollandiae* (Masked Owl) (listed as a vulnerable species under the BC Act).

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- Removal of 43.5 hectares of known habitat for *Daphoenositta chrysoptera* (Varied Sittella) and *Glossopsitta pusilla* (Little Lorikeet) (listed as a vulnerable species under the *BC Act*).
- Removal of 43.5 hectares of potential foraging and nesting habitat for threatened woodland birds such as *Artamus cyanopterus* (Dusky Woodswallow), *Chthonicola sagittata* (Speckled Warbler) and *Petroica boodang* (Scarlet Robin).
- Removal of 43.5 hectares of potential habitat, including potential roost trees for tree-roosting microbats such as *Falsistrellus tasmaniensis* (Eastern False Pipistrelle*)*, *Saccolaimus flaviventris* (Yellow Sheathtail Bat) and *Scoteanax rueppellii* (Greater Broad-nosed Bat).
- Removal of 43.5 hectares of potential foraging and roosting habitat, for forest owls such as *Ninox connivens* (Barking Owl) and *Ninox strenua* (Powerful Owl).
- Removal of 1.5 hectares of potential habitat for *Pseudomys gracilicaudatus* (Eastern Chestnut Mouse) (listed as a vulnerable species under the *BC Act*).
- Removal of 43.5 hectares of potential foraging, shelter and nest or den sites for *Dasyurus maculatus* (Spotted-tailed Quoll).
- Removal of 43.5 hectares of potential foraging and breeding habitat for Yellow-bellied Glider (*Petaurus australis*).
- Removal of 43.5 hectares of potential foraging and roosting habitat, for cockatoos such as *Callocephalon fimbriatum* (Gang-gang Cockatoo) and *Calyptorhynchus lathami* (Glossy Black Cockatoo).
- Removal of 43.5 hectares of potential foraging habitat for migratory nectarivorous species such as *Anthochaera phrygia* Regent Honeyeater), *Lathamus discolor* (Swift Parrot) and *Pteropus poliocephalus* (Grey-headed Flying-fox).
- Removal of 43.5 hectares of potential habitat for the threatened fauna species *Cercartetus nanus* (Eastern Pygmy Possum) (listed as a vulnerable species under the *BC Act*).

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The proposal would also have potential indirect impacts to adjoining vegetation associated with edge effects, light spill, noise and introduction of weeds and pathogens.

The proposal would not impact any threatened biota listed under the *Fisheries Management Act 1994*.

A BAM assessment and credit calculations have been performed in accordance with the methodology (OEH 2018d) and using credit calculator version 1.2.3. Credits required to be retired to offset the impacts of the proposal include:

- 1170 ecosystem credits for impacts on Scribbly Gum- Red Bloodwood-*Angophora inopina* heathy woodland on lowlands of the Central Coast (PCT 1636).
- 44 ecosystem credits for impacts on Smooth Barked Apple- Red Mahogany- Swamp Mahogany- Melaleuca sieberi heathy swamp woodland of coastal lowlands (PCT 1649).
- 669 species credits to offset impact to 43.5 hectares of *Angophora inopina* (Charmhaven Apple) habitat.
- Nine (9) species credits to offset impact to 0.28 hectares of known *Tetratheca juncea (*Black-eyed Susan) habitat.
- 18 species credits to offset impact to 0.58 hectares of known *Acacia bynoeana* (Bynoe's Wattle) habitat.

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- 1,337 species credits to offset impacts to 43.5 hectares of known *Petaurus norfolcensis* (Squirrel Glider) habitat.
- 33 species credits to offset impacts to 0.2 hectares of known Wallum Froglet (*Crinia tinnula*) habitat.

Other threatened species known to occur within the site that are likely to be impacted by the proposal are ecosystem credit species which would be offset through the retirement of the above listed ecosystem credits.

Further targeted surveys for seven additional species credit species are required and will be undertaken later in 2018.

To avoid and minimise potential impacts of the proposed conferral of biocertification on biodiversity, a series of mitigation and management measures have been identified, which would be implemented as part of the construction environmental management plan for the site. The residual impacts would be appropriately offset by retiring credits from a nearby stewardship site as well as other proposed stewardship sites within the Central Coast council area.

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Appendices

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Appendix A – Likelihood of occurrence table

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Threatened Biota Habitat Table

Databases Searched

Office of Environment and Heritage (OEH) (2018a) BioNet Atlas - threatened species results within a 10 km buffer

Office of Environment and Heritage (OEH) (2018h) *Biodiversity Assessment Method Calculator Version 1.2.1 – predicted threatened species based on habitat types present*

Department of the Environment and Energy (DoEE) (2018a) EPBC PMST Online Search including a 10 km buffer.

Note: Marine species which are restricted to marine environments only (such as whales, dolphins, sharks and seabirds) are excluded from the Likelihood of Occurrence Table as there is no marine habitat in immediately adjacent to the subject site.

Likelihood of Occurrence

Matters considered in determining the likelihood of occurrence include:

- Known natural distributions including prior records (database searches) and site survey results.
- Geological/ soil preferences.
- Specific habitat requirements (e.g. aquatic environs, seasonal nectar resources, tree hollows etc).
- Climatic considerations (e.g. wet summers; snow fall).
- Home range size and habitat dependence.
- Topographical preferences (e.g. coastal headlands, ridgetops, midslopes, gilgai, wetlands).

The likelihood of occurrence scale is defined in the following table.

Likelihood of occurrence scale

Scale	Description
Known	Species known to occur within the site (e.g. breeding and foraging habitat; foraging habitat; movement corridors). Detected on or immediately adjacent to the site.
High	Presence of high value suitable habitat (e.g. breeding and foraging habitat; important movement corridors). Not detected.
Moderate	Presence of medium value suitable habitat (e.g. disturbed breeding conditions; constrained foraging habitat; movement corridors). Not detected.

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Scale	Description
Low/Unlikely	Presence of low value suitable habitat (e.g. disturbed conditions; isolated small habitat area; fragmented movement corridors). Not detected.
None	No suitable habitat or corridors linking suitable habitat present. Not detected.

Table A1 Threatened flora known or predicted from the locality, habitat association and likelihood of occurring at the site

Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Flora						
Rutidosis heterogama	Heath Wrinklewort	V	V	Grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides (OEH 2018).	172 records within 10 km (OEH 2018a) Predicted within 10 km (DoEE 2018) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1636
Tetratheca juncea	Black-eyed Susan	V	V	It is usually found in low open forest/woodland with a mixed shrub understorey and grassy groundcover. However, it has also been recorded in heathland and moist forest. The majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape. Characteristic overstorey species include Smooth Bark Apple, Red Bloodwood and Brown Stringybark (OEH 2018).	155 records within 10 km (OEH 2018a); Predicted within 10 km (DoEE 2018) Predicted to occur (OEH 2018h)	KNOWN– species recorded within subject site
Acacia bynoeana	Bynoe's Wattle	E	V	This species is endemic to central eastern NSW, and is currently known from only 34 locations, many of which are only 1-5 plants. This species occurs mainly in heath and dry sclerophyll forest on sandy soils, seeming to prefer open, sometimes slightly disturbed sites such as trail margins, road edges, and in recently burnt open patches. This species flowers from September to March, and fruit matures in November.	34 records within 10 km (OEH 2018a) Predicted within 10 km (DoEE 2018) Predicted to occur (OEH 2018h)	KNOWN– species recorded within subject site (EcoLogical 2012)

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Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Asterolasia elegans	*Asterolasia elegans*	E	E	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby LGAs, may also occur in the western part of Gosford LGA. 7 known populations. Occurs on Hawkesbury sandstone, commonly amongst rocky outcrops and boulders in sheltered forests on mid- to lower slopes and valleys.	Predicted to occur OEH (2018h)	UNLIKELY- no suitable habitat present within subject site
Callistemon linearifolius	Netted Bottle Brush	V		Recorded from the Georges to Hawkesbury Rivers in Sydney, and north to Nelson Bay. There is also a recent record from the northern Illawarra. In Sydney, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. Grows in dry sclerophyll forest on the coast and adjacent ranges.	Five records within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1636
Maundia triglochinoides		V		Restricted to coastal NSW and extending into southern Queensland. The current southern limit is Wyong; former sites around Sydney are now extinct. This species grows in swamps, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients. It is associated with wetland species e.g. *Triglochin procerum* (OEH 2018).	Two records within 10 km (OEH 2018a) Predicted to occur OEH (2018h)	UNLIKELY- no suitable habitat present within subject site
Pelargonium sp. Striatellum	Omeo Stork's-bill	E	E	Only known in four populations in NSW, three of which exist on basalt plains of the Monaro and one at lake Bathurst. Habitat is just above the high-water level of ephemeral lakes in a zone between grasslands or pasture, wetland or aquatic communities. Flowers from October to March.	Predicted within 10 km (DoEE 2018)	UNLIKELY- no suitable habitat present within subject site
Pultenaea glabra	Smooth Bush-pea	V	V	Restricted to the higher Blue Mountains and has been recorded from the Katoomba-Hazelbrook and Mount Victoria areas, with unconfirmed sightings in the Mount Wilson and Mount Irvine areas. This species is primarily associated with riparian or swamp habitat areas in the mid to upper altitudes of the central Blue Mountains on sandstone derived soils. Grows in swamp margins, hillslopes, gullies and creekbanks and occurs within dry sclerophyll forest and tall damp heath on sandstone. Flowers September to November, fruit matures October to December.	Predicted within 10 km (DoEE 2018)	UNLIKELY- no suitable habitat present within subject site

