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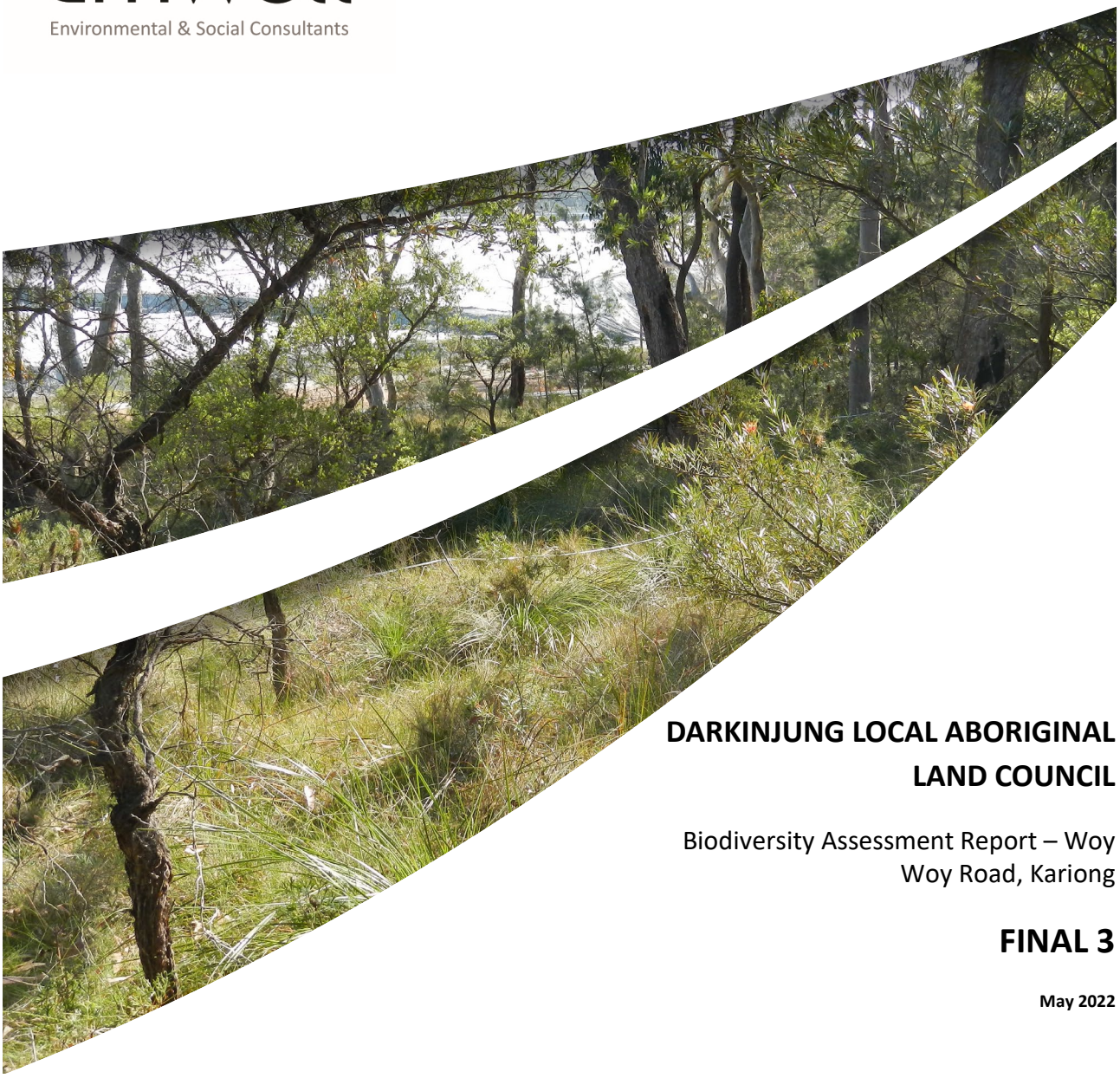

DARKINJUNG LOCAL ABORIGINAL LAND COUNCIL

Biodiversity Assessment Report – Woy Woy Road, Kariong

FINAL 3

May 2022

DARKINJUNG LOCAL ABORIGINAL LAND COUNCIL

Biodiversity Assessment Report – Woy Woy Road, Kariong

FINAL 3

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

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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
1	Allison Riley	3 September 2019	Allison Riley	3 September 2019
Final	Allison Riley	10 October 2019	Allison Riley	10 October 2019
Final 2	Naomi Buchhorn	11 April 2022	Naomi Buchhorn	11 April 2022
Final 3	Naomi Buchhorn	4 May 2022	Naomi Buchhorn	4 May 2022

Executive Summary

Darkinjung Local Aboriginal Land Council (Darkinjung LALC) is lodging a planning proposal for rezoning to allow for future subdivision and low density residential development of the land located at Lot 512 and Lot 513 DP 727686, Kariong NSW.

The Development Footprint is located at 300 Woy Woy Road Kariong, NSW in the Central Coast Local Government Area. The Development Footprint covers an area of approximately 6.17 hectares (ha) and is surrounded by residential dwellings to the north and west, Woy Woy Road to the west with large tracts of native vegetation in Brisbane Water National Park to the east, south and south west.

This Biodiversity Assessment Report (BAR) has been prepared by Umwelt (Australia) Pty Limited (Umwelt) on behalf of Darkinjung LALC to assess the potential biodiversity impacts of the proposed development in accordance with the Biodiversity Assessment Methodology (BAM).

Surveys of the Development Footprint identified three Plant Community Types (PCTs) and native fauna habitats being:

- 2.5 ha of PCT1641 Dwarf Apple Scribbly Gum heathy low woodland on sandstone ranges of the Central Coast (Good Condition)
- 2.6 ha of PCT1642 Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast (Good Condition)
- 0.7 ha of PCT 1699 Heath- leaved Banksia – Coral Fern wet heath on sandstone ranges of the lower Central Coast (Good Condition).

There is also 0.3 ha of land that has been illegally cleared in the north of the site and has been assessed as conforming to PCT 1642.

Following the application of avoidance and mitigation measures, the BAM assessment identified the following biodiversity credits required to offset the impacts of the Project:

- 75 ecosystem credits for PCT1641 Dwarf Apple Scribbly Gum heathy low woodland on sandstone ranges of the Central Coast (Good Condition)
- 75 ecosystem credits for PCT1642 Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast (Good Condition)
- 9 ecosystem credits for PCT 1699 Heath- leaved Banksia – Coral Fern wet heath on sandstone ranges of the lower Central Coast (Good Condition)
- 5 species credits for flora species *Callistemon linearifolius,* 9 species credits for *Darwinia glaucophylla,* 202 species credits for *Hibbertia procumbens* and 101 species credits for *Hibbertia puberula*
- 202 species credits for eastern pygmy possum, 151 species credits for large- eared pied bat, 270 species credits for swift parrot and 38 species credits for southern myotis.

Darkinjung LALC is committed to delivering a Biodiversity Offset Strategy that appropriately compensates for the unavoidable loss of biodiversity values as a result of the Project as required under the *Biodiversity Conservation Act 2016*. This will be undertaken using one or more of the following options:

- Strategic biocertification, or
- The establishment and retirement of credits within a Stewardship site and/or
- Securing required credits through the open credit market and/or
- Payments to the Biodiversity Conservation Fund.

Glossary

BAR	Biodiversity Assessment Report
BAM	Biodiversity Assessment Methodology
BC Act	NSW *Biodiversity Conservation Act 2016*
CEEC	Critically Endangered Ecological Community
Development Footprint	The total impact zone associated with the Project.
DoEE	Commonwealth Department of the Environment and Energy
DNG	Derived Native Grasslands
Ecosystem credit	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with PCT. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at an offset site.
EEC	Endangered Ecological Community
EP	Endangered Population
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
GDEs	Groundwater-dependent Ecosystems
GIS	Geographical Information System
IBRA	Interim Biogeographic Regionalisation for Australia (Version 7)
LGA	Local Government Area
MGA	Map Grid of Australia
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
PMST	Protected Matters Search Tool
Species credit	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection database.
Strahler Stream Order	Classification system that gives a waterway an 'order' according to the number of tributaries associated with it.
TEC	Threatened Ecological Community
TBDC	Threatened Biodiversity Data Collection
VIS	Vegetation Information System

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Appendices

1 Introduction

Darkinjung Local Aboriginal Land Council (Darkinjung LALC) is seeking to lodge a planning proposal for the rezoning of land located at Lot 512 and Lot 513 DP 727686, Kariong NSW to enable future low-density residential subdivision and development

The land is currently zoned C2 Environmental Conservation under the Gosford Local Environmental Plan (LEP) 2014. The planning proposal seeks to:

- rezone 5.72 hectares (ha) of the land from C2 Environmental Conservation to R2 Low Density Residential and 0.45 ha to C3 Environmental Management.

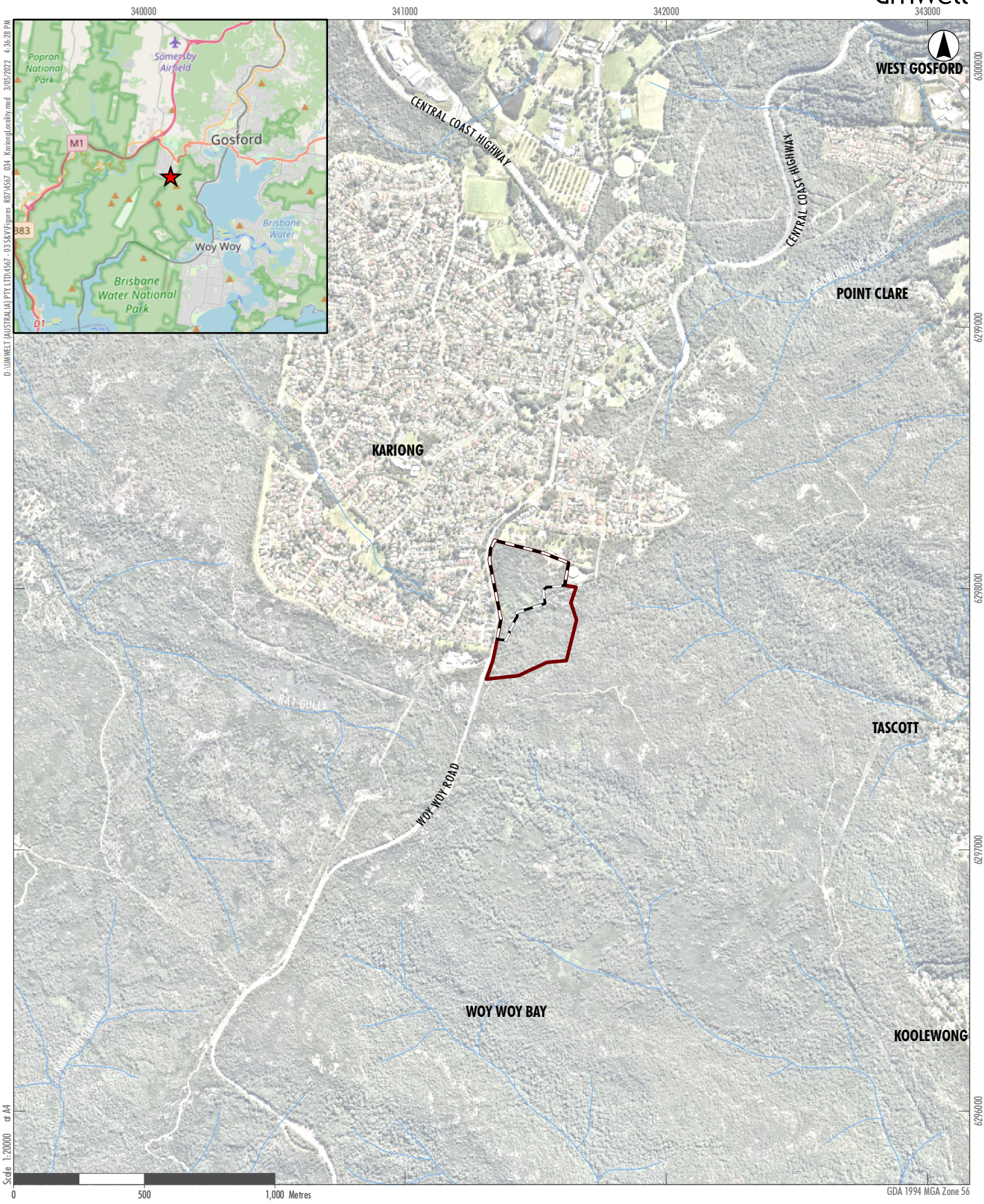
- amend the minimum lot size zoning from 40 ha to 550m^2 for that part proposed to be R2 and from 40 ha to 4000m^2 for that part of the land to be zoned C3.

The remainder of the land (7.09 ha), in the south, will remain as zone C2 Environmental Conservation.

The Development Footprint is located at 300 Woy Woy Road Kariong, 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 6.17 ha. It is surrounded by residential dwellings to the north and west, Woy Woy Road to the west and native vegetation in the Brisbane Water National Park to the east, south and south-west.

This Biodiversity Assessment Report (BAR) has been prepared by Umwelt to assess the potential biodiversity impacts of the residential subdivision in accordance with the Biodiversity Assessment Method 2020 (BAM) and the *Biodiversity Conservation Act 2016* (BC Act). It provides the findings of the biodiversity assessment of the proposed rezoning and residential subdivision. It addresses the specific requirements of the BAM (DPIE 2020a) that may apply to either biodiversity certification and/or biodiversity development assessment report.

A draft of the report was originally issued in October 2019 under the now repealed BAM 2017. This report has updated the assessment to BAM 2020.



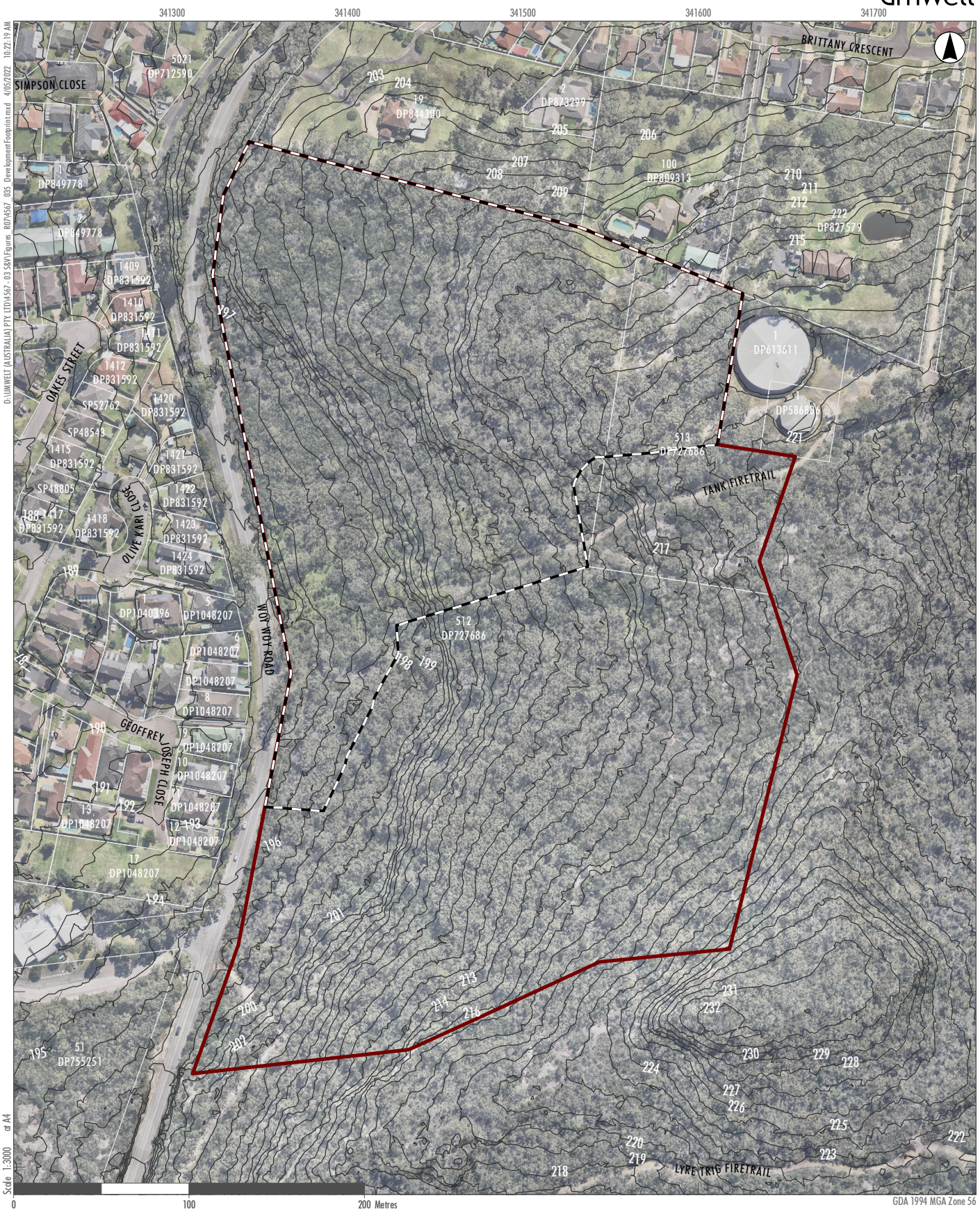
Legend

- Development Footprint
- Lots 512 & 513 DP 727686
- Watercourses

FIGURE 1.1

Locality Plan

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



Legend

- Development Footprint
- Lots 512 & 513 DP 727686
- Lot Boundaries
- 1m Contours

FIGURE 1.2

Development Footprint

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

1.1 Development Footprint Information

The Development Footprint will be subjected to a range of disturbances as described below and in **Section 5.0**

The Development Footprint entirely comprises remnant vegetation adjacent to existing disturbances such as residential land and major roadways. Intact vegetation is generally in moderate to good condition. Some areas, such as along roads, contain small outbreaks of exotic plant species and disturbances such as rubbish. Landscape details of the Development Footprint are detailed in **Table 1.1.**

A small area (0.3 ha) in the northern portion of the development footprint was subject to illegal clearing, with a remediation order issued on 25 October 2021 (DPIE 2021). Darkinjung LALC has agreed with the Department of Planning and Environment (DPE) that, for the purposes of this assessment, the area that was illegally cleared shall be assessed as conforming to the vegetation that was present prior to the clearing. Therefore, the area has been assessed and will be offset in accordance with the BAM.

Table 1.1 Development Footprint Location in the Landscape

Development Footprint Location in the Landscape	
IBRA Bioregion	Sydney Basin
IBRA Subregion	Pittwater
Mitchell Landscape	Gosford – Cooranbong Coastal Slopes
LGA	Central Coast
Development Footprint Size	6.17 hectares
Assessment Type	Site-based
Lot and DP	Lot 512 and 513 DP 727686

1.2 Local Ecological Context

The Development Footprint lies within the Central Coast region (refer to **Figure 1.1**). The locality is occupied by residential areas, with substantial intact vegetation extending to the south and west of the site as part of the Brisbane Water National Park. Woy Woy Road is located immediately to the west of the site providing transport routes northward and southward, contributing to vegetation fragmentation and a barrier to movement of flora and less mobile fauna.

Where there is remnant native vegetation in the locality, a number of Threatened Ecological Communities (TECs) are known to occur including *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC* listed under the BC Act*, Coastal Upland Swamps in the Sydney Basin Bioregion EEC* and *Subtropical and Temperate Coastal Saltmarsh EEC* listed under both the BC and EPBC Acts. Where there is suitable habitat a range of threatened flora species are known to occur in the wider locality (within a 10 kilometre (km) radius of the site) including spreading guinea flower (*Hibbertia procumbens*), Somersby mintbush (*Prostanthera junonis*), *Darwinia glaucophylla,* biconvex paperbark (*Melaleuca biconvexa*) and *Grevillea shiressii*. Records of threatened fauna species occur around the locality, including within the intact vegetated areas to the south of the site, and within Brisbane Water National Park. Records include red- crowned toadlet (*Pseudophryne australis*), giant burrowing frog (*Heleioporus australiacus*), powerful owl (*Ninox strenua*) and eastern pygmy possum (*Cercartetus nanus*).

1.3 Key Resources, Policies and Documents

The following key resources, policies and documents were used during the preparation of this BAR for the proposed development:

- Biodiversity Assessment Method Order 2020 (DPIE 2020).
- Biodiversity Assessment Method Operational Manual (Stage 1) (OEH 2018a).
- Biodiversity Assessment Calculator (Version 50), accessed April 2022.
- BioNet Atlas of NSW Wildlife database and mapping tool (DPE 2022), last accessed April 2022.
- Threatened Biodiversity Data Collection (TBDC) (DPIE 2021a), last accessed October 2021.
- Vegetation Information System (VIS) Classification Database (DPIE 2021b), last accessed October 2021.
- Surveying Threatened Plants and Their Habitats (DPIE 2016) and
- Department of Agriculture, Water, and the Environment (DAWE) Protected Matters Search Tool (DAWE 2021), last accessed October 2021.

1.4 Report Preparation

This BAR was prepared by Philippa Fagan (Senior Ecologist: Botanist) (BAM Accreditation Number BAAS18117) with review and technical direction from Naomi Buchhorn (Principal Ecologist) and Allison Riley (Principal Ecologist, BAM Accreditation Number BAAS17042). Field surveys were undertaken by Philippa Fagan and a number of other Umwelt ecologists under the guidance of the accredited assessor.

This BAR was finalised on 29 April 2022.

Philippa Fagan
Senior Ecologist: Botanist
BAM Accreditation No. BAAS18117

2 Methods

2.1 Landscape Features and Site Context

Landscape features such as IBRA bioregions, IBRA subregions and NSW Mitchell Landscape regions, native vegetation extent within a 1500 metre (m) buffer area, cleared areas, rivers, streams, wetlands, and connectivity features were identified within the Development Footprint where appropriate in accordance with Section 3.1 of the BAM (DPIE 2020a) (refer to **Figure 2.1**).

The 'Site Context' of the Development Footprint is calculated by assessing the native vegetation cover and patch size within the Development Footprint in accordance with Section 3.2 of the BAM (DPIE 2020a).

2.2 Native Vegetation Assessment

2.2.1 Literature and Database Review

A review of previous documents and reports relevant to the Project was undertaken. The information obtained was used to inform survey design and was also used to assist in the assessment of potentially occurring threatened and migratory species, endangered populations (EPs) and TECs.

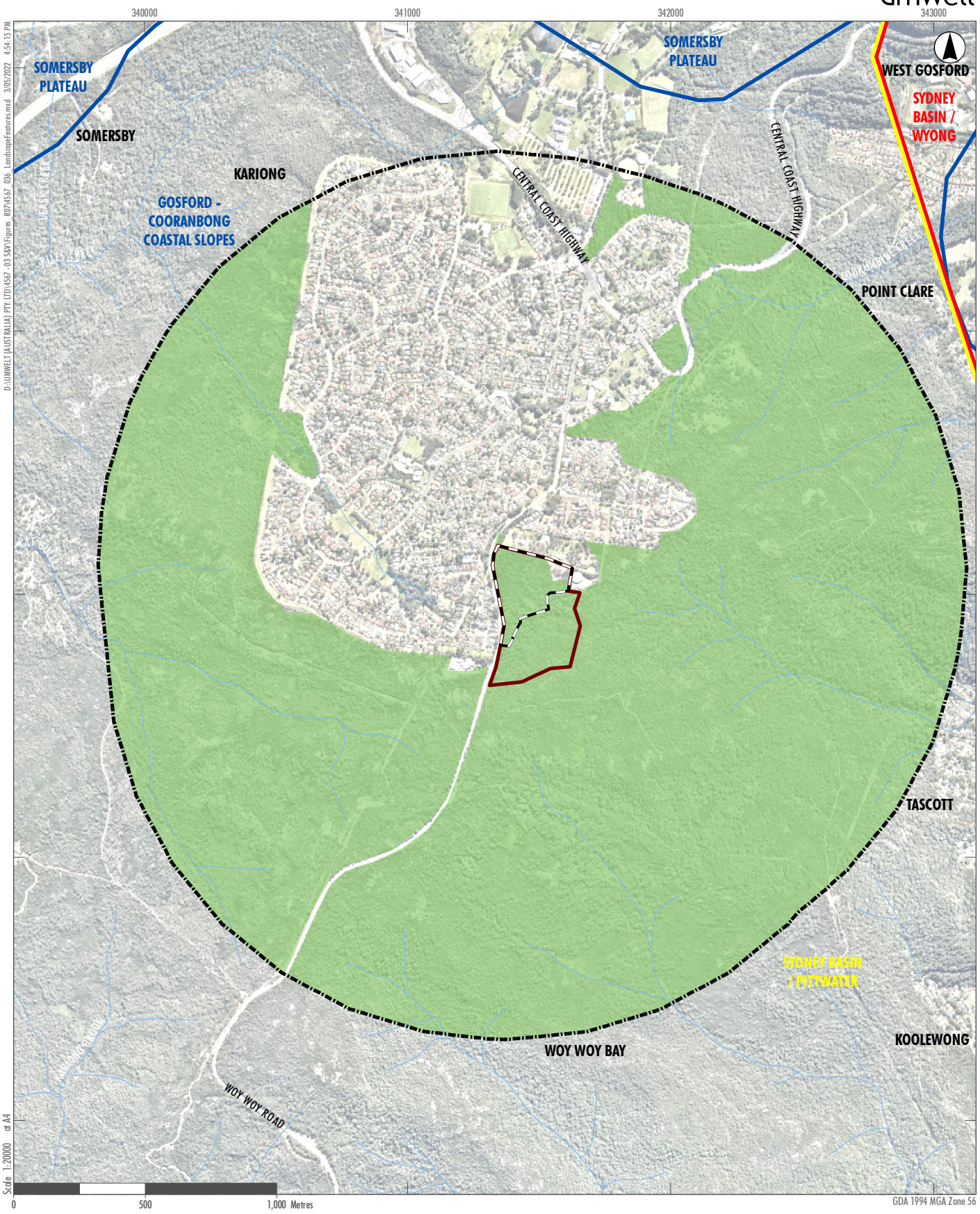
Relevant documents included:

- Conacher Consulting (2016) Ecological Investigation Report Lot 512 DP 727686 & Lot 513 DP 727686 Woy Woy Road Kariong.
- A Revised Interim Vegetation Classification of the Central Coast LGA (Bell 2019).
- Threatened Biodiversity Data Collection (DPIE 2021b) reporting for known/predicted threatened communities in the Wyong IBRA subregion.
- VIS Classification Database (DPIE 2021c), accessed October 2021.
- DAWE Protected Matters Search Tool for known/predicted EPBC Act-listed TECs, accessed October 2021 (DAWE 2021).

2.2.2 Floristic and Vegetation Integrity Survey

Floristic and vegetation integrity surveys were undertaken over the following survey periods:

- 27 to 28 August 2018
- 18 and 31 October 2018
- 23 to 24 January 2019
- 27 March 2019
- 1 and 2 April 2019.



Legend

- Development Footprint
- Lots 512 & 513 DP 727686
- 1500m Site Buffer
- Watercourses
- Mitchell Landscape Boundaries
- Native Vegetation Mapping

IBRA Region / Sub Region

- Sydney Basin / Pittwater
- Sydney Basin / Wyong

FIGURE 2.1

Landscape Features

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

A total of five BAM plots and two rapid vegetation assessments were conducted within the Development Footprint during the surveys undertaken for this assessment (refer to **Figure 2.2**). Floristic and vegetation integrity data was collected in accordance with minimum requirements under the BAM (DPIE 2020a).

Table 2.1 outlines the floristic survey effort in the Development Footprint.

Table 2.1 Adequacy of Floristic and Vegetation Integrity Survey in the Development Footprint

Veg. Zone	Plant Community Type (PCT) *Condition Class*	Contains Hollow-bearing Trees	Area in the Development Footprint (ha)	Number of Floristic and Vegetation Integrity Plots	
				Required	Completed
1	1641 – Dwarf Apple – Scribbly Gum heathy low woodland on sandstone ranges of the Central Coast *Good Condition*	Yes	2.5	2	2
2	1642 – Scribbly Gum – Red Bloodwood _ Old Man Banksia heathy woodland of southern Central Coast *Good Condition*	Yes	2.6	2	2
3	1699 – Heath- leaved Banksia – Coral Fern wet heath on sandstone ranges of the lower Central Coast *Good Condition*	No	0.7	1	1
-	Other/cleared	-	0.3	0	0
TOTAL			**6.1**	**5**	**5**

At each floristic and vegetation integrity plot, data was recorded according to Section 4 of the BAM (DPIE 2020a). This involved setting out 20 x 50 m, 20 x 20 m and 1 x 1m plots. The location of each plot was recorded using a hand-held GPS with accuracy of ± 5 m. The Map Grid of Australia (MGA) coordinate system was used.

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

For each flora species recorded in the plot, the following data was collected in accordance with Table 2 of the BAM (DPIE 2020a):

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

At each vegetation integrity plot the following attributes were recorded in accordance with the BAM (DPIE 2020a) to determine the condition of the vegetation zone:

- ***Composition*** - native plant species richness by growth form (within the 20 x 20 m plot).
- ***Structure*** – estimate foliage cover of native and exotic species by growth form (within the 20 x 20 m plot).
- ***Function*** (within the 20 x 50 m plot) including, number of large trees, presence or otherwise of tree stem size classes, presence or otherwise of canopy species regeneration, length of fallen logs, percentage cover for litter (recorded from five 1 x 1 m plots), number of trees with hollows and high threat exotic cover.

2.2.3 Targeted and Meandering Transects

Targeted transects for threatened flora species were conducted during the months of August, October, and January, 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. Further details on the timing of these transects is provided in **Section 2.3**. Opportunistic records of threatened species were also recorded during vegetation integrity surveys in March and April 2019.

Meandering transects were walked across much of the Development Footprint particularly during fauna habitat assessments and targeted fauna surveys. Opportunistic sampling of vegetation was undertaken along these transects, particularly searches for threatened and/or otherwise significant species, endangered populations and TECs. Meandering transects enable floristic sampling across a much larger area than plot-based survey, especially where the number of plots is limited.

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

2.2.4 Digital Aerial Photograph Interpretation

Digital imagery (aerial photographs) of the Development Footprint was viewed prior to and after vegetation survey to identify spatial patterns in vegetation, land use and landscape features. These informed field survey design and implementation, ecological assessment, and vegetation community mapping of the Development Footprint.

Vegetation communities in the Development Footprint were mapped on-screen overlaying the May 2018 high resolution aerial photographs. Mapping was undertaken using the Manifold System 8.0 GIS and ESRI ArcMaps 10.6.

2.2.5 Plant Identification and Nomenclature Standards

All vascular plants recorded or collected within plots and on meandering transects were identified using keys and nomenclature in Harden (1992, 1993, 2000 and 2002). Where known, changes to nomenclature and classification have been incorporated into the results. Updated taxonomy has been derived from PlantNET (Botanic Gardens Trust 2019).

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

For herbaceous and graminoid species, such as those belonging to the families Asteraceae, Orchidaceae, Cyperaceae and Poaceae, the allocation of specimens to sub-specific levels was affected by the availability of adequate flowering or fruiting material. In this case specimens are forwarded to the National Herbarium of New South Wales if they were considered to be of potential significance or importance.

2.2.6 Vegetation Mapping

Vegetation mapping was undertaken using best-practice techniques to delineate vegetation communities across the Development Footprint. Vegetation mapping involved the following key steps:

- preliminary review of digital airborne imagery to explore vegetation distribution patterns as dictated by change in canopy texture, tone, and colour, as well as topography
- predicting the distribution of particular vegetation communities based on understanding the distribution of PCTs (DPIE 2022c) and plant communities as described by Conacher Consulting (2016).
- ground-truthing of the vegetation map based on survey effort, and
- revision of vegetation community floristic delineations based on plot data.

Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata.

Legend

- Development Footprint
- Lots 512 & 513 DP 727686
- Lot Boundaries
- BAM Floristic and Vegetation Integrity Plots
- March 2019 Flora Survey Tracklog
- April 2019 Flora Survey Tracklog
- Summer 2019 Flora Survey Tracklog
- Spring 2018 Flora Survey Tracklog
- Winter 2018 Flora Survey Tracklog

FIGURE 2.2

Flora Survey Effort

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

2.2.7 Threatened Ecological Community Delineation Techniques

Where applicable, vegetation communities identified in the Development Footprint were compared to TECs listed under the Commonwealth EPBC Act and NSW BC Act and an assessment of similarity with the NSW Scientific Committee Final Determinations and the Commonwealth Threatened Species Scientific Committee Listing and Conservation Advice. The following approach was used:

- full-floristic plot assessments and meandering surveys to determine floristic composition and structure of each ecological community
- 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 and recovery plans published by the Commonwealth and NSW threatened species committees
- comparison with other assessments of TECs in the region.

2.2.8 Plant Community Type (PCT) Allocation

Each of the vegetation communities described within the Development Footprint were aligned with an equivalent PCT as detailed in the VIS Classification Database (DPIE 2022c). For each vegetation community described in the Development Footprint, the dominant and characteristic species were entered into the online plant community identification tab and an initial list of PCTs was generated. The profiles for each of the possible PCTs were then interrogated and the most appropriate match assigned based on floristic, structure, soil, landform, and distribution details.

Further detail regarding this allocation for individual PCT is outlined in **Section 3.2.1.**

2.3 Threatened Species

2.3.1 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:

- BioNet Atlas of NSW Wildlife database and mapping tool (DPE 2022), accessed April 2022.
- Threatened Biodiversity Data Collection (DPIE 2021a) for known/predicted threatened species in the Pittwater IBRA subregion, accessed April 2022.
- PlantNET (Botanic Gardens Trust 2019) database search for threatened plants within a 10 kilometre radius of the Development Footprint, accessed October 2021.
- DAWE Protected Matters Search Tool (DAWE 2022) for known/predicted EPBC Act-listed species, accessed October 2021.

A preliminary assessment using the TBDC was undertaken which provided a list of species-credit species that might require survey and the suitable survey periods for each species. The results of these database searches, literature review and TBDC review were used to design the appropriate survey requirements for species-credit species.

2.3.2 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.

Appendix A outlines the ecosystem credit species predicted by the BAM calculator or identified in the literature review.

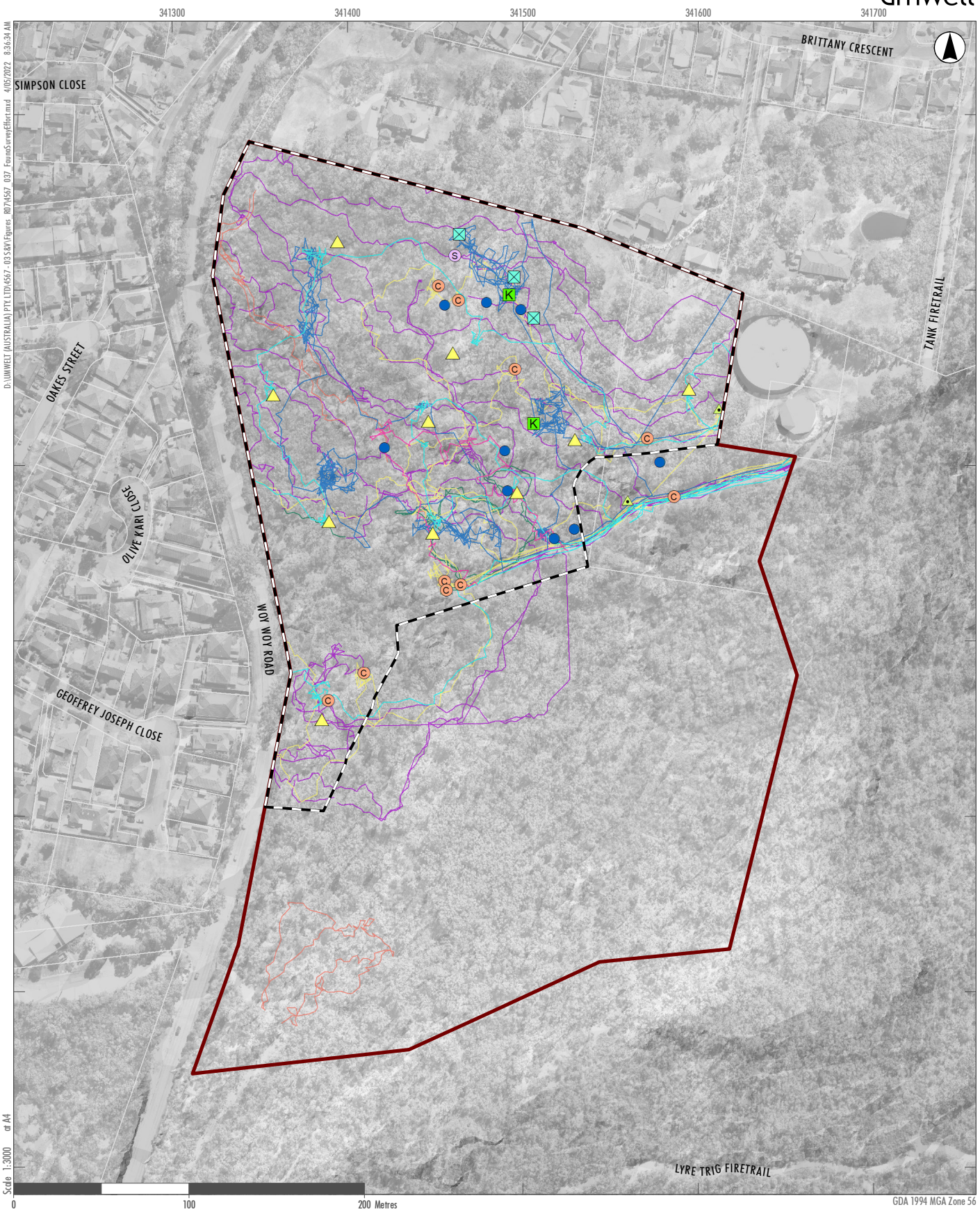
2.3.3 Species-credit Species

Targeted and opportunistic surveys and walking transects for species-credit species were undertaken across the Development Footprint (refer to **Figure 2.3**). **Table 2.2** outlines the dates, methods and species targeted during the surveys.

Table 2.2 Species credit species survey methodology and timing

Survey Date	Method	Species Targeted
27 and 28 August 2018	Spotlighting and call playback	barking owl (*Ninox connivens*) masked owl (*Tyto novaehollandiae*) powerful owl (*Ninox strenua*) sooty owl (*Tyto tenebricosa*)
	Threatened species transects Opportunistic observations and habitat assessments	rough doubletail (*Diuris praecox*) *Diuris bracteata*
	Habitat assessments (evidence of breeding)	white- bellied sea- eagle (*Haliaeetus leucogaster*) little eagle (*Hieraaetus morphnoides*) square- tailed kite (*Lophoictinia isura*) eastern osprey (*Pandion cristatus*)
29 August 2018	Diurnal habitat searches and assessments	broad-headed snake (*Hoplocephalus bungaroides*)
18 and 31 October 2018	Targeted threatened species transects and habitat mapping	thick lip spider orchid (*Caladenia tessellata*) netted bottlebrush (*Callistemon linearifolius*) spreading guinea flower (*Hibbertia procumbens*) Somersby mintbush (*Prostanthera junonis*) eastern underground orchid (*Rhizanthella slateri*) black eyed Susan (*Tetratheca juncea*) *Tetratheca glandulosa*
24 January 2019	Targeted threatened species transects	Giant dragonfly
23 and 24 January 2019	Threatened species transects	Bynoe's wattle (*Acacia bynoeana*) downy wattle (*Acacia pubescens*)

Survey Date	Method	Species Targeted
		Ancistrachne maidenii thick- leaf star- hair (*Astrotricha crassifolia*) *Baloskion longipes* leafless tongue orchid (*Cryptostylis hunteriana*) white- flowered wax plant (*Cynanchum elegans*) *Darwinia glaucophylla* Camfield's stringybark (*Eucalyptus camfieldii*) slaty red gum (*Eucalyptus glaucina*) *Epacris purpurascens* subsp. *purpurascens* Bauers midge orchid (*Genoplesium bauera*) small- flowered grevillea (*Grevillea parviflora* subsp. *parviflora*) *Grevillea shiressii* spreading guinea flower (*Hibbertia procumbens*) *Hibbertia puberula* subsp. *puberula* Deanes paperbark (*Melaleuca deanei*) Groves paperbark (*Melaleuca groveana*) *Micromyrtus blakelyi* hairy geebung (*Persoonia hirsuta*) heath wrinklewort (*Rutidosis heterogama*)
25 – 28 March 2019	Nocturnal searches Call- playback Gang- gang cockatoo and glossy black-cockatoo survey (breeding habitat assessment) Koala SAT tests	pale- headed snake (*Hoplocephalus bitorquatus*) bush stone- curlew (*Burhinus grallarius*) grey- headed flying- fox (*Pteropus poliocephalus*) koala (*Phascolarctos cinereus*) red- crowned toadlet (*pseudophryne australis*) giant burrowing frog (*Heleioporus australiacus*) green-thighed frog (*Litoria brevipalmata*) stuttering frog (*Mixophyes balbus*)
25 March – 6 May 2019	Remote camera	eastern pygmy possum (*Cercartetus nanus*) parma wallaby (*Macropus parma*) squirrel glider (*Petaurus norfolcensis*) greater glider (*Petauroides volans*) brush- tailed phascogale (*Phascogale tapoatafa*)
April 1 and 2 2019	BAM floristic and vegetation integrity plot surveys	NA
6 – 8 May 2019	Nocturnal searches Hollow bearing tree analysis Call- playback Stag watching Gang- gang cockatoo and glossy black-cockatoo survey (breeding habitat assessment)	gang- gang cockatoo (*Callocephalon fimbriatum*) glossy black- cockatoo (*Calyptorhynchus lathami*) powerful owl (*Ninox strenua*) barking owl (*Ninox connivens*) masked owl (T*yto novaehollandiae*) sooty owl (*Tyto tenebricosa*)



Legend

- Development Footprint
- Lots 512 & 513 DP 727686
- Lot Boundaries

Survey Effort

- Call Playback Locations
- Remote Camera Locations
- Bird Survey Location
- Spotlighting Survey Location
- Stag Watch Location
- Koala SAT
- Hollow Bearing Trees

- March 2019 Fauna Survey Tracklog
- March 2019 Bird Survey Tracklog
- March 2019 Spotlighting Survey Tracklog
- April 2019 Fauna Survey Tracklog
- Summer 2019 Giant Dragonfly Survey Tracklog
- Summer 2019 Fauna Survey Tracklog
- August 2018 Broad-headed Snake Survey Tracklog

FIGURE 2.3

Fauna Survey Effort

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

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).
- *Flora and Fauna Survey Guidelines* (CCC 2019).

Appendix B outlines the species-credit species predicted by the BAM calculator or identified in the literature review and the targeted survey effort undertaken in accordance with BAM survey requirements.

Appendix B also notes where species-credit species were not considered to require further survey in accordance with Section 5 (Step 3) of the BAM (DPIE 2020a).

2.3.4 Weather Conditions and Limitations

Table 2.3 outlines the weather conditions for the surveys. Data is derived from the Central Coast weather station in Gosford (061425) from the Bureau of Meteorology (2019).

Table 2.3 Weather Conditions for Surveys

Date	Daily Data			Monthly Data		
	Min-Max Temp.	Rainfall (mm)	Relative Humidity (%)	Min-Max Temp (mean)	Rainfall (total) (mm)	Relative Humidity (mean) (%)
27 August 2018	9.9-14.0	1.8	87	6.4-19.0	17.6	15.5
28 August 2018	9.1-14.6	0	51			
29 August 2018	2.4-15.8	0	51			
18 October 2018	17.6-25.1	0	88	13.6-21.7	258.0	95
31 October 2018	16.1-26.0	0	70			
23 January 2019	20.6-31.6	0	75	20.7-30.3	57	96
24 January 2019	21.6-25.9	0	85			
25 March 2019	20.0-25.5	4.4	81	17.7-26.6	256.4	65
26 March 2019	16.0-25.9	3	48.5			
27 March 2019	13.9-23.9	0	64			
28 March 2019	14.6-26.8	0	72			
1 April 2019	17.3-29.4	0	71	15.8-25.7	40.2	65

Date	Daily Data			Monthly Data		
	Min-Max Temp.	Rainfall (mm)	Relative Humidity (%)	Min-Max Temp (mean)	Rainfall (total) (mm)	Relative Humidity (mean) (%)
2 April 2019	16.8-32.4	0	63			
6 May 2019	13.8-20.4	0	54	10.3-22.0	17.6	62
7 May 2019	6.6-23.5	0	48			
8 May 2019	8.9-21.4	0	43			

3 Results

3.1 Landscape Value

The buffer area contains a range of landscape features typical of the landscapes around the Central Coast region. These landscape features are shown on **Figure 2.1** and outlined in relation to the Development Footprint in **Table 3.1**.

Table 3.1 Landscape Features in the Development Footprint

Landscape Features	
IBRA Bioregion	Sydney Basin
IBRA Subregion	Pittwater
Mitchell Landscape	Gosford – Cooranbong Coastal Slopes
Rivers, Streams, Estuaries	No Strahler streams in the Development Footprint
Wetlands (within, adjacent to and downstream)	*Coastal Upland Swamp in the Sydney Basin Bioregion* Endangered Ecological Community (EEC) occurs within the Development Footprint
Native Vegetation Cover	634.5 hectares in the 1500m buffer area (73%)
Areas of Geological Significance or Soil Hazard Features	None identified
Areas of Outstanding Biodiversity Value	None identified
Cleared Areas	0.3 hectares within the Development Footprint. As discussed in **Section 1.1** this area was illegally cleared and has been assessed as part of the vegetation community that it would have conformed to and has been included as part of the credit calculations.
Connectivity Features	The Development Footprint is part of extensive native vegetation extending to the east and south, which provides connectivity and enables transfer of genetic material for both flora and fauna in the locality. Not identified within a Priority Investment Area (OEH 2017c). Not identified as an important flyway for migratory species.