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Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Angophora inopina	Charmhaven Apple	V	V	Endemic to the central coast of NSW, this species typically occurs in four main vegetation communities: (i) Broad-leaved Scribbly Gum (*Eucalyptus haemastoma*)– Red Bloodwood (*Corymbia gummifera*)–Charmhaven Apple woodland/forest; (ii) Needlebush (*Hakea teretifolia*)–Fern-leaved Banksia (*Banksia oblongifolia*) wet heath; (iii) Red Mahogany (*Eucalyptus resinifera*)–Melaleuca sieberi–Charmhaven Apple sedge woodland; (iv) Brown Stringybark (*Eucalyptus capitellata*)–Red Bloodwood–Charmhaven Apple woodland/forest (DECCW 2010).	2762 records within 10 km (OEH 2018a) Predicted within 10 km (DoEE 2018) Predicted to occur (OEH 2018h)	KNOWN-recorded within PCT 1936 throughout the subject site
Eucalyptus camfieldii	Camfield's Stringybark	V	V	Occurs in shallow sandy soils overlying Hawkesbury sandstone, in coastal heath, mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas. Associated species frequently include stunted species of Narrow-leaved Stringybark (E. oblonga), Brown Stringybark and Broad-leaved Scribbly Gum (DECCW 2010).	Seven record within 10 km (OEH 2018a) Predicted within 10 km (DoEE 2018) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1636
Eucalyptus parramattensis subsp. parramattensis		EP		The species usually occurs from the Goulburn Valley on the Central West slopes to Hill Top on the Central Coast. The endangered population in the Lake Macquarie and Wyong local government areas is at the north-eastern limit of the species range and is quite separate from other known populations. The majority of the population occurs within Wyong in the Porter's Creek and the Wallarah Creek catchments. This species is associated with low moist areas alongside drainage lines and adjacent to wetlands. It is often found in woodland on sandy soils. The endangered population occurs on sandy alluvium within a floodplain community which also supports *Eucalyptus robusta* (Swamp mahogany), *E. tereticornis* (Forest Red Gum), *E. gummifera* (Sydney Bloodwood) as well as *Melaleuca* (Paperbark) species (DECCW 2010).	111 records within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1717

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Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Melaleuca biconvexa	Biconvex Paperbark	V	V	Generally grows in damp places, often near streams or low-lying areas on alluvial soils or low slopes of sheltered aspects (OEH 2018).	67 records within 10 km (OEH 2018a) Predicted within 10 km (DoEE 2018) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1717
Rhizanthella slateri	Eastern Underground Orchid	V	E	The species grows in eucalypt forest but no informative assessment of the likely preferred habitat for the species is available. Currently known only from 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. Flowers during October and November (Harden 1993).	Predicted to occur (OEH 2018h)	MODERATE may be habitat present within PCT 1636
Syzygium paniculatum	Magenta Lilly Pilly	E	V	On the NSW central coast species occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities (OEH 2018).	Predicted within 10 km (DoEE 2018)	UNLIKELY – no suitable habitat present
Caladenia tessellata	Thicked-lipped Spider-orchid	E	V	Known to exist within the Sydney and Central Coast area of NSW. It is found in grassy sclerophyll woodland. Found on clay loam or sandy soils. Flowers from September to November (this is reduced from late September to early October for southern populations).	Predicted within 10 km (DoEE 2018)	MODERATE suitable habitat present within PCT 1636
Cynanchum elegans	White Flowered Wax Plant	V	V	Occurs from Gerroa (Illawarra) to Brunswick Heads and west to Merriwa in the upper Hunter. Most common near Kempsey. Usually occurs on the edge of dry rainforest or littoral rainforest, but also occurs in Coastal Banksia Scrub, open forest and woodland, and Melaleuca scrub. Soil and geology types are not limiting.	Predicted within 10 km (DoEE 2018)	UNLIKELY – no suitable habitat present
Corunastylis insignis	Variable Midge Orchid	CE	CE	Recorded from four localities between Chian Valley Bay and Wyong in Wyong LGA, a small population has also been recorded within Lake Macquarie LGA. Found in patches of Kangaroo Grass Themeda australis in heathland and forest. Associated with dry sclerophyll woodland dominated by Scribbly Gum Eucalyptus haemostoma, Red Bloodwood Corymbia gummifera and Smooth-barked Apple Angophora costata. Flowers between August and November (TSSC, 2014).	23 records within 10 km (OEH 2018a) Predicted within 10 km (DoEE 2018) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1636

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Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Corunastylis sp. Charmhaven (NSW897773)	Midge Orchid	CE	CE	*Corunastylis* sp. Charmhaven (NSW896673) is currently only known from the Wyong Shire of NSW where it is restricted to a few locations in the Charmhaven, Warnervale and Tooheys Road (Bushells Ridge) areas. Found in low woodland and heathland with a shrubby understorey. Associated species include Black She-oak Allocasuarina littoralis, Prickly Tea-tree (*Leptospermum juniperinum)* and Prickly-leaved Paperbark (*Melaleuca nodosa*). Flowers approximately six weeks after a summer rain event usually in February or March (TSSC, 2014a).	96 records within 10 km (OEH 2018a); Predicted within 10 km (DoEE 2018)	MODERATE suitable habitat present within PCT 1636
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	The Leafless Tongue Orchid has been recorded from as far north as Gibraltar Range National Park south into Victoria around the coast as far as Orbost. It is known historically from a number of localities on the NSW south coast and has been observed in recent years at many sites between Batemans Bay and Nowra (although it is uncommon at all sites). Also recorded at Munmorah State Conservation Area, Nelson Bay, Wyee, Washpool National Park, Nowendoc State Forest, Ku-Ring-Gai Chase National Park and Ben Boyd National Park The larger populations typically occur in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*E. sieberi),* Red Bloodwood and Black Sheoak (*Allocasuarina littoralis*); appears to prefer open areas in the understorey of this community (OEH 2018).	20 records within 10 km (OEH 2018a) Predicted within 10 km (DoEE 2018) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1636
Genoplesium insignis	Variable Midge Orchid	E	CE	Recorded from four localities between Chain Valley Bay and Wyong in Wyong local government area. It grows in patches of *Themeda australis* (Kangaroo Grass) amongst shrubs and sedges in heathland and forest. Associated vegetation at Chain Valley Bay is described as dry sclerophyll woodland dominated by Scribbly Gum, Red Bloodwood, Smooth-barked Apple and Black She-oak. Fewer than twenty plants are recorded from three localities, while the number of plants present at the fourth locality (Chain Valley Bay) is not recorded (OEH 2018).	24 records within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1636
Genoplesium baueri	Yellow Gnat Orchid	E	E	Occurs from Ulladulla to Port Stephens, with only 13 known extant populations. Grows in sparse sclerophyll forest and moss gardens over sandstone	Predicted within 10 km (DoEE 2018)	UNLIKELY- no suitable habitat present within subject site

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Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Thelymitra sp. adorata	Wyong Sun Orchid	E	CE	The species occurs in woodland with grassy understorey in well-drained clay loam or shale derived soils. The vegetation type in which the majority of populations occur is Dooralong Spotted Gum - Ironbark Forest (NSW Scientific Committee 2008).	37 records within 10 km (OEH 2018a); Predicted within 10 km (DoEE 2018)	MODERATE suitable habitat present within PCT 1636
Thesium austral	Austral Toadflax	V	V	Found in small, scattered populations along the east coast, northern and southern tablelands. Occurs in grassland or grassy woodland. Found in association with Kangaroo Grass *Themeda australis*. Flowers in spring and summer.	Predicted within 10 km (DoEE 2018)	MODERATE suitable habitat present within PCT 1636
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	V	Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest (OEH 2018).	31 records within 10 km (OEH 2018a); Predicted within 10 km (DoEE 2018) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1636
Diuris praecox	Rough Double Tail	V	V	Grows on hills and slopes of near-coastal districts in open forests that have a grassy to fairly dense understorey.	Predicted to occur within 10 km (DoEE 2018a) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1636

All information in this table is taken from NSW OEH and Commonwealth DotE Threatened Species profiles (OEH, 2018a; DoEE 2018a) unless otherwise stated. The codes used in this table are: CE – Critically Endangered; E – Endangered; V – Vulnerable; EP – Endangered Population; CEEC – Critically Endangered Ecological Community; EEC – Endangered Ecological Community.

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Table A2 Threatened fauna known or predicted from the locality, habitat association and likelihood of occurring at the site.

Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Frogs						
Crinia tinnula	Wallum Froglet	V		Wallum Froglets are found only in acid paperbark swamps and sedge swamps of the coastal 'wallum' country. The species is a late winter breeder. Males call in choruses from within sedge tussocks or at the water edge (OEH 2018).	50 records within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	KNOWN – recorded in PCT 1649 (EcoLogical 2012)
Heleioporus australiacus	Giant Burrowing Frog	V	V	Occurs along the coast and eastern slopes of the Great Dividing Range south from Wollemi National Park. Appears to exist as 2 populations with a 100km gap in records between Jervis Bay and Eden. Northern population occurs on sandy soils supporting heath, woodland or open forest. Breeds in ephemeral to intermittent streams with persistent pools. Only infrequently moves to breeding sites, most commonly found on ridges away from creeks, several hundred metres from water.	Predicted within 10 km (DoEE 2018	LOW – marginal habitat present within the subject site
Litoria aurea	Green and Golden Bell Frog	E	V	Inhabits marshes, dams and stream-sides, particularly those containing bulrushes (Typha spp.) or spikerushes (Eleocharis spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available (OEH 2018).	4 records within 10 km (OEH 2018a) Predicted within 10 km (DoEE 2018) Predicted to occur (OEH 2018h)	LOW –no suitable habitat present within the site
Litoria brevipalmata	Green-thighed Frog	V		Occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain. It prefers wetter forest in the south of its range but extends into drier forest in northern NSW and Southern Queensland. (OEH 2018).	One record within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	UNLIKELY – marginal habitat present within the subject site

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Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Litoria littlejohni	Littlejohn's Tree Frog, Heath Frog	V	V	Occurs on plateaus and eastern slopes of the Great Dividing Range south from Watagan State Forest. Occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops, hunting either in shrubs or on the ground.	Predicted within 10 km (DoEE 2018)	UNLIKELY - no suitable habitat present within the subject site
Mixophyes iteratus	Giant Barred Frog, Southern Barred Frog	E	E	Giant Barred Frogs forage and live amongst deep, damp leaf litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1000 m. They breed around shallow, flowing rocky streams from late spring to summer (DECCW 2010). Occurs on the coast and ranges from south-eastern QLD to the Hawkesbury River in NSW, particularly in Coffs Harbour – Dorrigo area. Forage and live amongst deep, damp leaf litter in rainforest, moist eucalypt forest and nearby dry eucalypt forest. Breed in shallow, flowing rocky streams. Within Sydney Basin, confined to small populations in tall, wet forest in the Watagan Mountains north of the Hawkesbury and the lower Blue Mountains (White 2008b).	Predicted within 10 km (DoEE 2018)	UNLIKELY - no suitable habitat present within the subject site
Mixophyes balbus	Stuttering Frog	E	V	Occurs along the east coast of Australia. Has undergone a massive range reduction particularly in the south of its range: within the Sydney Basin, White (2008a) located only 3 populations south of Sydney (Macquarie Pass and Mt Werong) and Daly et al. (2002, in White 2008a) found only 2 extant populations between Macquarie Pass and Victoria. Inhabits rainforest and wet, tall, open forest. Shelter in deep leaf litter and thick understorey vegetation on the forest floor. Feeds on insects and smaller frogs, breeding in streams during summer after heavy rain. The species does not occur in areas where the riparian vegetation has been disturbed or where there have been significant upstream human impacts (Mahony et al 1997).	Predicted within 10 km (DoEE 2018)	UNLIKELY - no suitable habitat present within the subject site

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Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Birds						
Anthochaera phrygia	Regent Honeyeater	CE	CE	In NSW confined to two known breeding areas: the Capertee Valley and Bundarra-Barraba region. Non-breeding flocks occasionally seen in coastal areas foraging in flowering Spotted Gum and Swamp Mahogany forests, presumably in response to drought. Inhabits dry open forest and woodlands, particularly Box-Ironbark woodland and riparian forests of River Sheoak, with an abundance of mature trees, high canopy cover and abundance of mistletoes.	Predicted within 10 km (DoEE 2018) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1636
Artarmus cyanopterus	Dusky Woodswallow	V		The Dusky Woodswallow is widespread from the coast to inland, including the western slopes of the Great Dividing Range and farther west. It is often recorded in woodlands and dry open sclerophyll forests, and has also been recorded in shrublands, heathlands regenerating forests and very occasionally in moist forests or rainforests. The understorey is typically open with sparse eucalypt saplings, acacias and other shrubs, often with coarse woody debris. It is also recorded in farmland, usually at the edges of forest or woodland or in roadside remnants or wind breaks with dead timber. Dusky Woodswallows prefer larger remnants over smaller remnants.	3 records within 10 km (OEH 2018a)	MODERATE suitable habitat present within PCT 1636
Botaurus poiciloptilus	Australasian Bittern	E	E	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (Typha spp.) and spikerushes (Eleoacharis spp.). Nests are built in secluded places in densely-vegetated wetlands on a platform of reeds (OEH 2018).	2 records within 10 km (OEH 2018a) Predicted within 10 km (DoEE 2018)	UNLIKELY - no suitable habitat present within the subject site

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Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Calidris canutus	Red Knot		E	The Red-necked Stint is mostly found in coastal areas, including in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores. Occasionally they have been recorded on exposed or ocean beaches, and sometimes on stony or rocky shores, reefs or shoals. They also occur in saltworks and sewage farms; saltmarsh; ephemeral or permanent shallow wetlands near the coast or inland, including lagoons, lakes, swamps, riverbanks, waterholes, bore drains, dams, soaks and pools in saltflats. They sometimes use flooded paddocks or damp grasslands. They have occasionally been recorded on dry gibber plains, with little or no perennial vegetation (DoEE 2018).	Predicted within 10 km(DoEE 2018)	UNLIKELY- no suitable habitat present within the subject site
Calidris ferruginea	Curlew Sandpiper	E	CE	Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters (OEH 2018).	Predicted within 10 km (DoEE 2018)	UNLIKELY – no suitable habitat present within the subject site
Calidris tenuirostris	Great Knot	V	CE	In NSW, the species has been recorded at scattered sites along the coast to about Narooma. It has also been observed inland at Tullakool, Armidale, Gilgandra and Griffith. This species occurs within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons. Often recorded on sandy beaches with mudflats nearby, sandy spits and islets and sometimes on exposed reefs or rock platforms. Migrates to Australia from late August to early September, although juveniles may not arrive until October-November (OEH 2018).	Predicted within 10 km (DoEE 2018)	UNLIKELY – no suitable habitat present within the subject site

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Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Callocephalon fimbriatum	Gang-gang Cockatoo	V		The Gang-gang Cockatoo is distributed from southern Victoria through south- and central-eastern New South Wales. In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. In summer, this species is generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, it may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas. The species may also occur in sub-alpine Snow Gum Eucalyptus pauciflora woodland and occasionally in temperate rainforests. Favours old growth attributes for nesting and roosting (OEH 2018).	Predicted to occur (OEH 2018h)	MODERATE- potential habitat present within PCT 1636
Calyptorhynchus lathami	Glossy Black-cockatoo	V		Distributed from the east coast to the southern tablelands and central western plains. Occurs in woodland and open forests, rarely away from *Allocasuarina*. Feeds almost exclusively on the seeds of *Allocasuarina* species. Requires sufficient extent of forage within home range to support breeding. Roosts in leafy canopy trees, preferably eucalypts, usually <1km from feeding site. Nests in large (approximately 20cm) eucalypt hollows (Higgins, 1999).	18 records within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	HIGH- potential habitat present within PCT 1636
Dasyornis brachypterus	Eastern Bristlebird	E	E	Three main populations, in south-eastern Queensland, Central NSW and southern NSW. The species prefers open forest with dense tussocky grass understorey and sparse mid-storey near rainforest ecotone; all of these vegetation types are fire prone. Feeds on a variety of insects, particularly ants. Nests are elliptical domes constructed on or near the ground amongst dense vegetation and eggs are laid between August to February.	Predicted within 10 km (DoEE 2018)	UNLIKELY– no suitable habitat present within the subject site

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Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Daphoenositta chrysoptera	Varied Sittella	V		Sedentary, occurs across NSW from the coast to the far west. Inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Sensitive to habitat isolation and loss of structural complexity, and adversely affected by dominance of Noisy Miners. Cleared agricultural land is potentially a barrier to movement. Builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.	17 records within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	KNOWN – recorded within PCT 1936
Ephippiorhynchus asiaticus	Black-necked Stork	E		Inhabits permanent freshwater wetlands including margins of billabongs, swamps, shallow floodwaters, and adjacent grasslands and savannah woodlands. Feeds in shallow, still water on a variety of prey including fish, frogs, eels, turtles, crabs and snakes (OEH 2018).	5 records within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	UNLIKELY – no suitable habitat present within the subject site
Grantiella picta	Painted Honeyeater	V	E	A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. This species is nomadic, occurring at low densities throughout its range. Most breeding occurs on the inland slopes of the Great Dividing Range in NSW, and this is where the greatest densities of this species are found (OEH 2018).	Predicted within 10 km (DoEE 2018) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1636

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Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Glossopsitta pusilla	Little Lorikeet	V		Occurs from coast to western slopes of the Great Dividing Range. Inhabits dry, open eucalypt forests and woodlands. Occurrence is positively associated with patch size, and with components of habitat complexity including canopy cover, shrub cover, ground cover, logs, fallen branches and litter. Feed primarily on profusely-flowering eucalypts and a variety of other species including melaleucas and mistletoes. On the western slopes and tablelands Eucalyptus albens and E. melliodora are particularly important food sources for pollen and nectar respectively. Mostly nests in small (opening approx. 3cm) hollows in living, smooth-barked eucalypts, especially Eucalyptus viminalis, E. blakelyi and E. dealbata. Most breeding records are from the western slopes.	15 records within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	PRESENT recorded within PCT 1636
Haliaeetus leucogaster	White-bellied Sea Eagle	V	Marine	Preferred foraging habitat includes marine and estuarine wetlands and marine habitats. Nests in tall trees in open forest (OEH 2018).	19 records within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	UNLIKELY– no suitable habitat present within the subject site
Hieraaetus morphnoides	Little Eagle	V		Distribution throughout New South Wales is in the densely forested part of the Dividing Range. Occupies open eucalypt forest, woodland or open woodland. Acacia, Sheoak and riparian woodlands are favourable. Feeds on birds, reptiles and mammals. Nests in tall trees in remnant patches in winter and lays eggs in spring.	Two records within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1636
Ixobrychus flavicollis	Black Bittern	V		Occurs from southern NSW to Cape York and the Kimberley, and southwest WA. Inhabits terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. May occur in flooded grassland, forest, woodland, rainforest and mangroves as long as there is permanent water. Roosts by day in trees or within reeds on the ground. Nests in branches overhanging water and breeds from December to March.	Two records within 10 km (OEH 2018a)	UNLIKELY– no suitable habitat present within the subject site