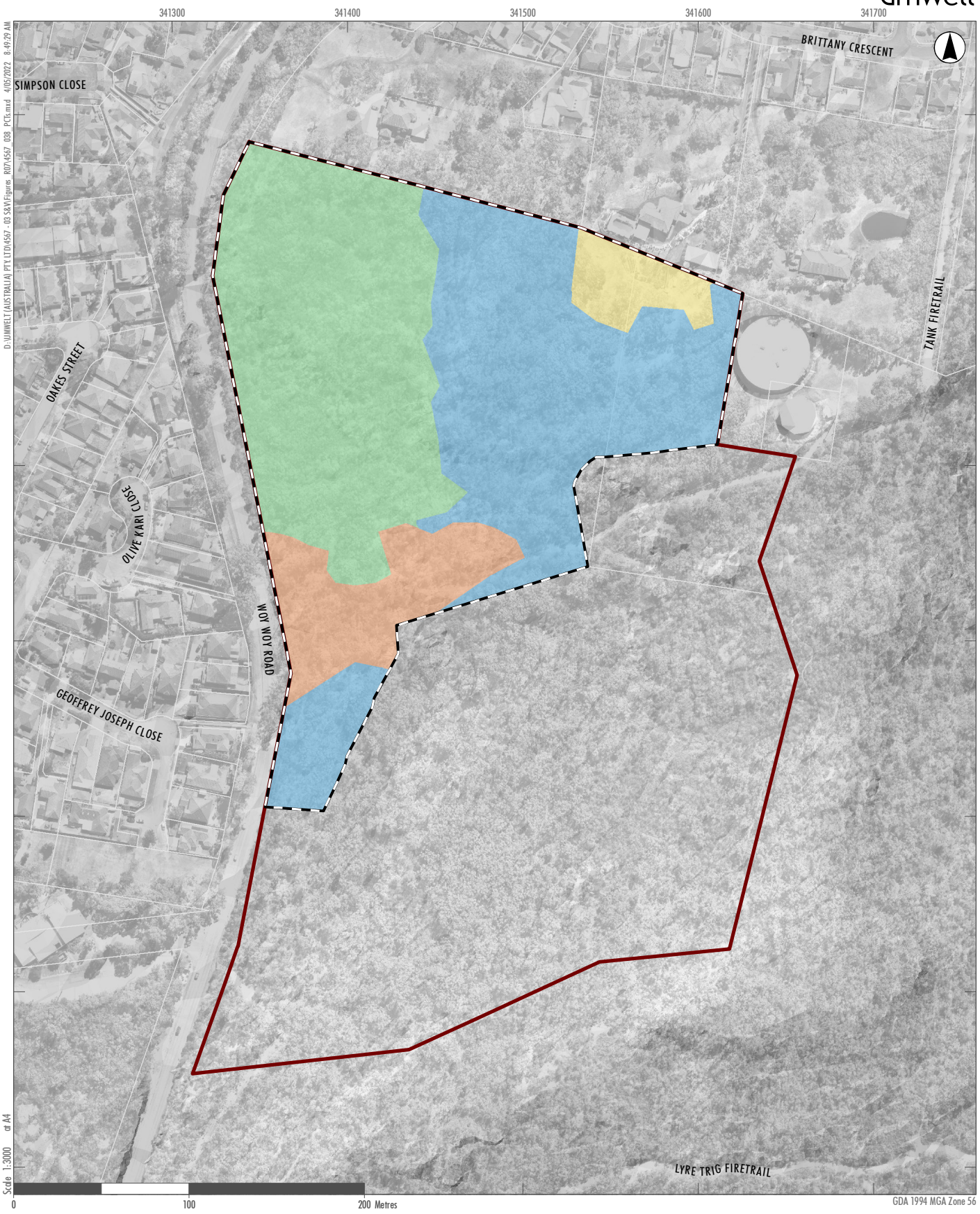
3.2 Native Vegetation within the Development Footprint

3.2.1 Plant Community Types and Vegetation Zones

Surveys of the Development Footprint identified three Plant Community Types (PCTs) across one condition class being (refer to **Figure 3.1**):

- PCT1641 Dwarf Apple – Scribbly Gum heathy low woodland on sandstone ranges of the Central Coast (*Good Condition*).
- PCT1642 Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast (*Good Condition*).
- PCT1699 Heath- leaved Banksia – Coral Fern wet heath on sandstone ranges of the lower Central Coast (*Good Condition*).

A description of the vegetation zones is outlined below, and a flora species list is included in **Appendix C**.



Legend

- Development Footprint
- Lots 512 & 513 DP 727686
- Lot Boundaries

Plant Community Type (Umwelt 2019)

- 1641 - Dwarf Apple Scribbly Gum heathy low woodland on sandstone ranges of the Central Coast (Good Condition)
- 1642 - Scribbly Gum c Red Bloodwood h Old Man Banksia heathy woodland of southern Central Coast (Good Condition)
- 1699 - 1699 Heath- leaved Banksia d Coral Fern wet heath on sandstone ranges of the lower Central Coast (Good Condition)
- Cleared/disturbed area to be assessed as PCT 1642

FIGURE 3.1

Plant Community Types in the Development Footprint

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

Zone 1 – PCT 1641 Dwarf Apple – Scribbly Gum heathy low woodland on sandstones ranges of the Central Coast (Good Condition)

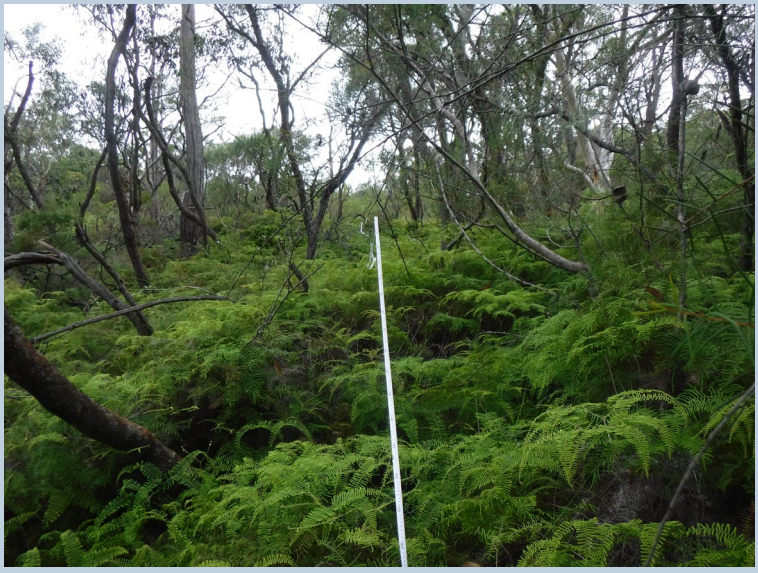
PCT Name	PCT 1641 Dwarf Apple – Scribbly Gum heathy low woodland on sandstones ranges of the Central Coast
Condition	Good
Formation	Heathlands
Class	Sydney Coastal Heaths
Percent cleared	44.00
Area in Development Footprint (ha)	2.5
Patch Size Class (ha)	>101
Location	Occurs in the western portion of the Development Footprint (refer to **Figure 3.1**).
Canopy Description	Sparse canopy dominated by dwarf apple (*Angophora hispida*) with the occasional scribbly gum (*Eucalyptus haematoma*) occurring due to the proximity to PCT 1642.
Mid-storey Description	A very dense mid- storey dominated by fern- leaved banksia (*Banksia oblongifolia*) and heath-leaved banksia (*Banksia ericifolia*), flaky- barked tea- tree (*Leptospermum trinervium*), black she-oak (*Allocasuarina littoralis*), fringed baeckea (*Baeckea diosmifolia*), tick bush (*Kunzea ambigua*), conesticks (*Isopogon anemonifolius*), mountain devils (*Lambertia formosa*) drumsticks (*Petrophile pulchella*) and tantoon (*Leptospermum polygalifolium*).
Ground Cover Description	This vegetation zone is characterised by a fairly dense ground layer of sedges, grasses, and herbs. Dominant species include *Cyathochaeta diandra,* oat speargrass (*Anisopogon avenaceus*), silky purple flag (*Patersonia sericea*), *Lepyrodia scariosa* and wiry panic (*Entolasia stricta*). Less dominant grasses are also present including bordered panic (*Entolasia marginata*).
PCT Allocation	Vegetation Zone 1 was aligned with PCT1641 as it supports a number of the species identified for the PCT as listed on the VIS Classification Database (DPE 2022c). It is dominated by dwarf apple (*Angophora hispida*) and scribbly gum (*Eucalyptus haemastoma*) which are the only two diagnostic species listed as occurring in the canopy. Further, the mid-stratum contains 75% of the species listed in the VIS Classification Database (DPE 2022c), with the ground stratum containing 5 of 7 (71%) of the listed diagnostic species. Furthermore, the vegetation description for this community is very close to what is occurring on site, being an *Angophora* dominated woodland occurring on dissected sandstone hills of the Central Coast. PCT1641 was therefore determined to be the best overall fit in terms of diagnostic species and the community's location in the landscape.
BC Act Status	This vegetation zone is not consistent with any TEC listed under the BC Act.
EPBC Act Status	This vegetation zone is not consistent with any TEC listed under the EPBC Act.

Zone 2 – PCT 1642 Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast (Good Condition)

PCT Name	Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast	
Condition	**Good**	
Formation	Dry Sclerophyll Forests (Shrubby sub-formation)	
Class	Sydney Coastal Dry Sclerophyll Forests	
Percent cleared	30.00	
Area in Development Footprint (ha)	2.6	
Patch Size Class (ha)	> 101	
Location	Occurs at the top of the ridge in the eastern portion of the Development Footprint (refer to **Figure 3.1**).	
Canopy Description	Mid-dense canopy dominated by scribbly gum (*Eucalyptus haemastoma*), red bloodwood (*Corymbia gummifera*) and silvertop ash (*Eucalyptus sieberi*). Scattered occurrences of Sydney red gum (*Angophora costata*), grey gum (*Eucalyptus punctata*) and blue- leaved stringybark (*Eucalyptus agglomerata*).	
Mid-storey Description	A fairly dense mid-storey is present and contains an array of species including tantoon (*Leptospermum polygalifolium*), conesticks (*Petrophile pulchella*), sweet wattle (*Acacia suaveolens*), heath- leaved banksia (*Banksia ericifolia*), broad- leaved geebung (*Persoonia levis*), narrow- leaved geebung (*Persoonia linearis*), old man banksia (*Banksia serrata*), prickly- leaved tea- tree (*Acacia ulicifolia*), prickly beard- heath (*Leucopogon juniperinus*) and native currant (*Leptomeria acida*).	
Ground Cover Description	This vegetation zone is characterised by a diverse and fairly dense ground layer of ferns, sedges and sub-shrubs. Dominant species include *Platysace linearifolia,* lesser flannel flower (*Actinotus minor*), *Cyathochaeta diandra, Xanthorrhoea media,* oat speargrass (*Anisopogon avenaceus*), pale mat- rush (*Lomandra glauca*), wiry panic (*Entolasia stricta*), *Lepyrodia scariosa* and screw fern (*Lindsaea linearis).*	
PCT Allocation	Vegetation Zone 2 was aligned with PCT1642 as it supports a high number of the diagnostic species identified for the PCT as listed on the VIS Classification Database (DPE 2022c). The canopy contains three of the four listed characteristic species, being *E. haemastoma, C. gummifera* and *A. costata,* as well as containing all seven diagnostic mid- storey species listed. The ground stratum also contains 100% of the species listed in the VIS Classification Database (DPE 2022c). PCT1642 was therefore determined to be the best overall fit in terms of diagnostic species and the community's location in the landscape.	

PCT Name	Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast
Condition	Good
BC Act Status	This vegetation zone is not consistent with any TEC listed under the BC Act. PCT 1642 can be aligned with *Kincumber Scribbly Gum Forest in the Sydney Basin Bioregion* Critically Endangered Ecological Community (CEEC) listed under the BC Act. However, the vegetation on site is not considered to be consistent with this CEEC, due to a lack of floristic similarity, with the majority of the diagnostics *Eucalyptus* species (*Eucalyptus piperita, Eucalyptus racemosa, Eucalyptus acmenoides, Eucalyptus pilularis, Eucalyptus resinifera* and *Syncarpia glomulifera*) being absent from the site (NSW Scientific Committee 2011). The only canopy species listed for the CEEC that are present on site are *Angophora costata* (in very low numbers) and *Corymbia gummifera* (NSW Scientific Committee 2011).
EPBC Act Status	This vegetation zone is not consistent with any TEC listed under the EPBC Act.

Zone 3 – PCT 1699 Heath- leaved Banksia – Coral Fern wet heath on sandstone ranges of the lower Central Coast (Good Condition)

PCT Name	Heath- leaved Banksia – Coral Fern wet heath on sandstone ranges of the lower Central Coast	
Condition	Good	
Formation	Freshwater Wetlands	
Class	Coastal Heath Swamps	
Percent cleared	0.00	
Area in Development Footprint (ha)	0.7	
Patch Size Class (ha)	>101	
Location	A small portion occurs on the poorly draining lower areas towards the southern boundary (refer to **Figure 3.1**).	
Canopy Description	Trees are largely absent, with occasional scattered red bloodwood (*Corymbia gummifera*) and blue- leaved stringybark (*Eucalyptus agglomerata*).	
Mid-storey Description	A relatively open midstorey containing scattered occurrences of heath- leaved banksia (*Banksia ericifolia*) is present, with occasional tantoon (*Leptospermum polygalifolium*), sweet pittosporum (*Pittosporum undulatum*), prickly moses (*Acacia ulicifolia*) and red- stemmed wattle (*Acacia myrtifolia*).	
Ground Cover Description	This vegetation zone is characterised by a dense layer of pouched coral fern (*Gleichenia dicarpa*), with other sedges and grasses such as wiry panic (*Entolasia stricta*), *Cyathochaeta diandra* and red- fruited saw- sedge (*Gahnia sieberiana*).	

PCT Name	Heath- leaved Banksia – Coral Fern wet heath on sandstone ranges of the lower Central Coast
Condition	Good
PCT Allocation	Vegetation Zone 3 was aligned with PCT1699 as it supports a number of the species and stratum specifics identified for the PCT as listed on the VIS Classification Database (DPE 2022c). It is dominated by heath- leaved banksia (*Banksia ericifolia*) and tantoon (*leptospermum polygalifolium*) which are two of the eight positive diagnostic species occurring in the mid stratum. Further, the ground layers contain two of the four (50%) species listed on the VIS Classification Database (DPE 2022c). Additionally the ground stratum contains the diagnostic species pouched coral fern (*Gleichenia dicarpa*) at almost 100% coverage, which is diagnostic for this PCT. PCT1699 was therefore determined to be the best overall fit in terms of diagnostic species and the community's location in the landscape, given that this PCT is described as a Banksia dominated wet heath occurring on dissected Hawkesbury sandstone from Peats Ridge to Mooney Creek, which accurately describes the vegetation on Development Footprint.
BC Act Status	This vegetation zone is consistent with *Coastal Upland Swamp in the Sydney Basin Bioregion* EEC listed under the BC Act. The vegetation within the Development Footprint has been found to be consistent with the EEC due to the floristic similarity found on site and the position in the landscape on poorly draining/waterlogged soils. In particular, a dominance of species such as *Banksia ericifolia, Baumea* sp. and *Gahnia sieberiana,* and an almost complete coverage of *Gleichenia dicarpa* in the ground layer, closely aligns to the description of this EEC (NSW Scientific Committee 2012). The absence of any tree species in the canopy, aside from those overhanging from adjacent communities, is also a conforming feature of this EEC and matches that which was found within the Development Footprint. The vegetation in the Development Footprint occurs on waterlogged sandy substrates, which conforms to the soil type described in the NSW Final Determination (NSW Scientific Committee 2012) for this community. Finally, many species found within the Coastal Upland Swamp EEC are absent from the surrounding vegetation communities (NSW Scientific Committee 2012), which is particularly true for the vegetation within the Development Footprint, which is starkly different from the surrounding vegetation, largely due to the dominance of the *Gleichenia dicarpa* which forms large colonies around swamps.
EPBC Act Status	This vegetation zone is also consistent with the *Coastal Upland Swamps in the Sydney Basin Bioregion* EEC under the EPBC Act. As per the assessment above according to the BC Act status, this vegetation zone within the Development Footprint is consistent with the EEC under the EPBC Act due to the floristic similarity found on site and the position in the landscape on poorly draining/waterlogged soils (DoE 2014). Characteristic species included in the EPBC conservation advice for this community have been extracted from the NSW final determination, therefore the NSW and Commonwealth listings share the same list of characteristic species.

3.2.2 Exotic Vegetation

The Development Footprint contains very few exotic species, and no areas have been mapped as exotic vegetation. One weed species present in the Development Footprint is classed as a High Threat Weed species under the BAM, whisky grass (*Andropogon virginicus*), and is identified in the flora species list in **Appendix C**.

There is a 0.3 ha area cleared of vegetation in the north- east portion of the Development Footprint. This area is largely devoid of any native vegetation, and contains various objects, such as an old container truck, and is apparently being used as storage by the adjoining landowner. As discussed in **Section 1.1**, this area will be assumed as conforming to PCT 1642, which is what it would have occurred there prior to the clearing and offset accordingly.

3.2.3 Threatened Ecological Communities

One threatened ecological community was recorded within the Development Footprint, *Coastal Upland Swamp in the Sydney Basin Bioregion* EEC listed under the BC Act and the EPBC Act.

3.2.4 Vegetation Integrity Score

Table 3.2 details the vegetation integrity scores for each of the vegetation zones in the Development Footprint. The vegetation integrity data for each of the vegetation zones is provided in **Appendix D**.

Table 3.2 Vegetation Zone Vegetation Integrity Scores

Veg Zone	PCT Name	Composition	Structure	Function	Current Vegetation Integrity Score
1	1641 Dwarf Apple – Scribbly Gum heathy low woodland on sandstone ranges of the Central Coast *Good Condition*	92.9	84.4	66.6	**80.5**
2	1642 Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast *Good Condition*	83.6	60.8	65.7	**69.4**
3	1699 Heath- leaved Banksia – Coral Fern wet heath on sandstone ranges of the lower Central Coast *Good Condition*	72.4	8.4	-	**24.6**

3.3 Threatened Species within the Development Footprint

3.3.1 Ecosystem-credit Species

A list of the ecosystem-credit species predicted to occur by the BAM Calculator and/or the literature review and whether they are considered likely to occur in the vegetation zones within the Development Footprint is provided in **Appendix A**. Threatened species records are shown on **Figure 3.2**.

Legend

- Development Footprint
- Lots 512 & 513 DP 727686

Threatened Species Observations

- Callistemon linearifolius
- Darwinia glaucophylla
- Hibbertia procumbens
- Hibbertia puberula subsp. puberula

FIGURE 3.2

Threatened Species

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

3.3.2 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 BAM Calculator assessment is provided in **Appendix B**. Species-credit species recorded or assumed present are shown in **Table 3.3** and further information on the surveys undertaken for these species is provided in **Appendix B**.

Table 3.3 Species-credit Species within the Development Footprint

Species	BC Act	EPBC Act	Species Presence	Justification
Netted Bottlebrush *Callistemon linearifolius*	V	-	**Yes (surveyed)**	Three individuals detected within Development Footprint.
eastern pygmy possum *Cercartetus nanus*	V		**Yes (assumed)**	There is a high number (29) of records within 10 km of the Development Footprint, including nine records within the suburb of Kariong itself. One record occurs immediately south of the Development Footprint, while two records occur immediately north of the Development Footprint. While remote cameras were deployed within the Development Footprint, this species is known to be difficult to detect and cannot be discounted. The species polygon has been aligned with PCTs 1641 and 1642 according to the TBDC (DPE 2022b).
large- eared pied- bat *Chalinolobus dwyeri*	V	V	**Yes (assumed)**	This species is considered to occur where there are potential roosts located within 2 km of associated PCTs. Potential roosts are caves, scarps, cliffs, rock overhangs and disused mines (DPIE 2021a; 2018b), and these features are highly likely to occur within 2 km of the Development Footprint. As it is not possible to survey within 2 km of the Development Footprint for any possible roosts, and as PCT 1642 is associated with this species according to the TBDC (DPIE 2021a), the species has been assumed to occur on site according to the requirements of the survey guidelines for *'Species- credit' Threatened Bats and Their Habitats* (OEH 2018b). The species polygon has been aligned with PCT 1642. There is one record of this species in the locality.
Darwinia glaucophylla	V	-	**Yes (surveyed)**	Approximately 11 patches recorded within Development Footprint associated with exposed sandstone.

Species	BC Act	EPBC Act	Species Presence	Justification
spreading guinea flower *Hibbertia procumbens*	E	-	**Yes (surveyed)**	Approximately 73 individuals detected within Development Footprint across PCT 1641 and PCT 1642.
Hibbertia puberula subsp. *puberula*	E	-	**Yes (surveyed)**	Two plants recorded at a single location within Development Footprint in PCT 1641.
swift parrot *Lathamus discolor*	E	CE	BOAMS important habitat area mapping	Important habitat areas mapped covering a total of 5.2 ha across the Development Footprint, encompassing the majority of all PCTs.
southern myotis *Myotis macropus*	V	-	**Yes (assumed)**	This species is considered to occur where there are waterbodies (> 3m) within 200 m of hollow-bearing trees in associated PCTs. There is a large dam located within 200 m of the Development Footprint. PCT 1641 and PCT 1642 are associated with this species according to the TBDC (DPIE 2022a) and the survey guidelines for *'Species- credit' Threatened Bats and Their Habitats* (OEH 2018b).

3.3.3 Species Habitat Polygons and Biodiversity Risk Weighting

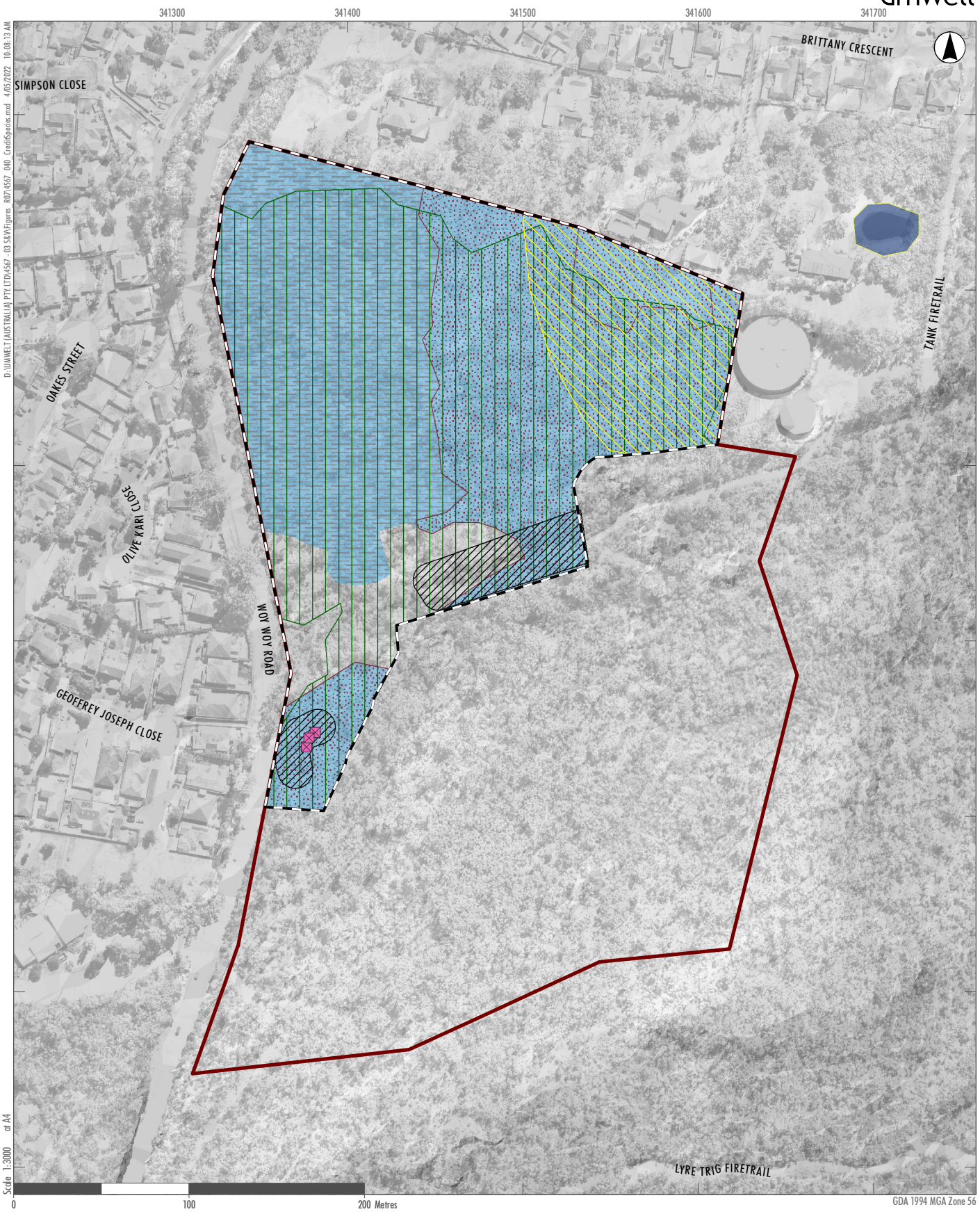
Species habitat polygons have been prepared for the species outlined in **Table 3.4**. Polygons are shown on **Figure 3.3**.

Table 3.4 Species-credit Species

Species	Biodiversity Risk Weighting	Species Habitat Polygon Area (ha)	Species Habitat Polygon Description
netted bottlebrush *Callistemon linearifolius*	2	NA – assessed by number of individuals	Three individuals situated in the south west of the Development Footprint (refer **Figure 3.3**).
eastern pygmy possum *Cercartetus nanus*	2	5.4*	All areas of Vegetation Zone (VZ 1 ((1641_Good) and VZ 2 (1642_Good*) (refer **Figure 3.3**).
large- eared pied- bat *Chalinolobus dwyeri*	3	2.9*	All areas of PCT 1642* (assumed to be within 2 km of roosting habitat) (refer **Figure 3.3**).
spreading guinea flower *Hibbertia procumbens*	2	5.4*	All areas of VZ 1 ((1641_Good) and VZ 2 (1642_Good*) (refer **Figure 3.3**).
Hibbertia puberula subsp. *puberula*	2	2.5	All areas of VZ 1 (1641_Good) (refer **Figure 3.3**).

Species	Biodiversity Risk Weighting	Species Habitat Polygon Area (ha)	Species Habitat Polygon Description
Darwinia glaucophylla	1.50	0.4	Disturbed areas situated adjacent to the track and exposed sandstone areas in the south of the Development Footprint, and adjacent to Woy Woy Road in the south west of the Development Footprint (refer **Figure 3.3**) including 0.3 ha in PCT 1642 and 0.1 ha in PCT 1699.
swift parrot ***Lathamus discolor***	3	5.2*	Aligned with important habitat mapping. Encompasses the majority of the Development Footprint (refer **Figure 3.3**), being 2.3 ha in PCT 1642, 0.6 ha in PCT 1699 and 2.3 ha in PCT 1641.
southern myotis ***Myotis macropus***	2	1.1*	Any portion of PCT 1641 and 1642 within a 200 m buffer from nearby dams (1.1 ha in PCT 1642*) (refer **Figure 3.3**).

*areas for these entities have incorporated the 0.3 ha of cleared land that is assumed to conform to PCT 1642



Legend

- Development Footprint
- Lots 512 & 513 DP 727686
- Callistemon linearifolius
- Southern Myotis Foraging Habitat
- Large-eared Pied Bat Habitat
- Hibbertia puberula subsp. puberula Habitat
- Eastern Pygmy Possum & Hibbertia procumbens Habitat
- Swift Parrot Important Areas
- Southern Myotis Foraging Habitat Buffer
- Darwinia glaucophylla Habitat

FIGURE 3.3

Species Credit Species Polygons

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

4 Avoidance and Minimisation of Impacts

Darkinjung LALC have sought to avoid and minimise the potential impacts on the ecological values of the Project primarily through site selection and through consideration of project design and scheduling of works.

Biodiversity surveys were initially conducted at the Kariong site to identify biodiversity constraints and determine the most appropriate locations for future development. An Ecological Investigation Report was prepared to identify the ecological characteristics of the site and provide preliminary ecological and bushfire hazard planning considerations to assist in the development of land use concept plans for the site (Conacher Consulting 2016).

The Ecological Investigation Report identified broad vegetation communities, including EECs, threatened flora species and threatened fauna species within the proposed development area and adjacent habitats within the Darkinjung LALC landholding.

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.

4.1 Site Selection and Avoidance of Native Vegetation and Habitat

While 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 (DPIE 2020a) have been completely avoided by the Project. Further detail on the assessment of prescribed impacts is outlined in **Section 5.2**.

Following the completion of the Ecological Investigation Report (Conacher Consulting 2016) a range of threatened flora and fauna species were identified within the proposed Development Footprint and the south of the site. Key threatened species avoided include:

- *Darwinia glaucophylla* - listed as Vulnerable under the BC Act.
- *Hibbertia procumbens* - listed as Endangered under the BC Act.
- Red-crowned toadlet (*Pseudophryne australis*) - listed as Vulnerable under the BC Act.
- Giant burrowing frog (*Heleioporus australiacus*) – listed as Vulnerable under the BC Act and EPBC Act.
- Eastern freetail-bat (*Mormopterus norfolkensis*) - listed as Vulnerable under the BC Act.
- Coastal Upland Swamp in the Sydney Basin Bioregion – Listed as an Endangered Ecological Community under the BC Act and EPBC Act.

While not all of the threatened species and ecological communities could be avoided by the proposed development, concentration of the proposed development impacts in the north of the site ensures that approximately 53 per cent of the site is avoided.

4.1.1 Size

The Development Footprint is approximately 6.17 ha, which is about 47 per cent of the total area of Lot 512 and 513 DP 727686. Darkinjung LALC, through the iterative planning and design, have actively avoided direct biodiversity impacts to approximately 7.1 ha of native vegetation in the south of Lot 512 and 513 DP 727686 which contains habitat for a range of listed flora and fauna species including, but not limited to, those occurring in the Development Footprint.

4.1.2 Location

The Development Footprint has been located immediately adjacent to Woy Woy Road, in areas more likely to be already subject to edge effects and indirect impacts from existing surrounding development. Edge effects noted during surveys include weed incursions, access tracks and rubbish dumping. The intact 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 site effectively infills the existing Kariong urban area, reducing edge effects elsewhere in the local area where inappropriate development could adversely impact biodiversity values.

4.1.3 Connectivity

As mentioned above, the Development Footprint has been positioned in the north of the site in an area already subject to edge effects and indirect impacts from existing surrounding development. In addition to this, the Development Footprint has been reduced in the south, to stop short of the existing residential development to the west of Woy Woy Road to retain all connectivity values that currently exists.

Impacts on connectivity were identified in the Ecological Investigation Report (Conacher Consulting 2016) and were a key consideration in the design of the proposed development. The Development Footprint has been designed to avoid impacts and minimise on connectivity in the local area and region. Existing connectivity values will be retained to the south east and east of the Development Footprint, and the functionality of corridors as identified in the Central Coast Regional Plan 2036 Biodiversity Corridors will be preserved through the appropriate siting of the proposed development.

4.2 Project Design

While detailed design plans aren't available, Darkinjung LALC 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.

4.3 Timing and Methods for Clearing Works

Darkinjung LALC has committed to the design and implementation of a comprehensive biodiversity impact minimisation strategy to minimise and mitigate the unavoidable impacts of the Project. The following specific control measures are integral to the minimisation of impacts on the biodiversity values of the Development Footprint and surrounds. Control measures include:

- demarcation of approved clearance boundaries
- weed management
- fencing and access control

- bushfire management, and
- pre-clearance and tree felling procedures.

4.3.1 Tree Felling Procedure

The supervision of all tree and vegetation removal works is to be completed by a suitably qualified and experienced ecologist. If an unanticipated ecological issue is encountered, further advice is to be sought on the most appropriate measures to ensure minimal impact on fauna species, particularly threatened species. Prior to the commencement of felling activities, a local veterinarian and/or qualified wildlife carer will be identified, and their contact details kept on hand, in the case their assistance is needed for injured wildlife. All personnel who are involved in the capture/handling/housing and/or transport of native fauna species (injured or uninjured) must be appropriately licensed under the requirements of the NSW Animal Ethics Committee. All clearing works will be completed at an appropriate time to minimise the risk of impacts on threatened species.

The following document the steps required to be completed as part of the tree felling process.

No more than two weeks prior to tree felling habitat trees, the following activities will be undertaken:

- Remove non-habitat trees/vegetation less than 3 m in height, as close to the habitat tree felling date as possible (less than one week) to create disturbance to discourage fauna usage of the habitat trees.
- In the event that threatened fauna are identified, provide a minimum 48 hour window for any threatened fauna species to vacate hollows or nests.

On the day of felling of habitat trees, the following activities will be undertaken:

- Complete a visual inspection of the area to be cleared for fauna species and nests that may have become active since pre-clearing surveys.
- Shake the habitat tree (with heavy machinery) for at least 30 seconds or as appropriate prior to felling to encourage fauna to abandon the tree.
- Ensure that habitat trees are lowered away from adjoining retained habitats.
- Lower the habitat tree as gently as possible with heavy machinery, noting in some situations (i.e., steep slopes) manual felling by chainsaw may be appropriate.
- Inspect all hollows and canopy of felled trees for remaining or injured fauna.
- Capture any displaced or injured fauna. Unharmed fauna are to be released into nearby secure habitats on the same day. Injured fauna are to be triaged immediately, humanely euthanized if required, or taken to a veterinarian or local volunteer wildlife carer group for further attention if required.
- Felled trees are to be rolled where appropriate so that the number of hollows blocked against the ground is minimised.
- In the event that threatened fauna are identified, provide a minimum 48 hour window for any threatened fauna species to vacate hollows or nests.

4.4 Summary of Measures

Table 4.1 outlines the avoidance and minimisation measures proposed for the Project including the timing, action, outcome, and responsibility of these measures.

Table 4.1 Avoidance and Minimisation Measures

Measure	Timing	Responsibility	Proposed Techniques	Outcome
Preliminary ecological site inspection	Pre-project design	N/A	N/A	• Preliminary assessment of areas of avoidance to inform project design.
Location and design of facilities in existing disturbed areas.	Project design	N/A	N/A	• Focus impacts on areas of low biodiversity value.
Pre-clearance Surveys and Tree Felling Procedure	Prior to clearance and during clearance activities	Site Manager	• Pre-clearance surveys and felling procedures as described above	• Minimisation of impacts to resident fauna species within the Development Footprint
Demarcation of approved clearance boundaries	Prior to clearance and during clearance activities	Site Manager	• Establish construction fencing or marking tape around areas not proposed for clearance.	• Minimisation of unnecessary impacts to surrounding vegetation and habitats.
Weed management	Construction and operation	Site Manager	• Chemical and physical removal of invasive weed species in accordance with the *Noxious and Environmental Weeds Handbook* (DPI 2014).	• Minimisation of environmental and noxious weeds in the Development Footprint. • Minimisation of weed spread from and into the wider locality.

5 Assessment of Impacts

5.1 Impacts on Native Vegetation and Habitat

5.1.1 Direct Impacts

The future subdivision will result in direct impacts on biodiversity values. Direct impacts include the loss of vegetation and fauna habitats as a result of clearance works and subsequent impacts from residential housing. The Development Footprint contains a range of habitat features (such as hollow-bearing trees, fallen logs and threatened flora species habitat) and species-credit species have been identified to occur within the Development Footprint.

Table 5.1 outlines the direct impacts on native vegetation, which totals approximately 6.17 ha. This assumes that the entire Development Footprint will be cleared as a result of the rezoning and subsequent development of the site. Avoidance and mitigation measures associated with minimising the impacts of these direct impacts are discussed in **Section 4.0**.

Table 5.1 Direct Impacts of the Proposed Modification on Biodiversity Features

Species	Area within the Development Footprint (ha)
Plant Community Type	
PCT1641 Dwarf Apple – Scribbly Gum heathy low woodland on sandstone ranges of the Central Coast	2.5
PCT1642 Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast	2.9*
PCT1699 Heath- leaved Banksia – Coral Fern wet heath on sandstone ranges of the lower Central Coast	0.7
Species-credit Species Habitats	
Callistemon linearifolius – netted bottlebrush	3 individuals
Cercartetus nanus - eastern pygmy possum	5.4*
Chalinolobus dwyeri - large- eared pied- bat	2.9*
Hibbertia procumbens - spreading guinea flower	5.4*
Hibbertia puberula	2.5
Darwinia glaucophylla	0.4
Lathamus discolor – swift parrot	5.2
Myotis macropus – southern myotis	1.1*

*Areas for these entities have incorporated the 0.3 ha of cleared land that is assumed to conform to PCT 1642

5.1.2 Indirect Impacts

The Project is not expected to result in any additional indirect impacts on the biodiversity values of surrounding lands. No substantial indirect impacts are expected to occur in relation to connectivity, corridors, habitat fragmentation or light emissions beyond minimal encroachment from the Development Footprint. However, some minor indirect impacts associated with water runoff, noise, dust, and weeds may occur during the during the subsequent development of the Development Footprint. These are discussed below.

No indirect impact zones have been identified for this Project.

5.1.2.1 Noise Impacts

Noise impacts have the potential to adversely impact native species. Potential impacts include:

- noise disturbing the roosting and foraging behaviour of fauna species
- noise reducing the occupancy of areas of suitable habitat.

Potential noise disturbance impacts on biodiversity are likely to be highest during construction of the Project. Upon completion, noise levels are likely to be like those already experienced in the area from the nearby Woy Woy Road and residences. Noise from proposed residences is not expected to be of any level of significance in relation to threatened species, populations, and communities.

5.1.2.2 Dust Impacts

Dust emissions have the potential to adversely impact native species during ground disturbance works and construction. Potential impacts include dust covering vegetation, which thereby potentially reduces vegetation health and growth. This subsequently impacts upon native fauna species. The design of the Project will include measures to minimise the potential for adverse dust impacts. Dust impacts will also only be present during the construction phase of the Project and will therefore be a temporary disturbance to the vegetation and habitats adjacent to the Development Footprint.

5.1.2.3 Weed Impacts

Weed species could be inadvertently brought into the Development Footprint with imported materials, on equipment, or could invade naturally through removal of native vegetation and establishment of gardens. The presence of weed species within the Development Footprint has the potential to decrease the value of extant vegetation to native species. Mitigation measures outlined in **Section 4.0** will be implemented to minimise the potential for weed encroachment into areas surrounding the Development Footprint.

There is unlikely to be any substantial change to impacts from weeds. Any additional impacts resulting from weeds are not expected to be of any level of significance in relation to threatened species, populations, and communities.

5.2 Prescribed Impacts

No impacts are expected to occur to threatened species' or communities' habitat associated with karst, caves, cliffs and other geological features of significance or human-made structures as these do not occur within the Development Footprint. However, small rocky areas and crevices do occur within the Development Footprint, which can be considered a prescribed impact. These areas are relatively small, considering the larger area of surrounding habitat.

No areas of non- native vegetation exist within the Development Footprint. There is a cleared area in the northern portion of the Development Footprint, however this area is largely devoid of any vegetation and is considered extremely unlikely to provide any habitat for threatened species. Threatened microbats may forage above this area for insects, however there is no roosting or breeding habitat available within this cleared area.

Important connectivity and movement habitat is unlikely to be substantially impacted by the Project given that it is located immediately adjacent to existing residential areas and will negligibly reduce the extent of the existing extensive vegetated corridor to the east and south. The Project proposes to impact a relatively minor proportion of this area of native vegetation and will not result in severing any major fauna movement habitat which would result in the loss of connectivity in the wider landscape, or movement important for threatened species to maintain their life cycle. The Development Footprint is located within the corridor identified in the Central Coast Regional Plan 2036 (NSW Government 2016) as connecting the central National parks and State Forests. The Project proposes to impact a relatively minor proportion of this area of native vegetation (approximately 300 m wide). The corridor itself will remain the same size overall, and minor impacts to connectivity will occur (refer to **Figure 2.1**). The remainder of Lot 512 DP 727686 is planned to be conserved through a Stewardship Agreement, which will provide in perpetuity conservation of a considerable section of the identified corridor in the Central Coast Regional Plan 2036 (NSW Government 2016).

Only those threatened fauna species that are not particularly mobile are likely to be impacted by the proposal. Similarly, threatened flora species and threatened ecological communities rely on connectivity for the exchange of genetic material. Therefore, impacts to connectivity limit the diversity within any given gene pool. However, considering the small area of connectivity to be removed, and given that the retained vegetation will remain almost entirely surrounded by native vegetation, impacts to genetic exchange are not anticipated such that these threatened species or communities would cease to exist in the locality.

No impacts on water quality or hydrological processes that sustain threatened species and threatened ecological communities are likely to occur. No creeks or mapped drainage lines occur within the Development Footprint. Wet soak areas were detected, especially in the vicinity of the *Coastal Upland Swamp in the Sydney Basin Bioregion* EEC, though these are only moist after rainfall.

No direct impacts to the hydrological processes of any offsite unmapped drainage lines are anticipated to occur as part of the proposed activity. Should any indirect impacts occur, these are expected to be short-term in duration and persist only during the construction phase of the Project. These should also be minimal provided appropriate erosion and sediment controls are in place.

Access to the Development Footprint will occur via Woy Woy Road. As the Development Footprint occurs immediately adjacent to this busy roadway, it is unlikely that any threatened species or animals that are part of a TEC would be adversely impacted by the increase in vehicle movement in or near to the Development Footprint. As the proposed activity would result in an increase in residences in the area, an increase in local vehicle movement is anticipated. However, the anticipated increase is not at such a scale that the increase in vehicle strikes would be significant to the decline of any threatened species.

The impacts of wind turbines are not applicable to this Project.

5.2.1 Uncertain Prescribed Impacts

Uncertain impacts are those that are unable to be reliably predicted during the assessment process or are infrequent in nature. These usually refer to impacts associated with caves, cliffs, mine subsidence and wind turbine strikes, and increased vehicle strikes. Indirect impacts associated with the interruption of ecosystem processes are also complex and difficult to quantify.

The Project is unlikely to result in any uncertain prescribed impacts.

5.3 Serious and Irreversible Impacts

Under the BC Act, a determination of whether an impact is serious and irreversible must be made in accordance with the principles prescribed in the BC Regulation. The principles have been designed to capture those impacts which are likely to contribute significantly to the risk of extinction of a threatened species or ecological community in New South Wales. These are 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
- will 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.

One of the species- credit species with habitat mapped within the Development Footprint is listed as potentially serious and irreversible impacts (SAII), swift parrot (*Lathamus discolor*).

Further assessment of the swift parrot against the principles of SAII species is provided below.

5.3.1 Swift Parrot SAII Assessment (S9.1 BAM 2020)

As noted in **Section 3.3.2** and shown in **Figure 5.1**, the Development Footprint occurs in an area that is mapped by DPIE as 'important habitat' for the swift parrot. The swift parrot important habitat area mapping was developed according to the following methods:

- Swift parrot sighting records from 1990-2018 were extracted from BioNet and BirdLife Australia Atlas. Records were checked and cleaned. Records were filtered to include only sightings with five or more birds. A 2 km radial buffer was applied.
- Important areas were defined by:
    - Areas with five or more records, where observations have occurred over two or more years and are within two kilometres of one another, or
    - Areas with a single record of 40 or more birds.

The NSW State Vegetation Type Map (including draft East Coast classification) was used to select Plant Community Types associated with the swift parrot within the buffers. Any areas of vegetation less than one hectare were excluded.

There is a total of 1604.76 hectares of important habitat shown within ten kilometres of the Development Footprint as shown in **Figure 5.1**.

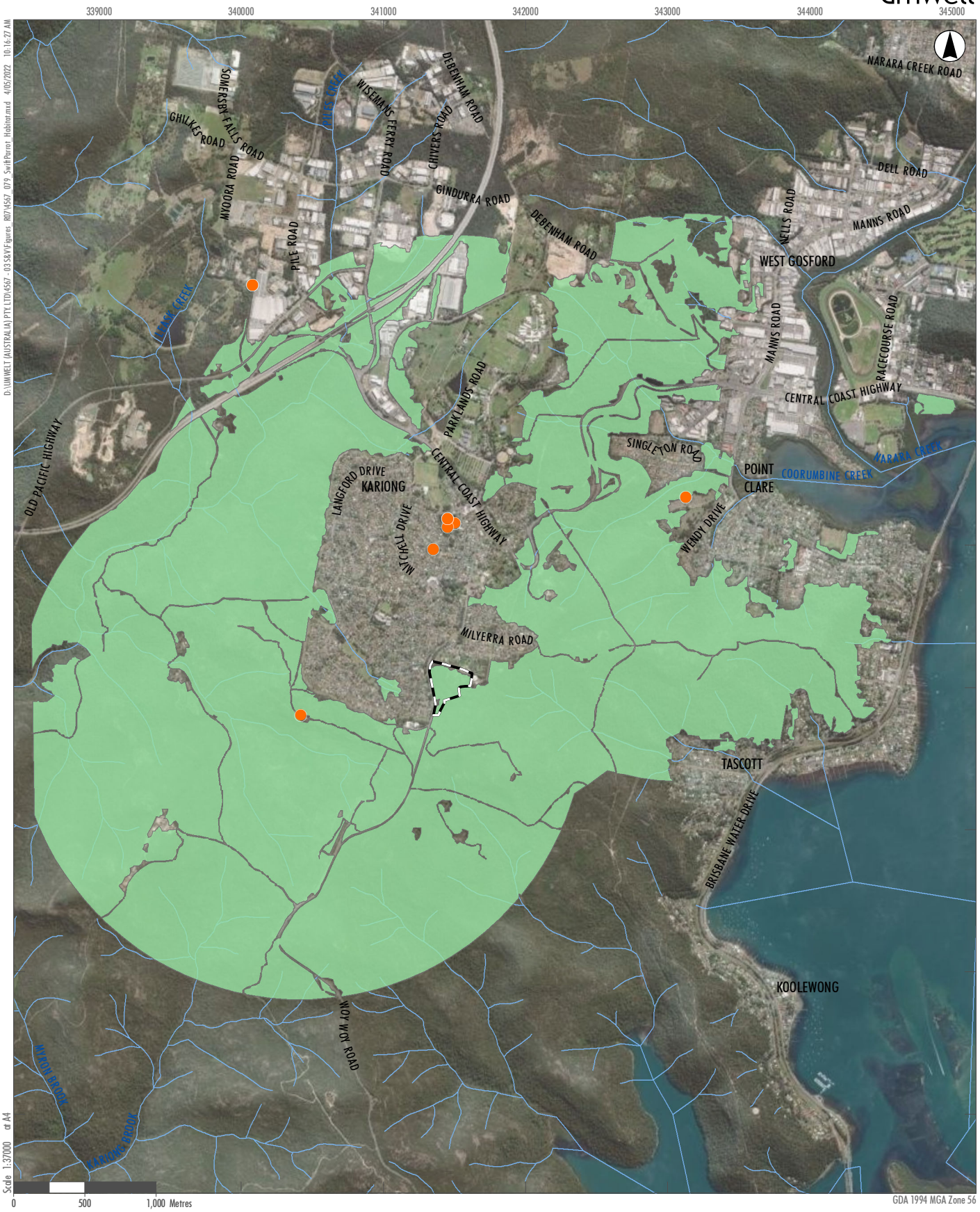
The swift parrot is listed as endangered under the BC Act and critically endangered under the EPBC Act. The species breeds in Tasmania and moves to mainland Australia for the non-breeding season (usually arriving between February and March) (Saunders and Tzaros 2011). Most of the population winters in Victoria and NSW where it disperses across broad landscapes foraging on nectar and lerps in eucalypts. They return to Tasmania in spring (September-October).