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Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Lathamus discolor	Swift Parrot	E	CE	Migrates to the Australian southeast mainland between March and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Red Bloodwood (C. gummifera), Mugga Ironbark (*E. sideroxylon*), and White Box (E. albens) (OEH 2018).	25 records within 10 km (OEH 2018a) Predicted within 10 km (DoEE 2018) Predicted to occur (OEH 2018h)	MODERATE suitable foraging habitat present within PCT 1636
Limosa limosa	Black-tailed Godwit	V	M	Found in all states of Australia on the coast, where it resides in sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats.	Predicted within 10 km (DoEE 2018)	UNLIKELY – no suitable habitat present within the subject site
Limosa lapponica	Bar-tailed Godwit		V	This species is usually found in sheltered bays, estuaries and lagoons (OEH 2018).	Predicted within 10 km (DoEE 2018)	UNLIKELY – no suitable habitat present within the subject site
Lophoictinia isura	Square-tailed Kite	V		Occurs across NSW, resident in North, northeast and along west-flowing rivers. Summer breeding migrant to southeast of state. Inhabits a variety of habitats including woodlands and open forests, with preference for timbered watercourses. Favours productive forests on the coastal plain, box-ironbark-gum woodlands on the inland slopes, and Coolibah/River Red Gum on the inland plains. In Sydney area nests in mature living trees within 100m of ephemeral/permanent watercourse. Large home range > 100 km2.	Predicted to occur (OEH 2018h)	MODERATE suitable foraging habitat present within PCT 1636
Neophema pulchella	Turquoise Parrot	V		Occurs from coast to inland slopes. In coastal area, most common between Hunter and Northern Rivers, and further south in S Coast. Inhabits open eucalypt woodlands and forests, typically with a grassy understorey. Favours edges of woodlands adjoining grasslands or timbered creek lines and ridges. Feeds on the seeds of native and introduced grasses and other herbs. Grasslands and open areas provide important foraging habitat for this species while woodlands provide important roosting and breeding habitat. Nests in tree hollows, logs or posts from August to December.	Predicted to occur (OEH 2018h)	MODERATE suitable foraging habitat present within PCT 1636

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Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Ninox connivens	Barking Owl	V		Inhabits eucalypt woodlands, open forest, swamp woodlands, and, especially in inland areas, timber along watercourses. During the day they roost along creek lines, usually in tall understorey trees with dense foliage such as Acacia and Casuarina species, or in dense clumps of canopy leaves in large eucalypts. The Barking owl feeds on a variety of prey, with invertebrates predominant for most of the year, and birds and mammals such as smaller gliders, possums, rodents and rabbits important during breeding. This species lives alone or in a pair with territories ranging from 30 to 200 hectares. Nests are built in hollows of large, old eucalypts (OEH 2018).	3 records within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	HIGH- suitable foraging and roosting habitat present within PCT 1636
Ninox strenua	Powerful Owl	V		Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The species requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. It roosts by day in dense vegetation and requires hollows for nesting. The main prey items are medium-sized arboreal marsupials, particularly the Greater Glider, Common Ringtail Possum and Sugar Glider (OEH 2018).	23 records within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	HIGH- suitable foraging and roosting habitat present within PCT 1636
Numenius madascariensis	Eastern Curlew		CE	Preferred foraging and roosting habitat are intertidal mudflats, particularly where mangroves are present, and saltmarsh. Intertidal coastal mudflats, coastal lagoons, sandy spits (OEH 2018).	Predicted within 10 km (DoEE 2018)	UNLIKELY – no suitable habitat present within the subject site
Petroica boodang	Scarlet Robin	V		In NSW occurs from coast to inland slopes. Breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within open understorey of shrubs and grasses and sometimes in open areas. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. Abundant logs and coarse woody debris are important habitat components.	1 record within 10 km (OEH 2018a)	MODERATE suitable habitat present within PCT 1636

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Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Ptilinopus regina	Rose-crowned Fruit Dove	V		Occurs from Newcastle north to Cape York, with vagrants occasionally as far south as Victoria. Occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful. Thought to be locally nomadic in response to fruit availability.	1 record within 10 km (OEH 2018a)	UNLIKELY – no suitable habitat present within the subject site
Ptilinopus superbus	Superb Fruit-dove	V		Occurs mainly north from NE NSW, much less common further south and largely confined to pockets of habitat south to Moruya. Vagrants occur south to VIC and TAS. Inhabits rainforest and closed forests, may also forage in eucalypt or acacia woodland with fruit-bearing trees. Nests 5-30m above ground in rainforest/rainforest edge tree and shrub species. Part of the population migratory/nomadic.	2 records within 10 km (OEH 2018a)	UNLIKELY – no suitable habitat present within the subject site
Rostratula australis	Australian Painted Snipe	V	E	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. Forages nocturnally on mud-flats and in shallow water (OEH 2018).	Predicted within 10 km (DoEE 2018)	UNLIKELY – no suitable habitat present within the subject site
Pandion haliaetus	Osprey	V	M	The species occurs in littoral and coastal habitats and terrestrial wetlands in tropical and temperate Australia, and offshore islands mostly found in coastal regions on cliffs, but also occur along rivers. Feeding requires expansive areas of open fresh, brackish or saline water. Occur sympatrically with the White-bellied Sea-eagle.	Predicted within 10 km (DoEE 2018)	MODERATE suitable foraging habitat present within PCT 1636
Sternula albifrons	Little Tern	E	M	In NSW occurs mainly north of Sydney, with smaller numbers south to VIC. Almost exclusively coastal, preferring sheltered environments; may occur several kilometres from the sea in harbours, inlets and rivers . Nests in low dunes or sandy beaches just above high tide mark near estuary mouths/ adjacent to coastal lakes and islands. Forage in shallow waters of estuaries, coastal lagoons and lakes, also along open coasts, less often at sea, and usually within 50 m of shore.	2 records within 10 km (OEH 2018a)	UNLIKELY – no suitable habitat present within the subject site

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Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Tyto tenebricosa	Sooty Owl	V		Occurs in the coastal, escarpment and tablelands regions of NSW. More common in the north and absent from the western tablelands and further west. Inhabits tall, moist eucalypt forests and rainforests, and are strongly associated with sheltered gullies, particularly those with tall rainforest understorey. Roosts in tree hollows, amongst dense foliage in gullies or in caves, recesses or ledges of cliffs or banks. Nest in large (>40cm wide, 100cm deep) tree hollows in unlogged/unburnt gullies within 100m of streams or in caves.	1 record within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1636
Tyto novaehollandiae	Masked Owl	V		This species occurs in dry eucalypt woodlands at altitudes from sea level to 1100 m and roosts and breeds in hollows and sometime caves in moist eucalypt forested gullies. It hunts along the edges of forests and roadsides and has a home range covering between 500 ha and 1000 ha. Prey for this species are principally terrestrial mammals but arboreal species may also be taken (OEH 2018).	10 records within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1636

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Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Mammals						
Cercartetus nanus	Eastern Pygmy-possum	V		Occurs along the east coast of NSW, and inland to the Pillaga, Dubbo, Parkes and Wagga Wagga. Inhabits range of habitats from coastal heath and woodland though open and closed forests, subalpine heath and rainforest (Tulloch and Dickman 1995). Inhabits rainforest, sclerophyll forests and heath. Banksia spp. and myrtaceous shrubs and trees are favoured food sources and nesting development footprints in drier habitats. Diet mostly pollen and nectar from Banksia spp., Eucalyptus spp., Callistemon spp. and insects (Ward and Turner 2008). Nests in hollows in trees, under the bark of Eucalypts, forks of tea-trees, abandoned bird nests and Xanthorrhoea bases (Ward and Turner 2008, Tulloch and Dickman 2006).	2 records within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1636
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Occurs from the coast to the western slopes of the divide. Largest numbers of records from sandstone escarpment country in the Sydney Basin and Hunter Valley (Hoye and Schulz 2008). Roosts in caves and mines and most commonly recorded from dry sclerophyll forests and woodlands. An insectivorous species that flies over the canopy or along creek beds (Churchill 2008). In southern Sydney appears to be largely restricted to the interface between sandstone escarpments and fertile valleys.	2 records within 10 km (OEH 2018a) Predicted within 10 km (DoEE 2018) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1636
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Inhabits a range of environments including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Den sites are in hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces. Females occupy home ranges of up to 750 ha and males up to 3,500 ha, usually traversed along densely vegetated creek lines.	3 records within 10 km (OEH 2018a) Predicted within 10 km (DoEE 2018) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1636

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Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. Hunts beetles, moths, weevils and other flying insects above or just below the tree canopy (OEH 2018).	14 records within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1636
Kerivoula papuensis	Golden-tipped Bat	V		The Golden-tipped Bat is distributed along the east coast of Australia in scattered locations from Cape York Peninsula in Queensland to Bega in southern NSW. It is found in rainforest and adjacent sclerophyll forest. Roost in abandoned hanging Yellow-throated Scrubwren and Brown Gerygone nests located in rainforest gullies on small first- and second-order streams (OEH 2018).	1 record within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1636
Miniopterus australis	Little Bentwing-bat	V		Occurs from Cape York to Sydney. Inhabits rainforests, wet and dry sclerophyll forests, paperbark swamps and vine thickets. Only one maternity cave known in NSW, shared with Eastern Bentwing-bats at Willi Willi, near Kempsey. Outside breeding season roosts in caves, tunnels and mines and has been recorded in a tree hollow on one occasion. Forages for insects beneath the canopy of well-timbered habitats (Churchill 2008, Hoye and Hall 2008).	36 records within 10 km (OEH 2018a)	KNOW –recorded within PCT 1636
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V		Generally occurs east of the Great Dividing Range along NSW coast (Churchill 2008). Inhabits various habitats from open grasslands to woodlands, wet and dry sclerophyll forests and rainforest. Essentially a cave bat but may also roost in road culverts, stormwater tunnels and other man-made structures. Only 4 known maternity caves in NSW, near Wee Jasper, Bungonia, Kempsey and Texas. Females may travel hundreds of kilometres to the nearest maternal colony (Churchill 2008).	41 records within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	KNOW –recorded within PCT 1636

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Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Mormopterus norfolkensis	Eastern Freetail-bat	V		Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. Forages in natural and artificial openings in vegetation, typically within a few kilometres of its roost. Roosts primarily in tree hollows but also recorded from man-made structures or under bark (Churchill 2008).	39 records within 10 km (OEH 2018a)	MODERATE suitable habitat present within PCT 1636
Myotis macropus	Southern Myotis	V		Mainly coastal but may occur inland along large river systems. Usually associated with permanent waterways at low elevations in flat/undulating country, usually in vegetated areas. Forages over streams and watercourses feeding on fish and insects from the water surface. Roosts in a variety of habitats including caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage, typically in close proximity to water (Campbell 2011). Breeds November or December (Churchill 2008).	21 records within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	MODERATE suitable foraging habitat present within PCT 1636
Petaurus norfolcensis	Squirrel Glider	V		Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey. Requires abundant tree hollows for refuge and nest sites. Occupies a home range of 3 to 5 hectares (OEH 2018).	99 records within 10 km (OEH 2018a)	KNOW –recorded within PCT 1636
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	V		Distributed from the mid north coast of New South Wales extending north into Queensland. Mostly found in heathland and is most common in dense, wet heath and swamps. Feeds at night via runways through the grassy and sedge understorey, within an area of less than half a hectare. Its diet consists of grass stems, invertebrates, fungi and seeds. Up to three litters are produced from spring to autumn; this strategy allows rapid build-up of numbers in years following fire.	2 records within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1649

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Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Petauroides volans	Greater Glider		V	The greater glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1200 m above sea level. It prefers taller montane, moist eucalypt forest with relatively old trees and abundant hollows.	Predicted within 10 km (DoEE 2018)	UNLIKELY – no suitable habitat present within the subject site
Petaurus australis	Yellow-bellied Glider	V		Occurs along the east coast to the western slopes of the Great Dividing Range. Inhabits a variety of forest types but prefers tall mature eucalypt forest with high rainfall and rich soils. Relies on large hollow-bearing trees for shelter and nesting, with family groups of 2-6 typically denning together. In southern NSW its preferred habitat at low altitudes is moist gullies and creek flats in mature coastal forests. Mostly feeds on sap, nectar and honeydew.	2 records within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1636
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		Found in almost all habitats, from wet and dry sclerophyll forest, open woodland, rainforests, heathland and waterbodies. Dependent on suitable hollow-bearing trees to provide roost sites, which may be a limiting factor on populations in cleared or fragmented habitats. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows (Churchill 1998). When foraging for insects, flies high and fast over the forest canopy, but lower in more open country (OEH 2018).	6 records within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1636
Phascolarctos cinereus	Koala	V	V	Occurs from coast to inland slopes and plains. Restricted to areas of preferred feed trees in eucalypt woodlands and forests. Home range varies depending on habitat quality, from < 2 to several hundred hectares.	5 records within 10 km (OEH 2018a) Predicted within 10 km (DoEE 2018)	MODERATE suitable feed trees present within PCT 1636

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Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Pseudomys novaehollandiae	New Holland Mouse, Pookila		V	Restricted to east of the Great Dividing Range, with annual rainfall >760 mm. Inhabits coastal heath and dry and wet sclerophyll forests. Requires relatively thick ground cover and appears restricted to areas of light and sandy soil (Johnston 2008). Feeds on fungi, roots, tubers, insects and their larvae, and other soft-bodied animals in the soil.	Predicted within 10 km (DoEE 2018)	UNLIKELY – no suitable habitat present within the subject site
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Roosts in camps within 20 km of a regular food source, typically in gullies, close to water and in vegetation with a dense canopy. Forages in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths, swamps and street trees, particularly in eucalypts, melaleucas and banksias. Highly mobile with movements largely determined by food availability (Eby and Law 2008). Will also forage in urban gardens and cultivated fruit crops.	28 records within 10 km (OEH 2018a) Predicted within 10 km (DoEE 2018) Predicted to occur (OEH 2018h)	KNOWN –Recorded flying over the subject site
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Species prefers rocky escarpments, cliffs and rock ledges (OEH 2018).	Predicted within 10 km (DoEE 2018) Predicted to occur (OEH 2018h)	UNLIKELY – no suitable habitat present
Potorous tridactylus tridactylus	Long-nosed Potoroo (SE mainland)	V	V	Restricted to east of the Great Dividing Range, with annual rainfall >760 mm. Inhabits coastal heath and dry and wet sclerophyll forests. Requires relatively thick ground cover and appears restricted to areas of light and sandy soil (Johnston 2008). Feeds on fungi, roots, tubers, insects and their larvae, and other soft-bodied animals in the soil.	Predicted within 10 km (DoEE 2018) Predicted to occur (OEH 2018h)	MODERATE suitable habitat present within PCT 1636
Scoteanax rueppellii	Greater Broad-nosed Bat	V		Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species (OEH 2018).	31 records within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	MODERATE- suitable habitat present within PCT 1636

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Scientific name	Common Name	BC Act status	EPBC Act status	Habitat Association	Nature of record	Likelihood of occurrence in the site
Reptiles						
Hoplocephalus bungaroides	Broad-headed Snake	E	V	The Broad-headed Snake is restricted to the sandstone ranges in the Sydney Basin and within a radius of approximately 200 km of Sydney. It is often found in rocky outcrops and adjacent sclerophyll forest and woodland. The most suitable sites occur in sandstone ridgetops. Common canopy species include *Corymbia eximia, C. gummifera, Eucalyptus sieberi, E. punctata* and *E. piperita*.	1 record within 10 km (OEH 2018a) Predicted to occur (OEH 2018h)	UNLIKELY – no suitable habitat present
Insects						
Petalura gigantea	Giant Dragonfly	E		The Giant Dragonfly is found along the east coast of NSW from the Victorian border to northern NSW. It is not found west of the Great Dividing Range. There are known occurrences in the Blue Mountains and Southern Highlands, in the Clarence River catchment, and on a few coastal swamps from north of Coffs Harbour to Nadgee in the south. Occurs in permanent swamps and bogs with some free water and open vegetation	Predicted to occur (OEH 2018h)	UNLIKELY – no suitable habitat present

Notes:

Marine and littoral threatened species (particularly shorebirds) which are restricted to coastal or estuarine environments were excluded from the threatened biota table.

Wildlife Atlas records: only records from 1980 or later were considered. All information in this table is taken from NSW OEH and Commonwealth DotE Threatened Species profiles (OEH, 2018b; DoEE 2018b) unless otherwise stated. The codes used in this table are: CE – Critically Endangered; E – Endangered; V – Vulnerable; EP – Endangered Population; CEEC – Critically Endangered Ecological Community; EEC – Endangered Ecological Community.

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Appendix B – Species recorded within subject site

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Flora species recorded within subject site

Family	Scientific Name	Common Name	Exotic	BC Act Status	EPBC Act Status	Veg Type (PCT)	
						1636	**1649**
Acanthaceae	*Brunoniella australis*	Blue Trumpet				X	
Anthericaceae	*Thysanotus spp.*					X	
Apiaceae	*Actinotus minor*	Lesser Flannel Flower				X	
Apiaceae	*Platysace linearifolia*					X	X
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak				X	X
Cyperaceae	*Baumea rubiginosa*						X
Cyperaceae	*Gahnia clarkei*	Tall Saw-sedge					X
Cyperaceae	*Lepidosperma concavum*					X	
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge				X	
Cyperaceae	*Ptilothrix deusta*					X	
Dilleniaceae	*Hibbertia riparia*					X	
Elaeocarpaceae	*Tetratheca juncea*	Black-eyed Susan		V,P	V	X	
Ericaceae	*Epacris microphylla*	Coral Heath				X	
Ericaceae	*Epacris pulchella*	Wallum Heath				X	X
Ericaceae	*Leucopogon juniperinus*	Prickly Beard-heath				X	
Ericaceae	*Leucopogon spp.*	A Beard-heath				X	
Ericaceae	*Sprengelia incarnata*	Pink Swamp Heath					X
Fabaceae (Faboideae)	*Gompholobium latifolium*	Golden Glory Pea				X	
Fabaceae (Faboideae)	*Gompholobium pinnatum*	Pinnate Wedge Pea				X	
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla				X	
Fabaceae (Faboideae)	*Mirbelia rubiifolia*	Heathy Mirbelia				X	
Fabaceae (Faboideae)	*Pultenaea retusa*					X	
Fabaceae (Faboideae)	*Pultenaea tuberculata*					X	
Fabaceae (Faboideae)	*Pultenaea villosa*	Hairy Bush-pea				X	

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Family	Scientific Name	Common Name	Exotic	BC Act Status	EPBC Act Status	Veg Type (PCT)	
Fabaceae (Mimosoideae)	*Acacia longifolia*						X
Fabaceae (Mimosoideae)	*Acacia myrtifolia*	Red-stemmed Wattle				X	
Fabaceae (Mimosoideae)	*Acacia suaveolens*	Sweet Wattle				X	X
Goodeniaceae	*Goodenia bellidifolia*					X	X
Goodeniaceae	*Goodenia heterophylla*					X	
Goodeniaceae	*Scaevola albida*	Pale Fan-flower					X
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort				X	
Haloragaceae	*Gonocarpus teucrioides*	Germander Raspwort				X	X
Iridaceae	*Patersonia sericea*	Silky Purple-Flag				X	
Lauraceae	*Cassytha glabella*					X	X
Lindsaeaceae	*Lindsaea linearis*	Screw Fern					X
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush					X
Lomandraceae	*Lomandra multiflora subsp. multiflora*	Many-flowered Mat-rush				X	
Lomandraceae	*Lomandra obliqua*					X	
Myrtaceae	*Angophora costata*	Sydney Red Gum				X	
Myrtaceae	*Angophora floribunda*	Rough-barked Apple				X	
Myrtaceae	*Angophora inopina*	Charmhaven Apple		V,P	V	X	
Myrtaceae	*Callistemon linearis*	Narrow-leaved Bottlebrush					X
Myrtaceae	*Corymbia gummifera*	Red Bloodwood				X	
Myrtaceae	*Eucalyptus capitellata*	Brown Stringybark				X	
Myrtaceae	*Eucalyptus globoidea*	White Stringybark				X	
Myrtaceae	*Eucalyptus haemastoma*	Broad-leaved Scribbly Gum				X	
Myrtaceae	*Eucalyptus resinifera*	Red Mahogany					X
Myrtaceae	*Eucalyptus robusta*	Swamp Mahogany					X
Myrtaceae	*Kunzea ambigua*	Tick Bush					X