Until recently it was thought that in NSW, swift parrots forage mostly in the coastal and western slopes region along the inland slopes of the Great Dividing Range but are patchily distributed along the north and south coasts including the Sydney region (Saunders and Tzaros 2011). However, evidence is gathering that the forests on the coastal plains from southern to northern NSW are also important. The central and north coast of NSW routinely support small numbers of swift parrots in winter, but numbers have increased during drought and the central and north coast are important drought refuges (Saunders and Heinsohn 2008).

Upon reaching their core non-breeding range on mainland Australia there is no known geographical pattern of movement. The movements of this species on the mainland are poorly understood, but it is considered to be nomadic and irruptive, moving in response to food supply. During the non-breeding season, the home-range varies tremendously between individuals and between years.

The swift parrot is likely to utilise coastal forest and river-flat vegetation associations. Key foraging tree species, identified in the recovery plan, for the coastal region of NSW, including Sydney Metro and Hunter-Central Rivers natural resource management region, include swamp mahogany (*Eucalyptus robusta*), blackbutt (*Eucalyptus pilularis*), forest red gum (*Eucalyptus tereticornis*) and spotted gum (*Corymbia maculata*) (Saunders and Tzaros 2011). The swift parrot has been recorded foraging on nectar and lerps on these trees. A five year study, from 2001 to 2005, of winter foraging behaviour of the swift parrot found that the most important tree in coastal NSW for both nectar and lerps was the forest red gum, accounting for 49% of all coastal foraging observations while swamp mahogany accounted for 40% of nectar observation (Saunders and Heinsohn 2008). It is noted that none of these species have been recorded on site.

Habitat critical for survival include habitats used by large proportions of the population, repeatedly used (site fidelity) or occupied for prolonged periods (site persistence (Saunders and Tzaros 2011). Site fidelity is considered important for the long-term survival. Priority sites for the swift parrot have been identified within the National Recovery Plan in Tasmania, Victoria, and Queensland (Saunders and Tzaros 2011). At the time of the recovery plan priority sites for the swift parrot in NSW had not been identified. NSW Save our Species strategy has identified the Central Coast management area, including the Central Coast, Lake Macquarie, and Newcastle local government areas, with a priority management site located on private land in the Newcastle local government area. Other management sites include Tarcutta Hills near Wagga Wagga and the Riverina.



Legend

- Development Footprint
- Watercourses
- Swift Parrot Important Areas

NSW Bionet Atlas TS Records

- Swift Parrot

FIGURE 5.1

Swift Parrot Important Habitat Mapping

Image Source: Nearmap (2019); Open Street Map (2019) Data source: NSW LPI (2019), NSW Bionet Altas records (2022)

As discussed above, areas of important habitat for the swift parrot in NSW have been mapped by DPIE and mapping is provided in **Figure 5.1**. **Figure 5.1** also provides the NSW Bionet Atlas (2022) records that are likely to have been considered in development of the mapping. Records shown in **Figure 5.1** are largely located in residential areas and/or at the edge of large remnant habitats. While this may be an artefact of data collection, the swift parrots are known to forage on scattered trees particularly in coastal areas (Saunders and Heinsohn 2008). In addition to BioNet records shown on **Figure 5.1**, **Plate 5.1** shows records of the swift parrot from Bird Data (2022) from 1995 to present in the vicinity of the Development Footprint (marked with a blue dot).

Plate 5.1 Bird Data sighting records of swift parrot in the vicinity of the Development Footprint

In relation to the Development Footprint, there have been no sightings of the swift parrot on site but there are regular sightings of this species nearby with a high number of records at Bateau Bay approximately 20 kilometres to the northeast (refer to **Plate 5.1**). The species is a regular visitor to Sutton Reserve in Bateau Bay. The Bird Data record in Kariong is from 2004, which is almost 20 years old.

While there have been no records of swift parrot on site, and preferred foraging resources for the swift parrot is only associated with the red bloodwood occurring in PCT 1642, in accordance with the BAM, important habitat mapping is used to determine impacts.

In relation to the swift parrot, none of the principles listed above as being a cause for SAII are considered likely to occur as a result of the proposed Project. Notwithstanding this, an assessment in accordance with Section 9.1.2 of the BAM is provided in **Table 5.2** and **Table 5.3**.

Table 5.2 SAII Assessment – Current Population Status

Criteria	Assessment
Evidence of rapid decline (Principle 1, clause 6.7(2)(a) BC Regulation) presented by an estimate of the:	
• **decline in population of the species in NSW in the past 10 years or three generations (whichever is longer), or**	Estimating the population size of this species in NSW is not possible due to its migratory nature and yearly fluctuations. The national population of this species was estimated to be 2000 in the mid 1990s (TSSC 2016). A recent score card for this species assessing change in the population since then has projected an annual percentage population decline between 4 - 5% (National Environmental Science Program Threatened Species Research Hub 2019). Other recent estimates are that the national population is between 750 and 300 individuals (Birdlife Australia 2021).
• **decline in population of the species in NSW in the past 10 years or three generations (whichever is longer) as indicated by: an index of abundance appropriate to the species; decline in geographic distribution and/or habitat quality; exploitation; effect of introduced species, hybridisation, pathogens, pollutants, competitors or parasites.**	Estimating the population size of this species in NSW is not possible due to its migratory nature and annual fluctuations to dispersal. As noted above the national population size is estimated at 2000 however it is unclear what the population is now but has been declining primarily due to threats in breeding habitat in Tasmania. However, loss of over-wintering foraging habitat is a threat to the population. Important over-wintering habitat has been mapped for swift parrot. About 1604.76 ha has been mapped within 10 km of the Development Footprint. It is unlikely that the removal of approximately 5.2 ha (or 0.3%) of potential foraging habitat would cause a further decline in the species or reduce its population size.
Evidence of small population size (Principle 2, clause 6.7(2)(b) BC Regulation) presented by:	
• **an estimate of the species' current population size in NSW,**	Estimating the population size of this species in NSW is not possible due to its migratory nature and annual fluctuations to dispersal over-winter. Roderick and Stuart (2016) report that frequently about 100 birds visit the Hunter Region each winter, representing about 5% of the total estimated population (estimated to be 2000). Known records of the swift parrot in the immediate locality occur at Bateau Bay, Kincumber and one sighting at Kariong from 2004.
• **an estimate of the decline in the species' population size in NSW in three years or one generation (whichever is longer), and**	Estimating the population size of this species in NSW is not possible due to its migratory nature and annual fluctuations to dispersal. It is estimated that 10 years ago, there were 2000 mature individuals breeding in Tasmania (Garnett et al 2011) and the population is now reportedly between 300 and 750 individuals (Birdlife Australia 2021). The species' population has declined over the previous decade as is recognised in the national conservation listing changing from endangered to critically endangered. Decline is likely to be attributed to a range of factors over a very wide geographic distribution.
• **where such data is available, an estimate of the number of mature individuals in each subpopulation, or the percentage of mature individuals in each subpopulation, or whether the species is likely to undergo extreme fluctuations**	The species is described as one national population because the entire species migrates from breeding sites in Tasmania to the mainland each winter.

Criteria	Assessment
Evidence of limited geographic range for the threatened species (Principle 3, clause 6.7(2)(c) BC Regulation) presented by:	
• **extent of occurrence**	This species is highly mobile and migrates from Tasmania to the mainland each year (DPIE 2021b). The extent of occurrence is estimated (low confidence) to be 57,000km^2 and is not considered limited (TSSC 2016).
• **area of occupancy**	The species breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland (DPIE 2021b). The conservation advice for listing of the species nationally identified that the area of occupancy for the swift parrot for breeding habitat is estimated to be between 41km^2 in 2014 to 713km^2 in 2011, an average of 425km^2 per year (TSSC 2016). Including breeding and foraging habitat it is estimated that the area of occupancy ranges from 18.5 to 355km^2 based on data from 2009 to 2014 (TSSC 2016). While an area of 5.2 ha of swift parrot important habitat is proposed to be removed, this represents a very minor area of important habitat mapped within the greater area, being a total of 1604.76 ha (**Figure 5.1**). The area to be removed represents 0.3% of this mapped habitat. Swift parrot important habitat mapping extends outside this area in the locality to the north and south, with areas mapped at Bateau Bay/ Forresters Beach to the north east, Cowan and within Ku- ring-gai Chase National Park to the south. Therefore, when Bateau Bay/ Forresters Beach is included, the total to be removed on the Central Coast region would be less than 0.3%.
• **number of threat-defined locations (geographically or ecologically distinct areas in which a single threatening event may rapidly affect all species occurrences), and**	Not applicable to this species in NSW due to its high mobility. The PCTs that are mapped as important habitat for the swift parrot in the Development Footprint are common in the region and extend outside the Development Footprint. Only PCT 1642 supports a known coastal foraging resource for the swift parrot – red bloodwood. There is approximately 20,686 ha of Exposed Hawkesbury Woodland, which conforms to PCT 1642 in the Central Coast Local Government Area (LGA) (Bell 2019). Removal of 2.6 ha represents about 0.01% of that PCT in the Central Coast LGA. There is approximately 719 ha of Dwarf Apple Woodland, which conforms to PCT 1641, in the Central Coast LGA (Bell 2019). The Development Footprint will clear about 2.5 ha or 0.35% of the PCT in the Central Coast LGA alone. This PCT contains no preferred or important trees for the species. More importantly for the swift parrot, there are large areas of vegetation communities in the Central Coast area that contain swamp mahogany (*Eucalyptus robusta*) as the dominant species. Swamp mahogany is a typical winter- flowering species that is known to provide important habitat for the swift parrot during its winter migration to mainland Australia, and for which the swift parrot shows strong fidelity. The three largest vegetation communities within Central Coast LGA and Lake Macquarie LGA that have swamp mahogany as the dominant species total 2,026 ha (Bell 2019) and 2,257 ha (Bell 2016) respectively. This proposal will not remove any swamp mahogany trees or any PCT potentially containing this species.

Criteria	Assessment
	One of the dominant trees on site is red bloodwood (*Corymbia gummifera*). While the profile for swift parrot states that red bloodwood is a favoured feed tree in winter, this species is in fact not typically a winter- flowering tree. When the swift parrot arrives in southern NSW, in autumn the red bloodwood is still flowering and may provide an important foraging resource. However, by the time the birds reach the Central Coast region of NSW in May, June or July, this tree has typically finished its flowering for the season (Cooke 2007). In a five year study in the early 2000s, there were no observations of swift parrots foraging on nectar from red bloodwood (Saunders and Heinsohn 2008). Swift parrots were observed foraging on lerps on red bloodwood on the north coast but this only accounted for two percent of the coastal foraging observations reported in Saunders and Heinsohn (2008). On the Central Coast the swift parrot is far more likely to be reliant on well- documented winter- flowering species being swamp mahogany, blackbutt and spotted gum, neither of which are found in the Development Footprint. Further, records of swift parrot from 1995 to 2014 in the Central Coast and Hunter Region alone do not mention any recordings in red bloodwood, whereas swamp mahogany was repeatedly mentioned (Roderick and Ingwersen 2014). The foraging habitat in the Development Footprint is unlikely to be regularly relied upon by any swift parrot that may occur in the locality in response to winter flowering trees, given that the dominant trees in the Development Footprint (smooth-barked apple (*Angophora costata*), scribbly gum (*Eucalyptus haemastoma*), red bloodwood (*Corymbia gummifera*), old man banksia (*Banksia serrata*) and dwarf apple (*Angophora hispida*)) are not typically flowering in winter when the swift parrot occurs in the region. Therefore, it is unlikely that this area of habitat would be relied upon year after year by the swift parrot as a foraging resource. Furthermore, the Project is avoiding a large area of vegetation on DLALC-owned land to the south (refer to **Figure 1.2**). It is reasonable to assume that this area contains similar PCTs to those which will be removed. This species also does not breed in NSW, so the removal of any potential nest sites, is not applicable to this assessment. Therefore, the quality of the habitat to be removed is not considered significant to the survival of the swift parrot.
• **whether the species' population is likely to undergo extreme fluctuations**	The population of this species is not likely to undergo extreme fluctuations, as it is not typically a 'boom and bust' species subject to major fluctuations in the availability of resources. Even if a 'boom' of winter- flowering trees occurred in NSW, this is unlikely to cause an extreme fluctuation of this species, because this would be occurring when the species is not breeding, and therefore will not affect the rate at which the species can produce young and increase the population.
Evidence that the species is unlikely to respond to management (Principle 4, clause 6.7(2)(d) BC Regulation) because:	
• **known reproductive characteristics severely limit the ability to increase the existing population on, or occupy new habitat (e.g., species is clonal) on, a biodiversity stewardship site**	This species does not have reproductive characteristics that severely limit its ability to increase in population size or occupy new habitat. While the species is reliant on old- growth forest in Tasmania for breeding, this is not applicable to this assessment.

Criteria	Assessment
• **the species is reliant on abiotic habitats which cannot be restored or replaced (e.g., karst systems) on a biodiversity stewardship site, or**	This species is not reliant on abiotic habitats.
• **life history traits and/or ecology is known but the ability to control key threatening processes at a biodiversity stewardship site is currently negligible (e.g., frogs severely impacted by chytrid fungus).**	This species does not have life history traits whereby the ability to control key threatening processes is negligible.

Table 5.3 SAII Assessment – Impact Assessment

In relation to the impacts from the proposal on the species at risk of an SAII, the assessor must include data and information on:	
The impact on the species' population (Principles 1 and 2) presented by:	
i. an estimate of the number of individuals (mature and immature) present in the subpopulation on the subject land (the site may intersect or encompass the subpopulation) and as a percentage of the total NSW population, and	No individuals were present in the Development Footprint. This species was not detected during surveys and is being assessed for important mapped habitat only.
ii. an estimate of the number of individuals (mature and immature) to be impacted by the proposal and as a percentage of the total NSW population, or	No individuals were present in the Development Footprint. This species was not detected during surveys and is being assessed for important mapped habitat only. Roderick and Stuart (2016) report that frequently about 100 birds visit the Hunter Region each winter, representing about five per cent of the total estimated population (estimated to be 2000). Known records of the swift parrot in the immediate locality occur in large numbers at Bateau Bay.
iii. if the species' unit of measure is area, provide data on the number of individuals on the site, and the estimated number that will be impacted, along with the area of habitat to be impacted by the proposal	No individuals were present in the Development Footprint. This species was not detected during surveys and is being assessed for important mapped habitat only. The area and quality of the habitat to be impacted will be used as a surrogate for the population of the species, as well as the mapped important habitat. 5.2 ha of important mapped habitat occurs in the Development Footprint. As stated above, the area to be removed represents 0.3% of the important habitat mapped in the local area, and 0.01% of PCT 1642 (the largest PCT to be removed and the one in which red bloodwood occurs) in the Central Coast LGA. This represents a minimal area of habitat to be removed. Furthermore, according to the National Recovery Plan for the Swift Parrot (Saunders and Tzaros, 2011), important foraging habitat in NSW includes woodland and forest with the following key tree species: • Mugga ironbark (*Eucalyptus sideroxylon*) • Grey box (*Eucalyptus microcarpa*) • White box (*Eucalyptus albens*) • Yellow box (*Eucalyptus melliodora*)

In relation to the impacts from the proposal on the species at risk of an SAII, the assessor must include data and information on:	
	• Swamp mahogany (*Eucalyptus robusta*) • Forest red gum (*Eucalyptus tereticornis*) • Blackbutt (*Eucalyptus pilularis*) • Spotted gum (*Corymbia maculata*). The Development Footprint occurs in an area where the swift parrot important habitat mapping does not align with important foraging habitat according to the National Recovery Plan. The surveyed habitat in the Development Footprint comprises the following PCTs and tree species: • PCT1641 Dwarf Apple – Scribbly Gum heathy low woodland on sandstone ranges of the Central Coast • PCT1642 Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast • PCT1699 Heath- leaved Banksia – Coral Fern wet heath on sandstone ranges of the lower Central Coast The trees that dominate the Development Footprint are not identified in the recovery plan as forming important winter foraging habitat for the swift parrot. The important feed trees present in the Central Coast locality are likely to be the swamp mahogany (*Eucalyptus robusta*), blackbutt (*Eucalyptus pilularis*) and forest red gum (*Eucalyptus tereticornis*), which do not occur on site. One of the dominant trees on site is red bloodwood (*Corymbia gummifera*). While the NSW Bionet profile for swift parrot states that, in addition to the aforementioned trees, red bloodwood is a favoured feed tree in winter, this species is in fact not typically a winter- flowering tree. The swift parrot migrates from Tasmania into Victoria and then onto NSW. In southern NSW red bloodwood does provide an important feed tree for the swift parrot upon its entry into NSW when arrival of the swift parrot coincides with flowering of the red bloodwood. However, by the time the birds reach the Central Coast region of NSW in May, June or July, this tree has typically finished its flowering for the season (Cooke 2007). On the Central Coast/Lake Macquarie area, particularly along the coast, the swift parrot is far more likely to be reliant on well-documented winter- flowering species being swamp mahogany and spotted gum (Roderick and Ingwersen 2014), neither of which are found in the Development Footprint. Further, records of swift parrot from 1995 to 2014 in the Central Coast and Hunter Region alone do not mention any recordings in red bloodwood, whereas swamp mahogany was repeatedly mentioned (Roderick and Ingwersen 2014). Therefore, the quality of the habitat to be removed is not considered high.
Impact on geographic range (Principles 1 and 3) presented by:	
i. the area of the species' geographic range to be impacted by the proposal in hectares, and a percentage of the total Area of Occupation (AOO), or Extent of Occupation (EOO) within NSW	Information regarding AOO or EOO is not available, due to the migratory nature of the species and its sporadic occurrence across NSW during migration. This species occupies breeding habitat in Tasmania, but also migrates into Victoria and NSW, therefore the proposed removal of 5.2 ha of habitat is negligible to this large area. However, as stated above, the area to be removed represents 0.3% of the important habitat mapped in the locality, and 0.01% of PCT 1642 (the largest PCT to be removed and the only one containing red bloodwood)

In relation to the impacts from the proposal on the species at risk of an SAII, the assessor must include data and information on:	
	in the Central Coast LGA. This represents a minimal area of habitat to be removed.
ii. the impact on the subpopulation as either: • **all individuals will be impacted (subpopulation eliminated);** • **OR impact will affect some individuals and habitat;** • **OR impact will affect some habitat, but no individuals of the species will be directly impacted**	5.2 ha of important mapped habitat occurs in the Development Footprint, but no individuals of the species will be directly impacted.
iii. to determine if the persisting subpopulation that is fragmented will remain viable, estimate (based on published and unpublished sources such as scientific publications, technical reports, databases, or documented field observations) the habitat area required to support the remaining population, and habitat available within dispersal distance, and distance over which genetic exchange can occur (e.g., seed dispersal) and pollination distance for the species	The swift parrot is assessed as one national population with no subpopulations. The removal of 5.2 ha of important habitat as mapped by DPE is unlikely to impact upon the viability of any individuals that may forage within the locality and Development Footprint. Genetic exchange is likely to remain unaffected due to the highly mobile nature of the species.
iv. to determine changes in threats affecting remaining subpopulations and habitat if the proposed impact proceeds, estimate changes in environmental factors including changes to fire regimes (frequency, severity); hydrology, pollutants; species interactions (increased competition and effects on pollinators or dispersal); fragmentation, increased edge effects, likelihood of disturbance; and disease, pathogens and parasites. Where these factors have been considered elsewhere in relation to the target species, the assessor may refer to the relevant sections of the BDAR or BCAR.	The removal of 5.2 ha or 0.3% of important mapped habitat in the locality is unlikely to change any potential threats for this highly mobile species. The proposal is not likely to change fire regimes, hydrology, pollutants, disease, pathogens and parasites. However, the removal of 5.2 ha for the Development Footprint has the potential to result in changes to species interactions, fragmentation, edge effects and likelihood of disturbance. Edge effects and fragmentation are not likely to significantly and directly disrupt the locally occurring population of swift parrots, because they are highly mobile and tend to forage wherever food is abundant including in isolated flowering trees, as opposed to requiring large contiguous tracts of native vegetation. However, the creation of fragmentation and edge effects does play a role in the interaction of bird species, particularly where aggression is shown by one species over another. By reducing the availability of habitat in the wider area, these threats can exacerbate such things as competition by locally- common, aggressive species, such as the noisy miner (*Manorina melanocephala*). This species tends to drive away other birds when they forage in open, cleared areas typically created by human disturbance. By removing 6.17 ha of native vegetation, the open areas created by this disturbance may increase the availability of habitat for noisy miners, thereby increasing the likelihood of this species to drive away less aggressive birds such as the swift parrot. Refer to **Section 4.0** for minimisation and avoidance measures.

6 Biodiversity Credit Impact Summary

6.1 Impacts Not Requiring Assessment

Under the BAM impacts to areas of land without native vegetation do not require further assessment. The Development Footprint contains approximately 0.3 ha of cleared land that may be developed by subdivision following rezoning on the land. Normally, cleared areas would not require assessment, in accordance with Section 9.2.1. of the BAM, however, as discussed in **Section 1.1**, this area was illegally cleared and has been assessed under the BAM as conforming to PCT 1642.