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Family	Scientific Name	Common Name	Exotic	BC Act Status	EPBC Act Status	Veg Type (PCT)	
Myrtaceae	*Leptospermum coriaceum*	Green Tea-tree				X	
Myrtaceae	*Leptospermum polygalifolium*	Tantoon				X	X
Myrtaceae	*Leptospermum trinervium*	Slender Tea-tree				X	X
Myrtaceae	*Melaleuca nodosa*					X	X
Myrtaceae	*Melaleuca sieberi*					X	X
Orchidaceae	*Cryptostylis subulata*	Large Tongue Orchid					X
Phormiaceae	*Dianella caerulea*	Blue Flax-lily				X	X
Phormiaceae	*Dianella revoluta*	Blueberry Lily				X	
Poaceae	*Andropogon virginicus*	Whisky Grass	*			X	
Poaceae	*Anisopogon avenaceus*	Oat Speargrass				X	
Poaceae	*Aristida spp.*	A Wiregrass				X	
Poaceae	*Aristida vagans*	Threeawn Speargrass				X	
Poaceae	*Chloris gayana*	Rhodes Grass	*			X	
Poaceae	*Cynodon dactylon*	Common Couch	*			X	
Poaceae	*Entolasia stricta*	Wiry Panic				X	X
Poaceae	*Eragrostis brownii*	Brown's Lovegrass				X	
Poaceae	*Panicum simile*	Two-colour Panic				X	X
Poaceae	*Paspalum urvillei*	Vasey Grass	*			X	
Poaceae	*Rytidosperma spp.*					X	
Poaceae	*Setaria pumila*	Pale Pigeon Grass	*			X	
Poaceae	*Themeda triandra*					X	X
Polygalaceae	*Comesperma ericinum*	Pyramid Flower				X	
Proteaceae	*Banksia oblongifolia*	Fern-leaved Banksia				X	X
Proteaceae	*Banksia spinulosa*	Hairpin Banksia				X	X
Proteaceae	*Hakea dactyloides*	Finger Hakea				X	
Proteaceae	*Isopogon anemonifolius*	Broad-leaf Drumsticks				X	
Proteaceae	*Lambertia formosa*	Mountain Devil				X	

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Family	Scientific Name	Common Name	Exotic	BC Act Status	EPBC Act Status	Veg Type (PCT)	
Proteaceae	*Persoonia levis*	Broad-leaved Geebung				X	
Proteaceae	*Persoonia oblongata*					X	
Proteaceae	*Petrophile pulchella*	Conesticks				X	
Restionaceae	*Empodisma minus*						X
Restionaceae	*Lepyrodia scariosa*					X	X
Thymelaeaceae	*Pimelea linifolia*	Slender Rice Flower				X	
Violaceae	*Hybanthus monopetalus*	Slender Violet-bush				X	
Xanthorrhoeaceae	*Xanthorrhoea latifolia*					X	X

V = Listed as vulnerable species

BC Act = Biodiversity Conservation Act 2018

EPBC Act – Environment Protection and Biodiversity Conservation Act 1999

Fauna species recorded within subject site

Class	Family	Scientific Name	Common Name		BC Act Status	EPBC Act Status	Observation
Amphibia	Myobatrachidae	*Limnodynastes peronii*	brown-striped frog				O
Aves	Acanthizidae	*Sericornis frontalis*	White-browed scrubwren				W
Aves	Acanthizidae	*Acanthiza pusilla*	brown thornbill				W
Aves	Aegothelidae	*Aegotheles cristatus*	Australian owlet-nightjar				W
Aves	Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra				W
Aves	Apodidae	*Hirundapus caudacutus*	white-throated needletail			M	W
Aves	Artamidae	*Cracticus nigrogularis*	pied butcherbird				W
Aves	Artamidae	*Cracticus tibicen*	australian magpie				O

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Class	Family	Scientific Name	Common Name		BC Act Status	EPBC Act Status	Observation
Aves	Artamidae	*Strepera graculina*	pied currawong				O
Aves	Climacteridae	*Cormobates leucophaea*	White-throated treecreeper				W
Aves	Corvidae	*Corvus coronoides*	Australian raven				W
Aves	Cuculidae	*Cacomantis flabelliformis*	fan-tailed cuckoo				O
Aves	Estrildidae	*Stagonopleura bella*	beautiful firetail				O, W
Aves	Estrildidae	*Taeniopygia bichenovii*	double-barred finch				O
Aves	Maluridae	*Malurus cyaneus*	superb fairy-wren				W
Aves	Meliphagidae	*Lichenostomus chrysops*	yellow-faced honeyeater				O, W
Aves	Meliphagidae	*Manorina melanocephala*	Noisy miner				W
Aves	Meliphagidae	*Acanthorhynchus tenuirostris*	Eastern spinebill				W
Aves	Meliphagidae	*Phylidonyris niger*	white-cheeked honeyeater				O, W
Aves	Meliphagidae	*Melithreptus brevirostris*	brown-headed honeyeater				W
Aves	Meliphagidae	*Anthochaera carunculata*	red wattlebird				O
Aves	Nectariniidae	*Dicaeum hirundinaceum*	mistletoebird				W
Aves	Neosittidae	*Daphoenositta chrysoptera*	varied sittella		V		O
Aves	Pachycephalidae	*Pachycephala rufiventris*	rufous whistler				W
Aves	Pachycephalidae	*Colluricincla harmonica*	grey shrike-thrush				W

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Class	Family	Scientific Name	Common Name		BC Act Status	EPBC Act Status	Observation
Aves	Petroicidae	*Eopsaltria australis*	eastern yellow robin				W
Aves	Psittacidae	*Trichoglossus haematodus*	rainbow lorikeet				W
Aves	Psittacidae	*Trichoglossus chlorolepidotus*	Scaly-breasted lorikeet				W
Aves	Psittacidae	*Glossopsitta pusilla*	Little lorikeet		V		W, O
Aves	Psittacidae	*Platycercus eximius*	eastern rosella				W
Aves	Psittacidae	*Glossopsitta concinna*	musk lorikeet				W
Aves	Rhipiduridae	*Rhipidura albiscapa*	grey fantail				W
Aves	Timaliidae	*Zosterops lateralis*	silvereye				W
Aves	Tytonidae	*^^Tyto novaehollandiae*	masked owl		V		W
Mammalia	Canidae	*Vulpes vulpes*	fox	*			F, O
Mammalia	Dasyuridae	*Antechinus stuartii*	brown antechinus				O
Mammalia	Macropodidae	*Wallabia bicolor*	Swamp wallaby				O
Mammalia	Muridae	*Rattus lutreolus*	swamp rat				O
Mammalia	Muridae	*Rattus fuscipes*	bush rat				O
Mammalia	Petauridae	*Petaurus norfolcensis*	Squirrel glider		V		O, W
Mammalia	Petauridae	*Petaurus breviceps*	Sugar glider				O
Mammalia	Phalangeridae	*Trichosurus sp.*	brushtail possum				W
Mammalia	Pseudocheiridae	*Pseudocheirus peregrinus*	common ringtail possum				O
Mammalia	Pteropodidae	*Pteropus poliocephalus*	grey-headed flying-fox		V	V	O

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Class	Family	Scientific Name	Common Name		BC Act Status	EPBC Act Status	Observation
Mammalia	Vespertilionidae	*Nyctophilus geoffroyi*	lesser long-eared bat				O
Mammalia	Molossidae	*Tadarida australis*	White-striped Freetail-bat				O
Mammalia	Molossidae	*Mormopterus ozimops ridei*	Ride's Freetail-bat				O
Mammalia	Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat				O
Mammalia	Molossidae	*Mormopterus norfolkensis*	Eastern Freetail-bat		V		O
Mammalia	Vespertilionidae	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat		V		O
Mammalia	Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat				O
Mammalia	Vespertilionidae	*Vespadelus pumilus*	Eastern Forest Bat				O
Mammalia	Vespertilionidae	*Miniopterus australis*	Little Bentwing-bat		V,P		O
Mammalia	Rhinolophidae	*Rhinolophus megaphyllus*	Eastern Horseshoe-bat				O
Mammalia	Vespertilionidae	*Vespadelus sp.*	Unidentified Eptesicus				O

V = Listed as vulnerable species

M = Listed as a migratory species

O= Observed

W = Heard/ recorded

BC Act = Biodiversity Conservation Act 2016

EPBC Act – Environment Protection and Biodiversity Conservation Act 1999

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Appendix C – PCT and vegetation integrity plot data

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Plot 1 – Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
			# spp	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**
			31	31	2	15	8	3	1	2	0	0
Species	**Cover**	**Abundance**	**Sum cover**	**Cover**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**
			163.8	163.8	35	53.4	53.4	0.9	0.1	21	0	0
Angophora costata	25	5	TG		25							
Eucalyptus capitellata	10	2	TG		10							
Melaleuca nodosa	15	12	SG			15						
Banksia spinulosa	20	40	SG			20						
Xanthorrhoea latifolia	20	100	OG							20		
Entolasia stricta	50	1000	GG				50					
Pimelea linifolia	0.1	10	SG			0.1						
Cassytha glabella	1	40	OG							1		
Pultenaea tuberculata	0.2	5	SG			0.2						
Themeda triandra	0.1	300	GG				0.1					
Platysace linearifolia	10	30	SG			10						
Mirbelia rubiifolia	1	10	SG			1						
Lepyrodia scariosa	0.1	200	GG				0.1					
Epacris pulchella	5	20	SG			5						
Gonocarpus tetragynus	0.3	100	FG					0.3				
Goodenia heterophylla	0.5	3	FG					0.5				
Lambertia formosa	0.1	3	SG			0.1						
Patersonia sericea	0.1	30	FG					0.1				
Lomandra multiflora	1	20	GG				1					
Anisopogon avenaceus	1	5	GG				1					
Epacris microphylla	0.1	10	SG			0.1						
Pultenaea retusa	0.1	3	SG			0.1						