6.2 Impacts Not Requiring Offset

Impacts on native vegetation not requiring offsets under the BAM include native vegetation that has a vegetation integrity score of less than 20 (where it is not associated with ecosystem-credit species habitat or a TEC), less than 17 (where it is associated with ecosystem-credit habitat or a TEC) or less than 15 (where it is representative of an EEC or CEEC).

As all native vegetation recorded within the Development Footprint has a higher vegetation integrity score than the required threshold, there are no areas of native vegetation impact not requiring offset.

6.3 Impacts Requiring Offset

Three PCTs and seven species-credit species are considered to require offsetting in accordance with the BAM (DPIE 2020a). **Table 6.1** summarises this outcome. This includes the area of illegally cleared land that has been assessed as part of PCT 1642.

Table 6.1 Impacts Requiring Offset

Veg Zone	PCT/Species-credit	Vegetation Integrity Score			Area (ha)	Credits Required
		Current	Future	Change		
1	PCT1641 Dwarf Apple – Scribbly Gum heathy low woodland on sandstone ranges of the Central Coast *Good Condition*	80.5	0	-80.5	2.5	**75**
2	PCT1642 Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast *Good Condition*	69.4	0	-69.4	2.9*	**75**
3	PCT1699 Heath- leaved Banksia – Coral Fern wet heath on sandstone ranges of the lower Central Coast *Good Condition*	24.6	0	-24.6	0.7	**9**
-	netted bottlebrush *Callistemon linearifolius*	-	-	-	3 individuals	**5**
-	eastern pygmy possum *Cercartetus nanus*	-	-	-	5.4*	**202**

Veg Zone	PCT/Species-credit	Vegetation Integrity Score			Area (ha)	Credits Required
		Current	Future	Change		
-	*Darwinia glaucophylla*	-	-	-	0.4	**9**
-	large- eared pied- bat *Chalinolobus dwyeri*	-	-	-	2.9*	**151**
-	spreading guinea flower *Hibbertia procumbens*	-	-	-	5.4*	**202**
-	*Hibbertia puberula*	-	-	-	2.5	**101**
-	swift parrot *Lathamus discolor*	-	-	-	5.2	**270**
-	southern myotis *Myotis macropus*	-	-	-	1.1*	**38**

*Areas for these entities have incorporated the 0.3 ha of cleared land that is assumed to conform to PCT 1642

7 Biodiversity Credit Report

A full Biodiversity Credit Report is included in **Appendix E**.

8 Biodiversity Offset Strategy

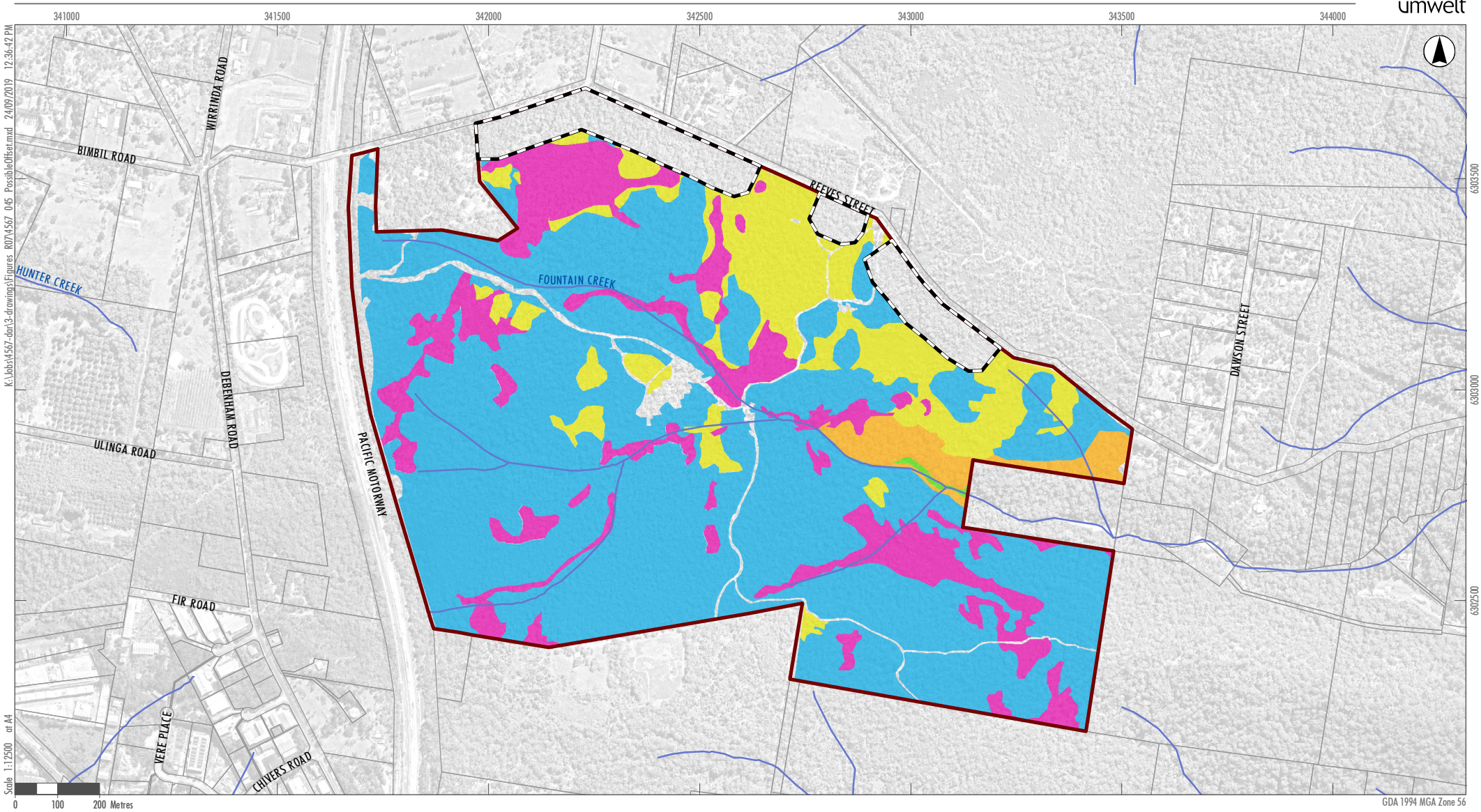
The Darkinjung LALC landholding at 300 Woy Woy Road Kariong is approximately twice the size of the proposed Development Footprint (refer to **Figure 2.1**). This area is located immediately south of the Development Footprint and comprises approximately 7.09 ha. Based on a high-level habitat suitability assessment undertaken by Conacher Consulting (2016) the site will likely generate a portion of the required credits to offset the impacts of the Project if it was to be established as a Biodiversity Stewardship site.

In addition to this, the remainder of Lot 481 DP 1184693 Reeves Street, Somersby located approximately four kilometres north of the Development Footprint comprises over 178 ha of similar vegetation communities (Conacher 2015) and is likely to generate the majority of the required credits to offset the impacts of the Project (refer to **Figure 8.1**).

Darkinjung LALC 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 2016 and Biodiversity Conservation Regulation 2017. Firstly, Darkinjung LALC has, where possible, altered the Project to avoid and minimise biodiversity impacts in the planning stage, and a range of impact mitigation strategies to mitigate the impact on ecological values (refer to **Section 4.0**) 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:

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



Legend

- Development Footprint
- Lot 48 DP118467
- Lot Boundaries
- Watercourses

Vegetation Communities (Cocacher 2015)

- Coastal Upland Swamp (EEC under BC Act and EPBC Act)
- Exposed Hawkesbury Woodland
- Hawkesbury Plateau Banksia Scrub
- Sandstone Ranges Warm Temperate Rainforest
- Sheltered Dry Hawkesbury Woodland

Image Source: Nearmap (March 2019) Data source: NSW LPI (2019); Conacher (2015)

FIGURE 8.1

Potential Somersby Offset Site

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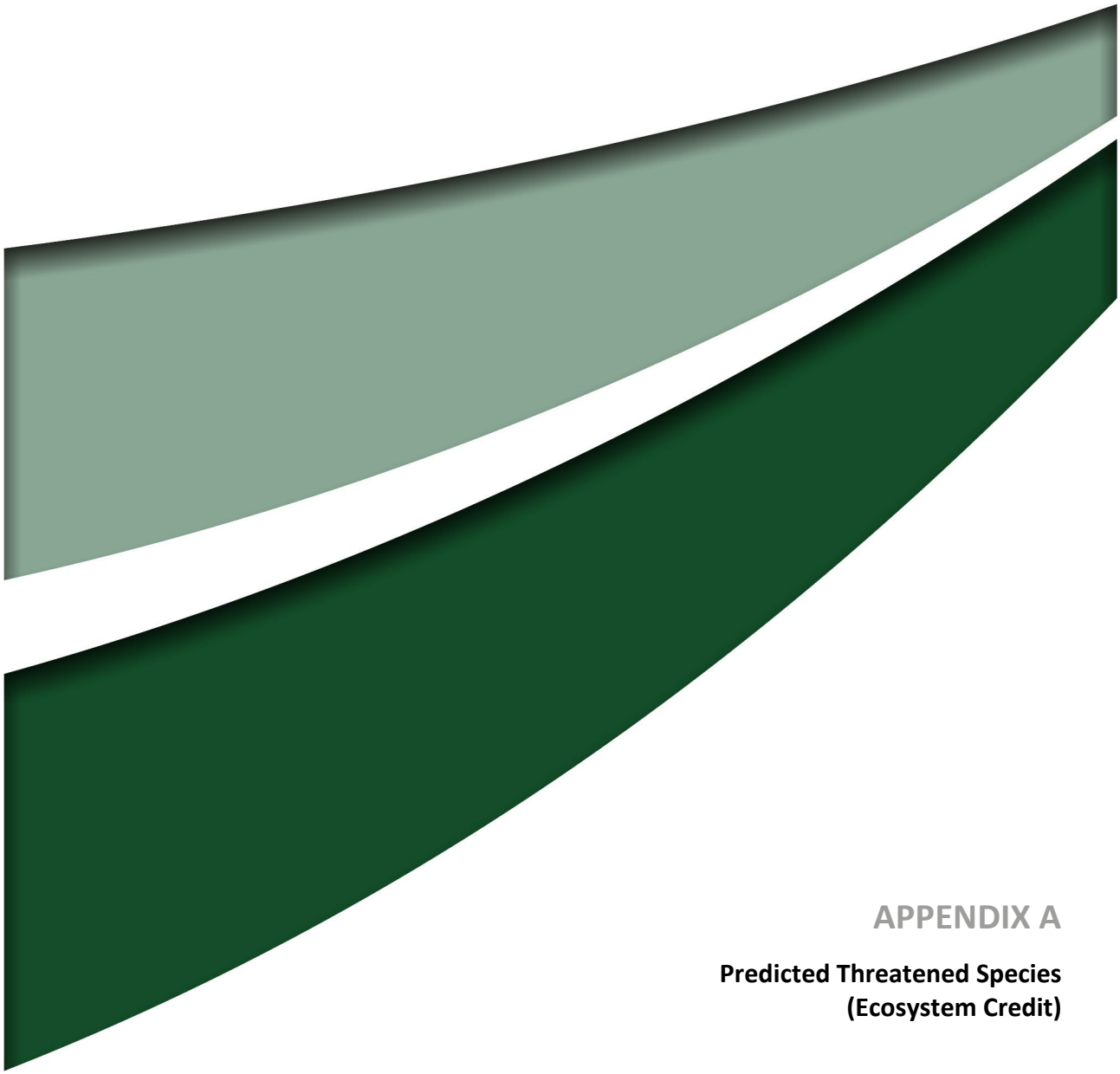


APPENDIX A

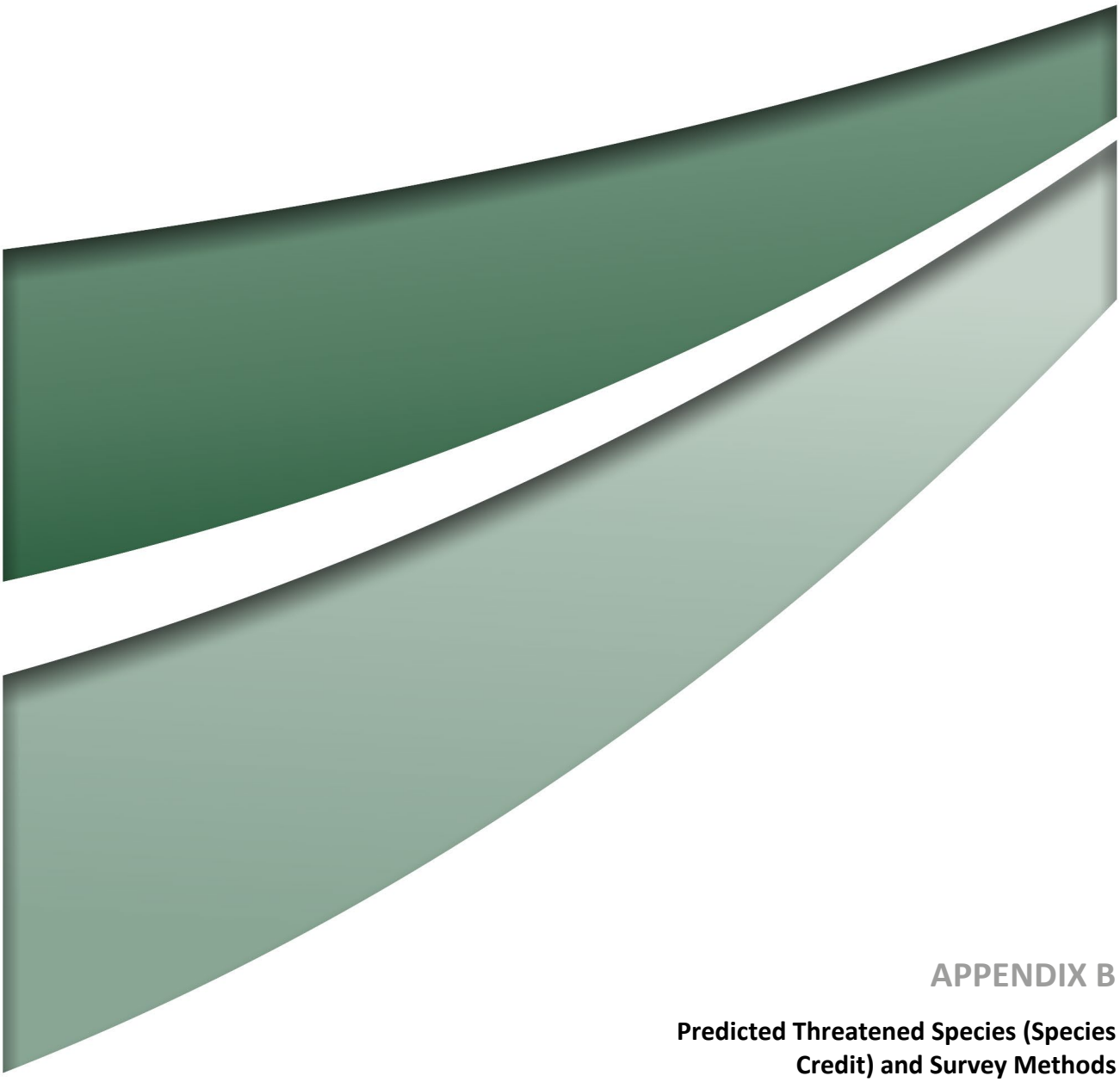
Predicted Threatened Species (Ecosystem Credit)

Predicted Threatened Species (Ecosystem Credit)

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint
regent honeyeater (foraging) *Anthochaera phrygia*	CE	CE	Very High	-
dusky woodswallow *Artamus cyanopterus*	V	-	Moderate	-
australasian bittern *Botaurus poicilopterus*	E	E	High	-
gang-gang cockatoo (foraging) *Callocephalon fimbriatum*	V	-	Moderate	-
glossy black-cockatoo (foraging) *Calyptorhynchus lathami*	V	-	High	Presence of *Allocasuarina* and *casuarina* species.
brown treecreeper (eastern subspecies) *Climacteris picumnus victoriae*	V	-	High	-
varied sittella *Daphoenositta chrysoptera*	V	-	Moderate	-
spotted-tailed quoll *Dasyurus maculatus*	V	E	High	-
white- fronted chat *Epthianura albifrons*	V	-	Moderate	-
eastern false pipistrelle *Falsistrellus tasmaniensis*	V	-	High	-
little lorikeet *Glossopsitta pusilla*	V	-	High	-
painted honeyeater *Grantiella picta*	V	V	Moderate	Mistletoes present at a density of greater than five mistletoes per hectare.
white-bellied sea-eagle (foraging) *Haliaeetus leucogaster*	V	-	High	Within 1km of a river, lake, large dam or creek, wetlands, and coastlines.
little eagle (foraging) *Hieraaetus morphnoides*	V	-	Moderate	-
broad-headed snake *Hoplocephalus bungaroides*	E	V	High	-
black bittern *Ixobrychus flavicollis*	V	-	Moderate	
golden-tipped bat *Kerivoula papuensis*	V	-	High	-
swift parrot (foraging) *Lathamus discolor*	E	CE	Moderate	-
square-tailed kite (foraging) *Photinias insure*	V	-	Moderate	-

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint
black-chinned honeyeater (eastern subspecies) *Melithreptus gularis*	V	-	Moderate	-
little bentwing-bat (foraging) *Miniopterus australis*	V	-	High	-
eastern bentwing-bat (foraging) *Miniopterus schreibersii oceanensis*	V	-	High	-
eastern freetail-bat (foraging) *Mormopterus norfolkensis*	V	-	High	-
turquoise parrot *Neophema pulchella*	V	-	High	-
barking owl (foraging) *Ninox connivens*	V	-	High	-
powerful owl (foraging) *Ninox strenua*	V	-	High	-
eastern osprey (foraging) *Pandion cristatus*	V	-	Moderate	-
yellow-bellied glider *Petaurus australis*	V	-	High	Hollow-bearing trees with hollows greater than 25cm diameter.
scarlet robin *Petroica boodang*	V	-	Moderate	-
koala (foraging) *Phascolarctos cinereus*	V	V	High	-
long-nosed potoroo *Potorous tridactylus*	V	V	High	Dense shrub layer or alternatively high canopy cover exceeding 70% (i.e., to capture populations inhabiting wet sclerophyll and rainforest).
eastern chestnut mouse *Pseudomys gracilicaudatus*	V	-	High	-
new Holland mouse *Pseudomys novaehollandiae*	-	V	Moderate	-
grey-headed flying-fox (foraging) *Pteropus poliocephalus*	V	V	High	-
Australian painted snipe *Rostraula australis*	E	E	High	-
greater broad- nosed bat *Saccolaimus flaviventris*	V	-	Moderate	-
greater broad-nosed bat Scoteanax rueppellii	V	-	High	-

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint
masked owl (foraging) *Tyto novaehollandiae*	V	-	High	-
sooty owl (foraging) *Tyto tenebricosa*	V	-	Moderate	-
Rosenberg's goanna *Varanus rosenbergi*	V	-	High	-



APPENDIX B

Predicted Threatened Species (Species Credit) and Survey Methods

Predicted Threatened Species (Species Credit) and Survey Methods

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
Flora Species						
Bynoe's wattle *Acacia bynoeana*	E	V	Sept-Mar	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in October 2018 and January 2019 in suitable habitat over 6 days. Opportunistic observations were completed throughout all Umwelt survey periods.
downy wattle *Acacia pubescens*	V	V	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in August 2018, October 2018, and January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
Ancistrachne maidenii	V	-	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in August 2018, October 2018, and January 2019 in suitable habitat over 6 days.
Asterolasia elegans	E	E	All year	-	Yes	**Species not present.** No habitat presents for this species within the Development Footprint. No records of this species within 10 km of the Development Footprint.
thick-leaf star-hair *Astrotricha crassifolia*	V	V	All year	-	Yes	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in January 2019 in suitable habitat over 2 days. Opportunistic observations were completed throughout all Umwelt survey periods.
dense cord- rush *Baloskion longipes*	V	V	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in January 2019 in suitable habitat over 2 days. Opportunistic observations were completed throughout all Umwelt survey periods.
thick lip spider orchid *Caladenia tessellata*	E	V	Sept-Nov^	-	Yes	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in October 2018 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
netted bottle brush ***Callistemon linearifolius***	V	-	Sept-Mar	-	No	**Species detected.** Three individuals located in the south- west of the Development Footprint in PCT 1642. Species habitat polygon mapped on **Figure 3.3.**
leafless tongue orchid ***Cryptostylis hunteriana***	V	V	Nov-Feb	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
white-flowered wax plant ***Cynanchum elegans***	E	E	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
Darwinia glaucophylla	V	-	All year	-	No	**Species detected.** Approximately 11 individuals detected within the Development Footprint in PCTs 1642 and 1699 in the south-west of the area, and adjacent to the track. Species habitat polygon mapped on **Figure 3.3.**
Diuris bracteata	E	Ex.	Aug-Sept	-	Yes	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in August 2018 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
camfield's stringybark ***Eucalyptus camfieldii***	V	V	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in August 2018, October 2018 and January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
Slaty Red Gum ***Eucalyptus glaucina***	V	V	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
Epacris purpurascens* subsp. *purpurascens	V	-	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in August 2018, October 2018, and January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
yellow gnat- orchid ***Genoplesium baueri***	E	E	Feb-Mar	-	Yes	**Species not detected.** This species was targeted as part of BAM plot/transect surveys conducted in March 2019. This species is typically found in moss gardens over sandstone and is unlikely to be present in the site.
small-flower grevillea ***Grevillea parviflora* subsp. *parviflora***	V	V	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in August 2018, October 2018, and January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
Grevillea shiressii	V	V	All year	-	Yes	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in August 2018, October 2018, and January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
wingless raspwort ***Haloragis exalata* subsp. *exalata***	V	V	All year	Waterbodies	No	**Species not present.** No habitat presents for this species within the Development Footprint. No records of the species within 10 km of the Development Footprint.
spreading guinea flower ***Hibbertia procumbens***	E	-	Dec-Mar	-	No	**Species detected.** Approximately 73 individuals detected within the Development Footprint across much of the area in PCTs 1641 and 1642. Species habitat polygon mapped in **Figure 3.3.**
Hibbertia puberula* subsp. *puberula	E	-	Sept - Feb	-	No	**Species detected.** One individual detected within the Development Footprint in PCT 1641. Species habitat polygon mapped in **Figure 3.3.**
biconvex paperbark ***Melaleuca biconvexa***	V	V	All year	-	No	**Species not present.** No habitat for this species within the Development Footprint.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
Deane's paperbark ***Melaleuca deanei***	V	V	Dec-Feb	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
Grove's paperbark ***Melaleuca groveana***	V	-	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
Micromyrtus blakelyi	V	V	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
hairy geebung ***Persoonia hirsuta***	E	E	Dec-May	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
Pimelea curviflora* subsp. *curviflora	V	V	All year	-	No	**Species not present.** No habitat presents for this species within the Development Footprint. No records of the species within 10 km of the Development Footprint.
tranquility mintbush ***Prostanthera askania***	E	E	Sept-Dec	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in October 2018 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
Somersby mintbush ***Prostanthera junonis***	E	E	Sept-Nov	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in October 2018 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
scrub turpentine ***Rhodamnia rubescens***	CE	-	All year	-	Yes	**Species not present.** No habitat presents for this species within the Development Footprint. No records of the species within 10 km of the Development Footprint.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
native guava *Rhodomyrtus psidioides*	CE	-	All year	-	Yes	**Species not present.** No habitat presents for this species within the Development Footprint. No records of the species within 10 km of the Development Footprint.
eastern underground orchid *Rhizanthella slateri*	V	E	Sept-Nov	-	Yes	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in October 2018 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
heath wrinklewort *Rutidosis heterogama*	V	V	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in August 2018, October 2018, and January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
magenta lilly pilly *Syzygium paniculatum*	E	V	All year	-	No	**Species not present.** No habitat presents for this species within the Development Footprint. No records of the species within 10 km of the Development Footprint.
black-eyed Susan *Tetratheca juncea*	V	V	Jul-Dec	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in August and October 2018 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
Tetratheca glandulosa	V	-	Jul-Nov	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in August and October 2018 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
austral toadflax *Thesium australe*	V	V	Nov-Feb	-	No	**Species not present.** No habitat presents for this species within the Development Footprint. No records of the species within 10 km of the Development Footprint.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
Fauna Species						
regent honeyeater (breeding) ***Anthochaera phrygia***	CE	CE	Sep-Dec	-	Yes	**Breeding habitat not present.** Consultation with OEH staff (John Seidel, Senior Team Leader Ecosystem Assessment – Conservation and Regional Delivery) was undertaken as part of the winter surveys to determine the need for targeted species credit surveys for the regent honeyeater in areas of preferred habitat. OEH advised that the potential development areas will not trigger the important habitat map for the regent honeyeater and the species can therefore be assessed as part of ecosystem credit requirements. As such there is no need to undertake targeted surveys for this species.
bush stone-curlew ***Burhinus grallarius***	E	-	All year	Fallen/standing dead timber including logs.	No	**Species not detected.** Habitat on site is marginal for this species. Nocturnal spotlighting searches were undertaken in March and May 2019 over six nights in suitable habitat areas between sunset and midnight using 30 watt hand-held spotlights and head torches. Call- playback was also undertaken for this species over three consecutive nights during March 2019. 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 and this species was not flushed during flora transects.
gang-gang cockatoo (breeding) ***Callocephalon fimbriatum***	V	-	Oct-Jan	Eucalypt tree species with hollows greater than 9cm diameter.	No	**No suitable breeding habitat present.** This species breeds in very tall, old- growth forests in mountain regions (DPIE 2022a). Habitat assessments and targeted searches were conducted in March and May 2019 over 2 days to identify potential breeding habitat available for the species across the Development Footprint. Suitable tree species containing hollows greater than 9 cm were recorded and inspected for occupants. Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
glossy black-cockatoo (breeding) ***Calyptorhynchus lathami***	V	-	Mar-Aug	Living or dead trees with hollows greater than 15cm diameter, and greater than 5m above ground.	No	**Species not detected.** Breeding habitat on site is marginal for this species. Habitat assessments were conducted in March and May 2019 over 2 days targeting suitable breeding hollows (greater than 15 cm diameter). No suitable hollows were detected. Unsuitable hollows (i.e., larger than 15 cm but less than 3 m from the ground) were stagwatched for signs of diurnal activity. None detected. Opportunistic observations were completed throughout all Umwelt survey periods.
eastern pygmy possum ***Cercartetus nanus***	V	-	Oct-Mar	-	No	**Assumed Present.** However, this species is highly cryptic and a high number (25) of records exist within 10 km of the Development Footprint. 14 of these records have been submitted since 1 January 2009, with three of these being extremely close to the Development Footprint. Bushnell Trophy Cam HD cameras were installed at 10 locations within the Development Footprint from 25 March 2019 to 6 May 2019 (43 nights). At each site, a remote camera was mounted on a tree trunk and positioned towards a bait station containing peanut butter, honey, and oats. Cameras were set to take three photos in quick succession when movement was detected. Nocturnal spotlighting searches were also undertaken in March and May 2019 over six nights in suitable habitat areas between sunset and midnight using 30 watt hand-held spotlights and head torches.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
large-eared pied bat *Chalinolobus dwyeri*	V	V	Sept-Mar	Land within 2km of rocky areas containing cliffs, caves, overhangs, escarpments, outcrops, or crevices. Land within 2km of old mines or tunnels.	Yes	**Breeding and roosting habitat not present, however species assumed present.** Habitat assessments for suitable breeding habitat for this species (caves, scarps, rocky areas, overhangs, crevices, cliffs, escarpments, or old mines) was conducted opportunistically during all survey periods in 2018 and 2019. While there are some rocky areas, these areas do not contain crevices or caves that would be utilised by this species. All of these areas were checked for the presence of bats, and none were detected. This species is considered to occur where there are potential roosts located within 2 km of associated PCTs. As it is not possible to survey within 2 km of the Development Footprint for any possible roosts, and as PCT 1642 is associated with this species, the species has been assumed to occur on site. The species polygon has been aligned with PCT 1642.
white-bellied sea-eagle (breeding) *Haliaeetus leucogaster*	V	-	Jul-Dec	Living or dead mature trees within suitable vegetation within 1km of rivers, lakes, large dams or creeks, wetlands, and coastlines.	No	**No suitable breeding habitat present.** This species requires very tall, dead, or alive, trees suitable for a very large stick nest. Habitat assessments and targeted searches were conducted in August and October 2018 to identify potential breeding habitat available for the species across the Development Footprint. Suitable tree species were inspected for large stick nests and/or evidence of breeding pairs. Opportunistic observations for very large stick nests were completed throughout all Umwelt survey periods, none of which were detected.
giant burrowing frog *Heleioporus australiacus*	V	V	Sept-May	-	No	**Species not detected.** Targeted searches and spotlighting conducted in March and May 2019 over six nights in areas of suitable habitat. Call- playback was also undertaken for this species over three consecutive nights during March 2019. This involved playing the call of the species for five minutes, followed by a listening period of five minutes.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
little eagle (breeding) ***Hieraaetus morphnoides***	V	-	Aug-Oct	Nest trees; live (occasionally dead) large old trees within vegetation.	No	**No suitable breeding habitat present.** This species requires very tall, dead, or alive, trees suitable for a very large stick nest. Habitat assessments and targeted searches were conducted in August and October 2018 to identify potential breeding habitat available for the species across the Development Footprint. Suitable tree species were inspected for large stick nests and/or evidence of breeding pairs. Opportunistic observations for very large stick nests were completed throughout all Umwelt survey periods. None were detected.
pale-headed snake ***Hoplocephalus bitorquatus***	V	-	Nov-Mar	Within 500m of moderate to good vegetation.	No	**Species not detected.** Targeted searches and walking transects were undertaken during March 2019 in suitable habitat over three nights. Opportunistic observations were completed throughout all Umwelt survey periods. No records of this species within 10 km of the site.
broad-headed snake (breeding) ***Hoplocephalus bungaroides***	E	V	Aug-Sept	Including escarpments, outcrops, and pagodas within the Sydney Sandstone geologies	Yes	**Species not detected.** Targeted searches and walking transect were undertaken during August 2018 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods. Limited rocky habitat is available within the Development Footprint.
swift parrot (breeding) ***Lathamus discolor***	E	CE	May-Aug	-	Yes	**Breeding/Important habitat not present.** Important area mapping in the BOAMS shows important habitat across almost the entirety of the Development Footprint, encompassing 5.2 ha.
green and golden bell frog ***Litoria aurea***	E	V	Nov-Mar	Semi-permanent/ephemeral wet areas, within 1km of swamps or waterbodies.	No	**Species not present.** No habitat for this species within the Development Footprint.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
green-thighed frog *Litoria brevipalmata*	V	-	Oct-Mar	-	No	**Species not detected.** Targeted searches and spotlighting conducted in March over three consecutive nights in areas of suitable habitat. Call- playback was also undertaken for this species over three consecutive nights during March 2019. This involved playing the call of the species for five minutes, followed by a listening period of five minutes.
littlejohn's tree frog *Litoria littlejohni*	V	V	Jul-Nov	-	No	**Species not present.** No habitat for this species within the Development Footprint.
square-tailed kite (breeding) *Lophoictinia isura*	V	-	Sept-Jan	Nest trees.	No	**No suitable breeding habitat present.** This species requires very tall, dead, or alive, trees suitable for a very large stick nest. Habitat assessments and targeted searches were conducted in August and October 2018 to identify potential breeding habitat available for the species across the Development Footprint. Suitable tree species were inspected for large stick nests and/or evidence of breeding pairs. Opportunistic observations for very large stick nests were completed throughout all Umwelt survey periods. None were detected.
parma wallaby *Macropus parma*	V	-	All year	-	No	**Species not detected.** Bushnell Trophy Cam HD cameras were installed at 10 locations within the Development Footprint from 25 March 2019 to 6 May 2019 (43 nights). At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and oats. Cameras were set to take three photos in quick succession when movement was detected. Nocturnal spotlighting searches were also undertaken in March and May 2019 over six nights in suitable habitat areas between sunset and midnight using 30 watt hand-held spotlights and head torches.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
Maroubra land snail ***Meridolum maryae***	E	-	All year	-	No	**Species not present.** Geographically constrained. This species is confined to a narrow band of habitat along the coast from the north-eastern corner of the Royal National Park to Palm Beach in Sydney. No survey required.
little bentwing-bat (breeding) ***Miniopterus australis***	V	-	Dec-Feb	Caves, tunnels, mine, culverts, or other structures known or suspected to be used for breeding.	Yes	**Breeding habitat not present.** Habitat assessments for suitable breeding habitat for this species (caves, scarps, rocky areas, overhangs, crevices, cliffs, escarpments or old mines) was conducted opportunistically during all survey periods in 2018 and 2019. While there are some rocky areas, these areas do not contain crevices or caves that would be utilised by this species. All of these areas were checked for the presence of bats and none were detected.
eastern bentwing-bat (breeding) ***Miniopterus schreibersii oceanensis***	V	-	Nov-Feb	Caves, tunnels, mines, culverts, or other structures known or suspected to be used for breeding.	Yes	**Breeding habitat not present.** Habitat assessments for suitable breeding habitat for this species (caves, scarps, rocky areas, overhangs, crevices, cliffs, escarpments, or old mines) was conducted opportunistically during all survey periods in 2018 and 2019. While there are some rocky areas, these areas do not contain crevices or caves that would be utilised by this species. All of these areas were checked for the presence of bats, and none were detected.
stuttering frog ***Mixophyes balbus***	E	V	Sept-Mar	-	Yes	**Species not detected.** Targeted searches and spotlighting conducted in March over three consecutive nights in areas of suitable habitat. Call- playback was also undertaken for this species over three consecutive nights during March 2019. This involved playing the call of the species for five minutes, followed by a listening period of five minutes.
giant barred frog ***Mixophyes iteratus***	E	E	Oct-Mar	Land within 50m of semi-permanent and permanent drainages	No	**Species not present.** No habitat for this species is present within the Development Footprint.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
southern myotis *Myotis macropus*	V	-	Nov-Mar	Hollow-bearing trees, bridges, caves, or artificial structures, within 200m of riparian zone. Within 500m of foraging habitat.	No	**Species assumed present.** This species is considered to occur where there are waterbodies (> 3m) within 200 m of hollow-bearing trees in associated PCTs. There is one dam located within 200 m from the Development Footprint, and PCTs 1641 and 1642 are associated with this species. Species polygon mapped in **Figure 3.3.**
barking owl (breeding) *Ninox connivens*	V	-	May-Dec	Living or dead trees with hollows greater than 20cm diameter and greater than 4m above the ground.	No	**Species not detected.** Habitat assessments were conducted in March and May 2019 over 2 days to identify potential habitat available for the species across the Development Footprint. Suitable living trees and stags were recorded and inspected for any evidence of occupation (e.g., scats, whitewash, noise). Two suitable nesting trees (containing a hollow larger than 20 cm) were stagwatched at dusk during May 2019. Nothing was observed entering or exiting the hollow. Nocturnal spotlighting searches were undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over six nights in March and May 2019. Call- playback was also undertaken for this species over three consecutive nights during May 2019. 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.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
powerful owl (breeding) ***Ninox strenua***	V	-	May-Aug	Living or dead trees with hollow greater than 20cm diameter.	No	**Species not detected.** Habitat assessments were conducted in March and May 2019 over 2 days to identify potential habitat available for the species across the Development Footprint. Suitable living trees and stags were recorded and inspected for any evidence of occupation (e.g., scats, whitewash, noise). Several suitable nesting trees (containing a hollow larger than 20 cm) were stagwatched at dusk during May 2019. Nothing was observed entering or exiting the hollow. Nocturnal spotlighting searches were undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over six nights in March and May 2019. Call- playback was also undertaken for this species over three consecutive nights during May 2019. 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.
eastern osprey (breeding) ***Pandion cristatus***	V	-	Apr-Nov	Living and dead trees (>15m) or artificial structures within 100m of a floodplain for nesting.	No	**No suitable breeding habitat present.** This species requires very tall, usually dead but occasionally alive, trees suitable for a very large stick nest. Habitat assessments and targeted searches were conducted in August 2018, October 2018, and March 2019 to identify potential breeding habitat available for the species across the Development Footprint. Suitable tree species were inspected for large stick nests and/or evidence of breeding pairs. Opportunistic observations for very large stick nests were completed throughout all Umwelt survey periods. None were detected.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
giant dragonfly *Petalura gigantea*	E	-	Dec-Jan	Within 500 m of swamps	Yes	**Species not detected.** Habitat assessments and targeted searches conducted in January 2019 within and adjacent to suitable swamp habitats. Opportunistic observations were completed throughout all Umwelt survey periods.
squirrel glider *Petaurus norfolcensis*	V	-	All year	-	No	**Species not detected.** Bushnell Trophy Cam HD cameras were installed at 10 locations within the Development Footprint from 25 March 2019 to 6 May 2019 (43 nights). At each site, a remote camera was mounted on a tree trunk and positioned towards a bait station containing peanut butter, honey, and oats. Cameras were set to take three photos in quick succession when movement was detected. Nocturnal spotlighting searches were undertaken in March and May 2019 over six nights in suitable habitat areas between sunset and midnight using 30 watt hand-held spotlights and head torches. Call- playback was also undertaken for this species over three consecutive nights during March 2019. 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.
brush-tailed rock-wallaby *Petrogale penicillata*	E	V	All year	Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines.	Yes	**Species not present.** Habitat on site is unsuitable for this species. This species is found on rocky escarpments, outcrops, and cliffs with a preference for complex structures with fissures, caves and ledges. The Development Footprint does not contain suitable habitat for the species and therefore does not require further assessment.

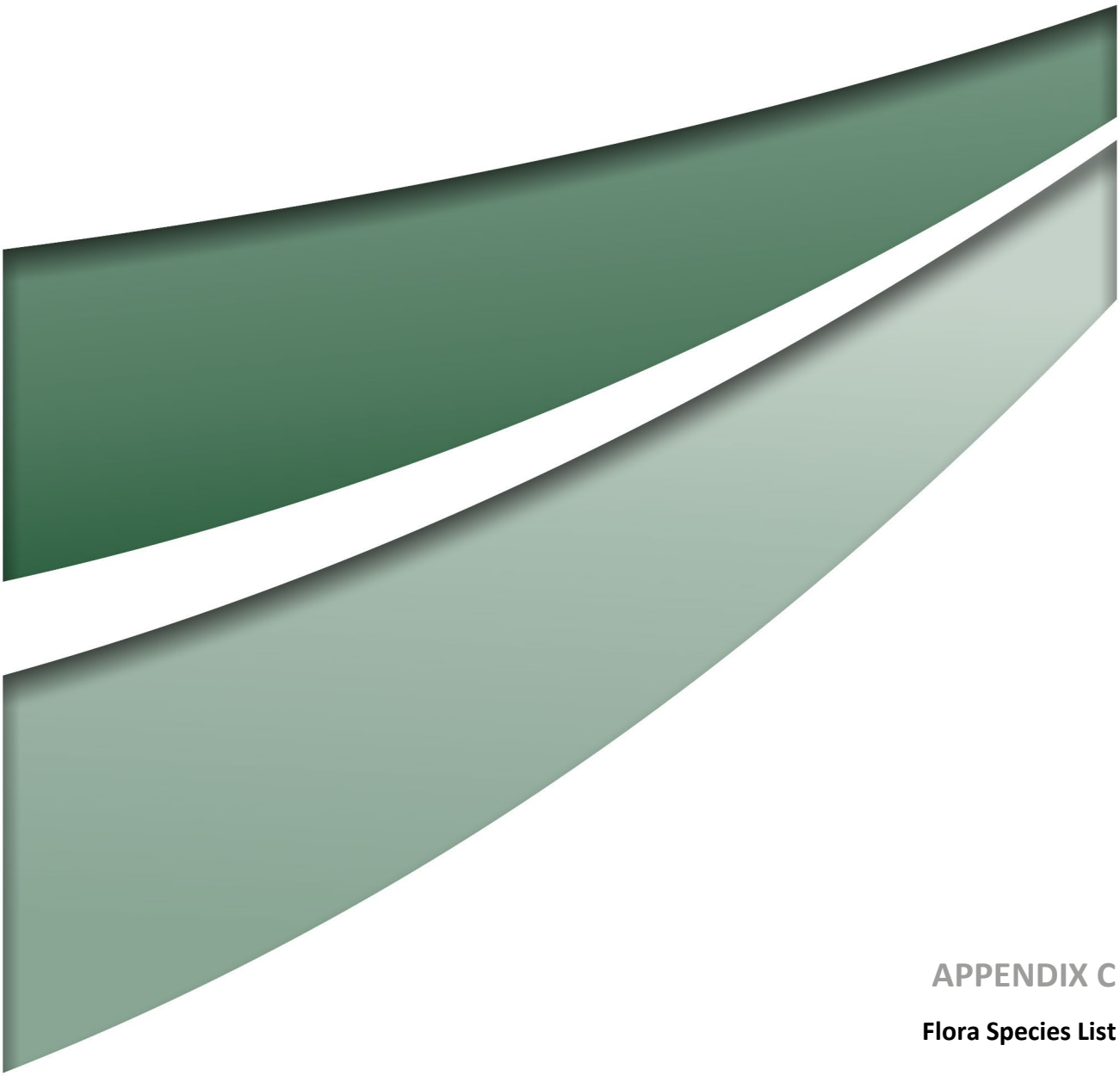
Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
koala (breeding) ***Phascolarctos cinereus***	V	V	All year	-	No	**Species not detected.** Bushnell Trophy Cam HD cameras were installed at 10 locations within the Development Footprint from 25 March 2019 to 6 May 2019 (43 nights). At each site, a remote camera was mounted on a tree trunk and positioned towards a bait station containing peanut butter, honey, and oats. Cameras were set to take three photos in quick succession when movement was detected. Three Spot Assessment Techniques (SAT) searches were undertaken in the woodland vegetation across the Development Footprint during March 2019. This involves searching underneath suitable trees (at least 30 trees) for Koala scats. Nocturnal spotlighting searches were undertaken in March and May 2019 over six nights in suitable habitat areas between sunset and midnight using 30 watt hand-held spotlights and head torches. Call- playback was also undertaken for this species over three consecutive nights during March 2019. 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.
greater glider ***Petauroides volans***	-	V	All year	Hollow- bearing trees	No	**Species not detected.** Habitat on site is marginal for this species. Bushnell Trophy Cam HD cameras were installed at 10 locations within the Development Footprint from 25 March 2019 to 6 May 2019 (43 nights). At each site, a remote camera was mounted on a tree trunk and positioned towards a bait station containing peanut butter, honey, and oats. Cameras were set to take three photos in quick succession when movement was detected. Nocturnal spotlighting searches were undertaken in March and May 2019 over six nights in suitable habitat areas between sunset and midnight using 30 watt hand-held spotlights and head torches.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
Long-nosed potoroo *Potorous tridactylus*	V	V	All year	Dense shrub layer or alternatively high canopy cover exceeding 70% (i.e., to capture populations inhabiting wet sclerophyll and rainforest))	No	**Species not detected.** Habitat on site is marginal for this species. Bushnell Trophy Cam HD cameras were installed at 10 locations within the Development Footprint from 25 March 2019 to 6 May 2019 (43 nights). At each site, a remote camera was mounted on a tree trunk and positioned towards a bait station containing peanut butter, honey, and oats. Cameras were set to take three photos in quick succession when movement was detected. Nocturnal spotlighting searches were undertaken in March and May 2019 over six nights in suitable habitat areas between sunset and midnight using 30 watt hand-held spotlights and head torches.
red-crowned toadlet *Pseudophryne australis*	V	-	All year	-	No	**Species not detected.** Targeted searches and spotlighting conducted in March and May 2019 over six nights in areas of suitable habitat. Call- playback was undertaken for this species over three consecutive nights during March 2019. This involved playing the call of the species for five minutes, followed by a listening period of five minutes.
grey-headed flying-fox (breeding) *Pteropus poliocephalus*	V	V	Oct-Dec	Breeding camps.	No	**No camps detected.** Individual foraging flying- foxes detected. However, the entire Development Footprint was traversed during targeted searches for threatened flora and fauna species in August and October 2018, and January, March, and May 2019. Opportunistic observations were completed throughout all Umwelt survey periods and no flying- fox camps were detected.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
masked owl (breeding) ***Tyto novaehollandiae***	V	-	May-Aug	Living or dead trees with hollows greater than 20cm diameter.	No	**Species not detected.** Habitat assessments were conducted in March and May 2019 over 2 days to identify potential habitat available for the species across the Development Footprint. Suitable living trees and stags were recorded and inspected for any evidence of occupation (e.g., scats, whitewash, noise). Several suitable nesting trees (containing a hollow larger than 20 cm) were stagwatched at dusk during May 2019. Nothing was observed entering or exiting the hollow. Nocturnal spotlighting searches were undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over six nights in March and May 2019. Call- playback was also undertaken for this species over three consecutive nights during May 2019. 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.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
sooty owl (breeding) ***Tyto tenebricosa***	V	-	Apr-Aug	Caves/hollow-bearing trees	Yes	**Species not detected.** Habitat assessments were conducted in March and May 2019 over 2 days to identify potential habitat available for the species across the Development Footprint. Suitable living trees and stags were recorded and inspected for any evidence of occupation (e.g., scats, whitewash, noise). Several suitable nesting trees (containing a hollow larger than 20 cm) were stagwatched at dusk during May 2019. Nothing was observed entering or exiting the hollow. Nocturnal spotlighting searches were undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over six nights in March and May 2019. Call- playback was also undertaken for this species over three consecutive nights during May 2019. 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.
eastern cave bat ***Vespadelus troughtoni***	V	-	Nov-Jan	Caves or within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices, or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds.	Yes	**Breeding habitat not present.** Habitat assessments for suitable breeding habitat for this species (caves, scarps, rocky areas, overhangs, crevices, cliffs, escarpments, or old mines) was conducted opportunistically during all survey periods in 2018 and 2019. None detected. Species is also not associated with any of the PCTs found on site (OEH, 2019b).