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			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Lomandra obliqua	0.1	15	GG				0.1					
Panicum simile	0.1	10	GG				0.1					
Lindsaea linearis	0.1	20	EG						0.1			
Gompholobium pinnatum	0.1	5	SG			0.1						
Comesperma ericinum	0.1	1	SG			0.1						
Melaleuca sieberi	1	15	SG			1						
Leptospermum polygalifolium	0.5	2	SG			0.5						
Pultenaea tuberculata	0.1	20	SG			0.1						
Aristida spp.	1	50	GG				1					

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Plot 2 - PCT 1649 –Smooth Barked Apple- Red Mahogany- Swamp Mahogany- Melaleuca sieberi heathy swamp woodland of coastal lowlands

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
			# spp	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**
			21	21	3	6	8	1	1	2	0	0
Species	**Cover**	**Abundance**	**Sum cover**	**Cover**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**
			111.6	111.6	25	42.6	35.8	0.1	0.1	8	0	0
Melaleuca sieberi	35	50	SG			35						
Allocasuarina littoralis	10	12	TG		10							
Eucalyptus robusta	5	3	TG		5							
Entolasia stricta	5	2000	GG				5					
Cassytha glabella	5	100	OG							5		
Acacia longifolia	5	50	SG			5						
Xanthorrhoea latifolia	3	10	OG							3		
Banksia spinulosa	0.5	2	SG			0.5						
leptospermum polygalifolium	1	1	SG			1						

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			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Lindsaea linearis	0.1	10	EG						0.1			
Gahnia clarkei	0.5	3	GG				0.5					
Leptospermum trinervium	1	2	SG			1						
Angophora costata	10	3	TG		10							
Lepyrodia scariosa	5	200	GG				5					
Themeda triandra	5	200	GG				5					
Eragrostis brownii	0.1	3	GG				0.1					
Epacris pulchella	0.1	2	SG			0.1						
Baumea rubiginosa	0.1	50	GG				0.1					
Gonocarpus tetragynus	0.1	10	FG					0.1				
Panicum simile	0.1	10	GG				0.1					

Plot 3 – Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
			# spp	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**
			34	34	4	18	7	3	0	2	0	0
Species	**Cover**	**Abundance**	**Sum cover**	**Cover**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**
			161	161	32	28.3	94.3	0.4	0	6	0	0
Eucalyptus haemastoma	25	5	TG		25							
Angophora inopina	3	4	TG		3							
Hakea dactyloides	5	50	SG			5						
Lambertia formosa	5	50	SG			5						
Isopogon anemonifolius	2	20	SG			2						
Eucalyptus capitellata	2	1	TG		2							
Xanthorrhoea latifolia	5	50	OG							5		
Lepidosperma laterale	1	50	GG				1					

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			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Cassytha glabella	1	100	OG							1		
Epacris pulchella	0.3	40	SG			0.3						
Banksia oblongifolia	10	80	SG			10						
Entolasia stricta	70	1000	GG				70					
Hibbertia riparia	0.1	3	SG			0.1						
Platysace linearifolia	0.1	5	SG			0.1						
Petrophile pulchella	1	10	SG			1						
Panicum simile	0.1	5	GG				0.1					
Leptospermum trinervium	2	5	SG			2						
Lepyrodia scariosa	20	500	GG				20					
Thysanotus spp.	0.1	2	FG					0.1				
Persoonia oblongata	0.1	1	SG			0.1						
Actinotus minor	0.2	30	FG					0.2				
Pimelea linifolia	0.1	1	SG			0.1						
Acacia suaveolens	0.1	1	SG			0.1						
Pultenaea tuberculata	0.1	2	SG			0.1						
Pultenaea villosa	0.1	2	SG			0.1						
Anisopogon avenaceus	0.1	3	GG				0.1					
Aristida spp.	0.1	5	GG				0.1					
Melaleuca sieberi	2	1	SG			2						
Leucopogon spp.	0.1	3	SG			0.1						
Pultenaea retusa	0.1	2	SG			0.1						
Comesperma ericinum	0.1	1	SG			0.1						
Gonocarpus tetragynus	0.1	20	FG					0.1				
Corymbia gummifera	2	2	TG		2							
Lepidosperma concavum	3	50	GG				3					

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Plot 4 - PCT 1649 –Smooth Barked Apple- Red Mahogany- Swamp Mahogany- Melaleuca sieberi heathy swamp woodland of coastal lowlands

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
			# spp	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**
			28	**28**	**1**	**12**	**8**	**6**	**0**	**1**	**0**	**0**
Species	**Cover**	**Abundance**	**Sum cover**	**Cover**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**
			139	139	10	98.6	29.1	1.2	0	0.1	0	0
Melaleuca sieberi	5	8	SG			5						
Melaleuca nodosa	85	1000	SG			85						
Baumea rubiginosa	10	50	GG				10					
Entolasia stricta	5	200	GG				5					
Gonocarpus tetragynus	0.3	200	FG					0.3				
Acacia suaveolens	0.1	10	SG			0.1						
Gahnia clarkei	5	20	GG				5					
Gonocarpus teucrioides	0.1	100	FG					0.1				
Eucalyptus resinifera	10	3	TG		10							
Lomandra longifolia	2	20	GG				2					
Leptospermum polygalifolium	0.1	2	SG			0.1						
Baumea rubiginosa	3	100	GG				3					
Epacris pulchella	0.1	20	SG			0.1						
Dianella caerulea var. caerulea	0.5	30	FG					0.5				
Scaevola albida	0.1	1	FG					0.1				
Cassytha glabella	0.1	20	OG							0.1		
Kunzea ambigua	0.1	2	SG			0.1						

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			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Acacia longifolia	7	10	SG			7						
Lepyrodia scariosa	3	100	GG				3					
Panicum simile	0.1	10	GG				0.1					
Themeda triandra	1	20	GG				1					
Banksia oblongifolia	0.2	1	SG			0.2						
Banksia spinulosa	0.3	2	SG			0.3						
Goodenia bellidifolia	0.1	10	FG					0.1				
Sprengelia incarnata	0.1	10	SG			0.1						
Platysace linearifolia	0.1	2	SG			0.1						
Cryptostylis subulata	0.1	3	FG					0.1				
Acacia suaveolens	0.5	2	SG			0.5						

Plot 5 – Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
			# spp	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**
			37	36	3	18	6	5	1	3	0	0
Species	**Cover**	**Abundance**	**Sum cover**	**Cover**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**
			145.8	130.8	26	28.3	71.6	0.7	0.1	4.1	0	0
Eucalyptus haemastoma	15	3	TG									
Corymbia gummifera	20	12	TG		20							
Angophora costata	5	3	TG		5							
Petrophile pulchella	20	15	SG			20						
Patersonia sericea	0.3	30	FG					0.3				
Hibbertia riparia	0.1	10	SG			0.1						
Entolasia stricta	50	1000	GG				50					
Allocasuarina littoralis	1	4	TG		1							
Cassytha glabella	1	50	OG							1		

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			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Lambertia formosa	1	20	SG			1						
Banksia spinulosa	0.3	5	SG			0.3						
Leptospermum trinervium	0.3	1	SG			0.3						
Themeda triandra	5	100	GG				5					
Lepidosperma laterale	1	50	GG				1					
Lepyrodia scariosa	15	500	GG				15					
Acacia myrtifolia	0.3	1	SG			0.3						
Xanthorrhoea latifolia	3	50	OG							3		
Hardenbergia violacea	0.1	1	OG							0.1		
Melaleuca sieberi	0.5	1	SG			0.5						
Gompholobium latifolium	0.1	1	SG			0.1						
Persoonia levis	0.8	1	SG			0.8						
Epacris pulchella	0.1	20	SG			0.1						
Anisopogon avenaceus	0.3	30	GG				0.3					
Pultenaea tuberculata	0.1	5	SG			0.1						
Banksia oblongifolia	3	10	SG			3						
Hakea dactyloides	1	5	SG			1						
Ptilothrix deusta	0.3	10	GG				0.3					
Gonocarpus tetragynus	0.1	100	FG					0.1				
Platysace linearifolia	0.1	20	SG			0.1						
Brunoniella australis	0.1	5	FG					0.1				
Mirbelia rubiifolia	0.1	10	SG			0.1						
Actinotus minor	0.1	20	FG					0.1				
Lindsaea linearis	0.1	20	EG						0.1			
Comesperma ericinum	0.1	1	SG			0.1						
Leucopogon juniperinus	0.1	1	SG			0.1						
Leptospermum coriaceum	0.3	20	SG			0.3						
Hybanthus monopetalus	0.1	2	FG					0.1				

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Plot 6 – Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
			# spp	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**
			34	34	4	12	9	7	0	2	0	0
Species	**Cover**	**Abundance**	**Sum cover**	**Cover**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**	**Sum**
			154.4	154.4	45	7.4	96	0.7	0	5.3	0	0
Angophora costata	10	2	TG		10							
Eucalyptus haemastoma	5	1	TG		5							
Melaleuca nodosa	3	3	SG			3						
Melaleuca sieberi	1	1	SG			1						
Allocasuarina littoralis	20	45	TG		20							
Corymbia gummifera	10	3	TG		10							
Callistemon linearis	1	3	SG			1						
Xanthorrhoea latifolia	5	50	OG							5		
Entolasia stricta	80	1000	GG				80					
Hybanthus monopetalus	0.1	3	FG					0.1				
Platysace linearifolia	0.2	20	SG			0.2						
Lepidosperma concavum	5	50	GG				5					
Mirbelia rubiifolia	0.1	30	SG			0.1						
Gonocarpus tetragynus	0.1	100	FG					0.1				
Rytidosperma spp.	0.1	5	GG				0.1					
Epacris pulchella	0.1	20	SG			0.1						
Goodenia heterophylla	0.1	20	FG					0.1				
Aristida vagans	0.1	10	GG				0.1					
Eragrostis brownii	0.1	5	GG				0.1					
Dianella revoluta	0.1	1	FG					0.1				