^ Survey period derived from resources other than TBDC.



APPENDIX C

Flora Species List

Flora Species List

The following list was developed from the floristic plot surveys of the Development Footprint. It includes all species of vascular plants observed during these surveys. It is acknowledged that the list is not comprehensive, as not all species are readily detected at any one time of the year. Many species flower only during restricted periods of the year, and some flower only once in several years. In the absence of flowering material, many of these species cannot be identified, or even detected.

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

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

sp.	specimens that are identified to genus level only.

The following abbreviations or symbols are used in the list:

AA	denotes abundance rating according to BAM
PC	cover measure according to BAM
asterisk (*)	denotes species non-native species
double asterisk (**)	denotes High Threat Weed species under the BAM
subsp.	subspecies and
var.	variety.

All vascular plants recorded or collected were identified using keys and nomenclature in Harden (1992, 1993, 2000 and 2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from PlantNET (Botanic Gardens Trust 2018), the on-line plant name database maintained by the National Herbarium of New South Wales.

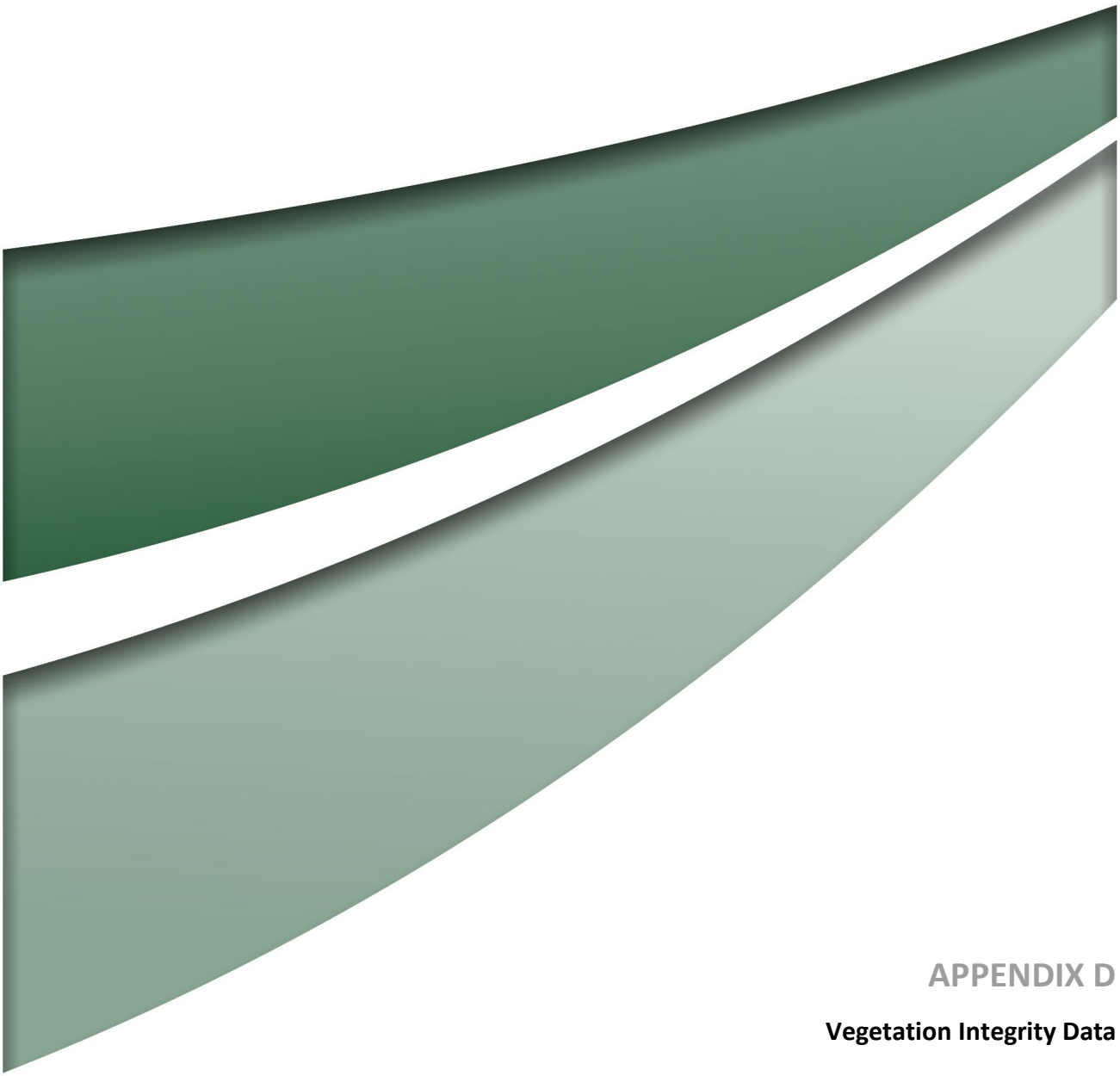
Common names used follow Harden (1992, 1993, 2000 and 2002) where available, and draw on other sources such as local names where these references do not provide a common name.

Family	Scientific Name	Common Name	Q01		Q02		Q03		Q04		Q05	
			AA	PC	AA	PC	AA	PC	AA	PC	AA	PC
Apiaceae	*Actinotus minor*	Lesser Flannel Flower	20	0.1	100	0.1			1000	1	3	0.1
Apiaceae	*Platysace linearifolia*		50	0.2	100	0.5			25	0.1	100	1
Apocynaceae	*Parsonsia straminea*	Common Silkpod			50	0.1	1	0.1	20	0.1		
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak	10	2	5	0.5	1	0.1				
Cyperaceae	*Baumea* sp.						500	0.3				
Cyperaceae	*Caustis flexuosa*	Curly Wig									10	0.1
Cyperaceae	*Cyathochaeta diandra*		200	5	1000	1	1000	5	1000	10	500	5
Cyperaceae	*Gahnia sieberiana*	Red-fruit Saw-sedge					2	0.2				
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge							1000	0.5	20	0.1
Cyperaceae	*Lepidosperma urophorum*								1000	1		
Cyperaceae	*Schoenus apogon*	Fluke Bogrush									20	0.1
Dilleniaceae	*Hibbertia acicularis*										2	0.1
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower			20	0.1			20	0.5	2	0.1
Dilleniaceae	*Hibbertia linearis*										3	0.1
Dilleniaceae	*Hibbertia obtusifolia*	Hoary Guinea Flower	20	0.1	100	0.5			200	2	5	0.1
Ericaceae (Epacridoideae)	*Epacris pulchella*	Wallum Heath	10	0.1	75	0.5	5	0.1	50	0.5		
Ericaceae (Epacridoideae)	*Epacris* sp.				40	0.1						
Ericaceae (Epacridoideae)	*Leucopogon juniperinus*	Prickly Beard-heath	5	0.1							5	0.1
Ericaceae (Epacridoideae)	*Woollsia pungens*				1	0.1						
Euphorbiaceae	*Ricinocarpos pinifolius*	Wedding Bush					2	0.1				
Fabaceae (Faboideae)	*Bossiaea ensata*	Sword Bossiaea	20	0.2	5	0.1			5	0.1		
Fabaceae (Faboideae)	*Bossiaea heterophylla*	Variable Bossiaea	10	0.1					15	0.1	5	0.1
Fabaceae (Faboideae)	*Bossiaea obcordata*	Spiny Bossiaea									10	0.1
Fabaceae (Faboideae)	*Gompholobium latifolium*	Golden Glory Pea									3	0.1
Fabaceae (Faboideae)	*Hovea linearis*										1	0.1
Fabaceae (Faboideae)	*Mirbelia rubiifolia*	Heathy Mirbelia	1	0.1	10	0.1						
Fabaceae (Faboideae)	*Pultenaea paleacea*	Chaffy Bush-pea							10	0.2	2	0.1
Fabaceae (Faboideae)	*Pultenaea rosmarinifolia*		10	0.1	25	0.1						

Family	Scientific Name	Common Name	Q01		Q02		Q03		Q04		Q05	
			AA	PC	AA	PC	AA	PC	AA	PC	AA	PC
Fabaceae (Mimosoideae)	*Acacia linifolia*	Narrow-leaved Wattle					2	0.1			1	0.1
Fabaceae (Mimosoideae)	*Acacia longifolia*										1	0.1
Fabaceae (Mimosoideae)	*Acacia myrtifolia*	Red-stemmed Wattle					2	0.1				
Fabaceae (Mimosoideae)	*Acacia oxycedrus*	Spike Wattle	10	0.1	5	0.5						
Fabaceae (Mimosoideae)	*Acacia suaveolens*	Sweet Wattle	10	0.1	10	0.5	3	0.1	12	1	2	0.1
Fabaceae (Mimosoideae)	*Acacia ulicifolia*	Prickly Moses					1	0.1	1	0.1	5	0.1
Gleicheniaceae	*Gleichenia dicarpa*	Pouched Coral Fern					3000	98	100	2		
Goodeniaceae	*Dampiera stricta*		10	0.1	10	0.1					2	0.1
Goodeniaceae	*Goodenia* sp.				25	0.1			25	0.1		
Iridaceae	*Patersonia sericea*	Silky Purple-Flag	50	5	500	0.5			500	1	10	0.1
Lauraceae	*Cassytha glabella*								75	0.1	1	0.1
Lindsaeaceae	*Lindsaea linearis*	Screw Fern	20	0.1					100	0.1	10	0.1
Lomandraceae	*Lomandra filiformis*				100	0.1						
Lomandraceae	*Lomandra glauca*	Pale Mat-rush									200	1
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush			100	0.1						
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*	Many-flowered Mat-rush	3	0.1								
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*	Many-flowered Mat-rush			50	0.1			200	0.1		
Lomandraceae	*Lomandra obliqua*		10	0.1	200	0.2					20	0.1
Myrtaceae	*Angophora costata*	Sydney Red Gum							0	0.5		
Myrtaceae	*Angophora hispida*	Dwarf Apple	50	2	10	2						
Myrtaceae	*Baeckea diosmifolia*	Fringed Baeckea	1	0.1	75	0.2						
Myrtaceae	*Callistemon citrinus*	Crimson Bottlebrush							2	0.5		
Myrtaceae	*Corymbia gummifera*	Red Bloodwood			1	0.5	2	0.2	0	5	7	10
Myrtaceae	*Darwinia fascicularis* subsp. *fascicularis*				40	0.2						
Myrtaceae	*Eucalyptus agglomerata*	Blue-leaved Stringybark					1	5	0	5	2	5
Myrtaceae	*Eucalyptus haemastoma*	Broad-leaved Scribbly Gum	1	2	5	10			0	5	4	35
Myrtaceae	*Eucalyptus punctata*	Grey Gum									2	10
Myrtaceae	*Kunzea* sp.				10	0.5						

Family	Scientific Name	Common Name	Q01		Q02		Q03		Q04		Q05	
			AA	PC	AA	PC	AA	PC	AA	PC	AA	PC
Myrtaceae	*Leptospermum arachnoides*		1	0.1								
Myrtaceae	*Leptospermum continentale*	Prickly Teatree					1	0.1				
Myrtaceae	*Leptospermum polygalifolium*						10	5	25	5		
Myrtaceae	*Leptospermum trinervium*	Slender Tea-tree	30	10	15	20					5	2
Myrtaceae	*Leptospermum divaricatum*								15	7		
Orchidaceae	*Cryptostylis erecta*	Tartan Tongue Orchid							25	0.1	5	0.1
Orchidaceae	*Cryptostylis* sp.						5	0.1				
Orchidaceae	*Cryptostylis subulata*	Large Tongue Orchid			20	0.1						
Phormiaceae	*Dianella revoluta*	Blueberry Lily	10	0.1	10	0.1					2	0.1
Phyllanthaceae	*Phyllanthus hirtellus*	Thyme Spurge			50	0.1					3	0.1
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry	5	0.1								
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum					2	0.1				
Poaceae	*Anisopogon avenaceus*	Oat Speargrass	200	5	1000	0.5			1000	10	500	5
Poaceae	*Entolasia marginata*	Bordered Panic									500	0.2
Poaceae	*Entolasia stricta*	Wiry Panic	500	10	1000	1	100	1	1000	2	###	2
Proteaceae	*Banksia ericifolia*	Heath-leaved Banksia	100	45	100	15	35	15	12	10	14	10
Proteaceae	*Banksia oblongifolia*	Fern-leaved Banksia	10	3	10	0.5	3	0.1	12	0.5	4	1
Proteaceae	*Grevillea buxifolia*	Grey Spider Flower									1	0.1
Proteaceae	*Hakea gibbosa*		20	3	20	5	1	0.1	1	0.5		
Proteaceae	*Hakea teretifolia*	Needlebush	20	0.5	30	15			5	1		
Proteaceae	*Isopogon anemonifolius*	Broad-leaf Drumsticks			75	0.5					20	0.5
Proteaceae	*Isopogon* sp.								30	0.5		
Proteaceae	*Lambertia formosa*	Mountain Devil	1	0.1	10	0.5			25	1	2	0.1
Proteaceae	*Persoonia levis*	Broad-leaved Geebung			2	0.5			1	0.2	2	0.1
Proteaceae	*Petrophile pulchella*	Conesticks	5	0.1							5	0.1
Ranunculaceae	*Ranunculus* sp.		20	0.1	1	0.1			10	0.1		
Restionaceae	*Lepyrodia scariosa*		1000	15	1000	15			1000	10	20	0.1
Rutaceae	*Boronia ledifolia*	Sydney Boronia	10	0.1	50	0.5			10	0.1		

Family	Scientific Name	Common Name	Q01		Q02		Q03		Q04		Q05	
			AA	PC	AA	PC	AA	PC	AA	PC	AA	PC
Santalaceae	*Leptomeria acida*	Sour Currant Bush									2	0.2
Schizaeaceae	*Schizaea bifida*	Forked Comb Fern									3	0.1
Smilacaceae	*Smilax glyciphylla*	Sweet Sarsparilla					1	0.1				
Xanthorrhoeaceae	*Xanthorrhoea media*						50	0.2			3	0.1
Xanthorrhoeaceae	*Xanthorrhoea minor* subsp. *minor*		10	0.2								
Xanthorrhoeaceae	*Xanthorrhoea* sp.				15	0.5			10	1		
		TOTAL		**37**		**45**		**25**		**41**		**48**



APPENDIX D

Vegetation Integrity Data

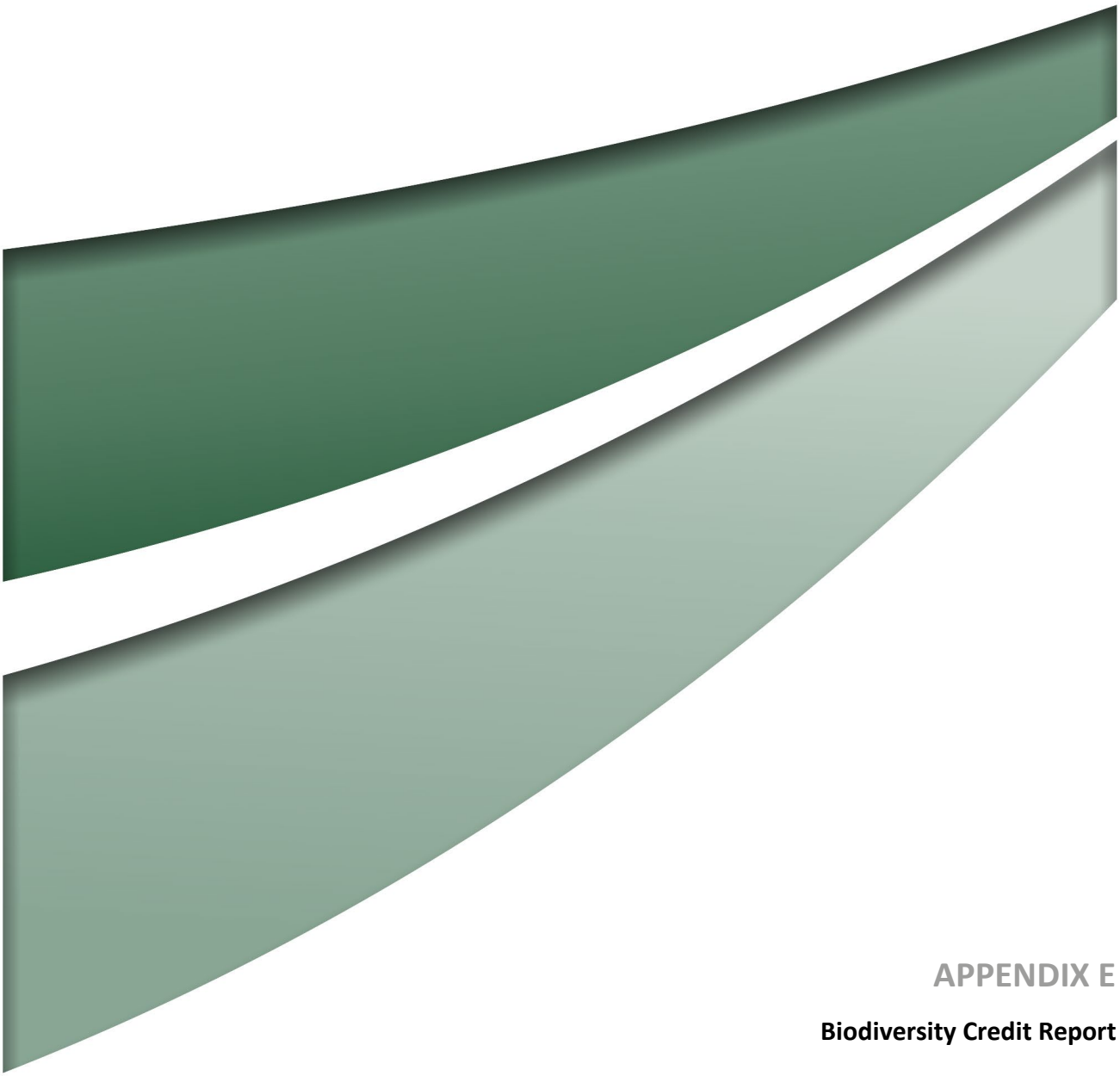
Vegetation Integrity Data

The following vegetation integrity data was collected from surveys of the Development Footprint. It includes the composition, structure and function attributes that are recorded in each BAM plot. This data is assessed against benchmark data for PCTs and entered into the BAM Calculator to assess the condition of each PCT in the Development Footprint.

The following abbreviations are used in the table below:

Tr	Tree (growth form)
Sh	Shrub (growth form)
Gr	Grass (growth form)
Fb	Forb (growth form)
Fn	Fern (growth form)
Ot	Other (growth form)

	COMPOSITION						STRUCTURE						FUNCTION										
	Tr	Sh	Gr	Fb	Fn	Ot	Tr	Sh	Gr	Fb	Fn	Ot	Regen	Stem Classes (cm)					No. Large Trees	No. Hollow Trees	Litter (%)	Fallen Logs (m)	High Threat Weeds
													>5	5-10	10-20	20-30	30-50	50-80					
Q01	3	20	8	4	1	1	6	63.2	35.5	5.3	0.1	0.1	1	1	1	1	1	1	0	0	53	10	0.2
Q02	4	25	10	5	0	1	13	61.7	18.6	0.9	0	0.1	1	1	1	1	1	1	1	0	41	11	0
Q03	3	13	5	1	1	1	5.3	21.1	6.7	0.1	98	0.1	1	1	1	1	1	1	1	0	19.0	200	0
Q04	4	21	8	4	2	2	15.5	31	34.6	2.2	2.1	0.2	1	1	1	1	0	1	0	0	57.0	38	0
Q05	4	24	12	5	2	1	60	16.5	13.9	0.5	0.2	0.1	1	1	1	1	1	1	1	1	68.0	38	0



APPENDIX E

Biodiversity Credit Report

BAM Credit Summary Report

Proposal Details

Assessment Id
00015326/BAAS18117/19/00015327

Proposal Name
Kariong Development Assessment

BAM data last updated *
24/11/2021

Assessor Name
Philippa Fagan

Report Created
27/04/2022

BAM Data version *
50

Assessor Number
BAAS18117

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	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	Sensitivity to loss (Justification)	Species sensitivity to gain class	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Ecosystem credits

Dwarf Apple - Scribbly Gum heathy low woodland on sandstone ranges of the Central Coast												
1	1641_good	Not a TEC	80.5	80.5	2.5	PCT Cleared - 44%	High Sensitivity to Potential Gain			1.50		75
											Subtotal	**75**
Heath-leaved Banksia - Coral Fern wet heath on sandstone ranges of the lower Central Coast												
3	1699_good	Coastal Upland Swamp in the Sydney Basin Bioregion	24.6	24.6	0.7	PCT Cleared - 0%	High Sensitivity to Potential Gain	Endangered Ecological Community		2.00		9
											Subtotal	**9**
Scribbly Gum - Red Bloodwood - Old Man Banksia heathy woodland of southern Central Coast												
2	1642_good	Not a TEC	69.4	69.4	2.9	PCT Cleared - 30%	High Sensitivity to Potential Gain			1.50		75
											Subtotal	**75**
											Total	**159**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	Sensitivity to loss (Justification)	Sensitivity to gain (Justification)	BC Act Listing status	EPBC Act listing status	Potential SAII	Species credits

Callistemon linearifolius / Netted Bottle Brush (Flora)									
1642_good	N/A	N/A	3			Vulnerable	Not Listed	False	5
								Subtotal	**5**
Cercartetus nanus / Eastern Pygmy-possum (Fauna)									
1641_good	80.5	80.5	2.5			Vulnerable	Not Listed	False	101
1642_good	69.4	69.4	2.9			Vulnerable	Not Listed	False	101
								Subtotal	**202**
Chalinolobus dwyeri / Large-eared Pied Bat (Fauna)									
1642_good	69.4	69.4	2.9			Vulnerable	Vulnerable	True	151
								Subtotal	**151**
Darwinia glaucophylla / Darwinia glaucophylla (Flora)									
1642_good	69.4	69.4	0.3			Vulnerable	Not Listed	False	8
1699_good	24.6	24.6	0.1			Vulnerable	Not Listed	False	1
								Subtotal	**9**
Hibbertia procumbens / Spreading Guinea Flower (Flora)									
1641_good	80.5	80.5	2.5			Endangered	Not Listed	False	101
1642_good	69.4	69.4	2.9			Endangered	Not Listed	False	101
								Subtotal	**202**
Hibbertia puberula / Hibbertia puberula (Flora)									
1641_good	80.5	80.5	2.5			Endangered	Not Listed	False	101
								Subtotal	**101**

Lathamus discolor / Swift Parrot (Fauna)									
1641_good	80.5	80.5	2.3			Endangered	Critically Endangered	True	139
1642_good	69.4	69.4	2.3			Endangered	Critically Endangered	True	120
1699_good	24.6	24.6	0.6			Endangered	Critically Endangered	True	11
								Subtotal	**270**
Myotis macropus / Southern Myotis (Fauna)									
1642_good	69.4	69.4	1.1			Vulnerable	Not Listed	False	38
								Subtotal	**38**

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