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			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Lepyrodia scariosa	10	300	GG				10					
Anisopogon avenaceus	0.3	30	GG				0.3					
Persoonia levis	0.1	3	SG			0.1						
Cassytha glabella	0.3	20	OG							0.3		
Comesperma ericinum	0.1	1	SG			0.1						
Actinotus minor	0.1	5	FG					0.1				
Patersonia sericea	0.1	10	FG					0.1				
Petrophile pulchella	0.5	3	SG			0.5						
Lambertia formosa	1	8	SG			1						
Lomandra obliqua	0.1	3	GG				0.1					
Leptospermum trinervium	0.2	1	SG			0.2						
Cryptostylis subulata	0.1	1	FG					0.1				
Panicum simile	0.3	30	GG				0.3					
Pultenaea tuberculata	0.1	10	SG			0.1						

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Summary of vegetation integrity plot data

Plot	PCT	Area	Patch size	Condition class	Zone	Easting	Northing	Bearing	Tree	Shrub	Grass	Forbs	Ferns	Other	Tree	Shrub
1	1636	43.5	101	High	56	357994	6323911	80	2	15	8	3	1	2	35.0	53.4
3	1636	43.5	101	High	56	358229	6323886	110	4	18	7	3	0	2	32.0	28.3
5	1636	43.5	101	High	56	358452	6324030	221	3	18	6	5	1	3	26.0	28.3
6	1636	43.5	101	High	56	358590	6324250	56	4	12	9	7	0	2	45.0	7.4
2	1649	1.5	101	High	56	357837	6323839	1	3	6	8	1	1	2	25.0	42.6
4	1649	1.5	101	High	56	358354	6323881	99	1	12	8	6	0	1	10.0	98.6

Plot	Grass	Forbs	Ferns	Other	Large Trees	Hollow rees	Litter Cover	Length Fallen Logs	Tree Stem 5to10	Tree Stem 10to20	Tree Stem 20to30	Tree Stem 30to50	Tree Stem 50to80	Tree Regen	High Threat Exotic	
1	53.4	0.9	0.1	21.0	0	2	55.0	12.0	1	1	1	1	1	1	0.0	
3	94.3	0.4	0.0	6.0	0	1	24.0	0.0	1	1	1	1	1	1	0.0	
5	71.6	0.7	0.1	4.1	0	4	50.0	9.0	1	1	1	1	1	1	0.0	
6	96.0	0.7	0.0	5.3	0	2	56.0	33.0	1	1	1	1	1	1	0.0	
2	35.8	0.1	0.1	8.0	0	3	30.0	0.0	1	1	1	1	0	1	0.0	
4	29.1	1.2	0.0	0.1	0	1	6.0	1.0	1	1	1	1	1	1	0.0	

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Appendix D – Biodiversity credit report

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BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00010691/BAAS17098/18/00010692	Motolink Rezoning BCAR	24/02/2018
Assessor Name	Report Created	BAM Data version *
Arien Quin	10/05/2018	3
Assessor Number	* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.	
BAAS17098		

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Candidate SAII	Ecosystem credits
Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast								
1	1636_High	61.5	43.5	0.25	High Sensitivity to Potential Gain	1.75		1170
							Subtotal	**1170**

Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands								
2	1649_High	58.4	1.5	0.25	High Sensitivity to Potential Gain	2.00	TRUE	44
							Subtotal	**44**
							Total	**1214**

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Candidate SAII	Species credits
Acacia bynoeana / Bynoe's Wattle (Flora)						
1636_High	61.5	0.58	0.25	2	False	18
					Subtotal	**18**
Angophora inopina / Charmhaven Apple (Flora)						
1636_High	61.5	43.5	0.25	1	N/A	669
					Subtotal	**669**
Crinia tinnula / Wallum Froglet (Fauna)						
1649_High	58.4	1.5	0.25	1.5	False	33
					Subtotal	**33**

Petaurus norfolcensis / Squirrel Glider (Fauna)						
1636_High	61.5	43.5	0.25	2	False	1337
					Subtotal	**1337**
Tetratheca juncea / Black-eyed Susan (Flora)						
1636_High	61.5	0.28	0.25	2	False	9
					Subtotal	**9**

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https://projects.ghd.com/OC/Newcastle/motorwaylinksitebiod/Delivery/Documents/2218652_REP_Biodiveristy Certification Assessment Report.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	A. Quin	D. Williams		S. Pearce		16/05/2018
B	A. Quin	D. Williams		S. Pearce		21/05/2018

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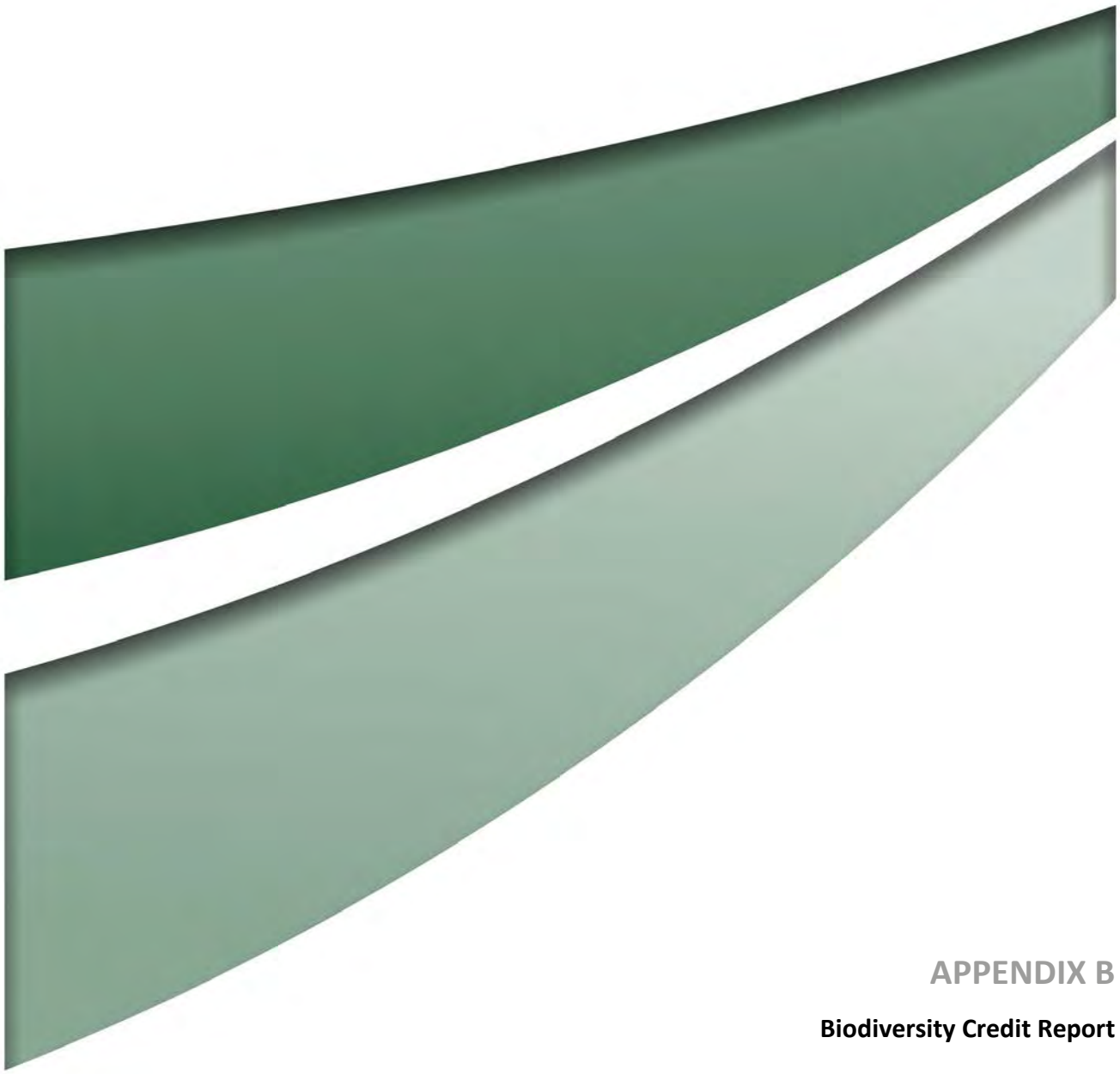

APPENDIX B

Biodiversity Credit Report

BAM Credit Summary Report

Proposal Details

Assessment Id
00010691/BAAS17048/19/00010692

Proposal Name
Motorway link Rezoning BCAR

BAM data last updated *
12/06/2019

Assessor Name
Arien Quin

Report Created
09/07/2019

BAM Data version *
11

Assessor Number
BAAS17098

BAM Case Status
Open

Date Finalised
To be finalised

Assessment Revision
0

Assessment Type
Biocertification

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast								
1	1636_High	61.5	41.4	0.25	High Sensitivity to Potential Gain	1.75		1114
							Subtotal	**1114**

Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands								
2	1649_High	60.9	1.4	0.25	High Sensitivity to Potential Gain	2.00		43
							Subtotal	**43**
							Total	**1157**

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Potential SAII	Species credits
Acacia bynoeana / Bynoe's Wattle (Flora)						
1636_High	61.5	0.58	0.25	2	False	18
					Subtotal	**18**
Angophora inopina / Charmhaven Apple (Flora)						
1636_High	61.5	41.4	0.25	1	N/A	636
					Subtotal	**636**
Crinia tinnula / Wallum Froglet (Fauna)						
1649_High	60.9	1.4	0.25	1.5	False	32
					Subtotal	**32**
Petaurus norfolcensis / Squirrel Glider (Fauna)						
1636_High	61.5	41.4	0.25	2	False	1273
1649_High	60.9	1.4	0.25	2	False	43
					Subtotal	**1316**

Tetratheca juncea / Black-eyed Susan (Flora)						
1636_High	61.5	41.4	0.25	2	False	1273
1649_High	60.9	1.4	0.25	2	False	43
					Subtotal	**1316**

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