Reeves Street, Somersby

Flora and fauna assessment

Prepared for Darkinjung Local Aboriginal Land Council

August 2023

Reeves Street, Somersby

Flora and fauna assessment

Darkinjung Local Aboriginal Land Council

E230446 RP1

August 2023

Version	Date	Prepared by	Reviewed by	Comments
V1	27 June 2023	Ireni Clarke	Nathan Garvey	Draft for review
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Approved by

Nathan Garvey
Associate Director
30 August 2023

Ground floor 20 Chandos Street
St Leonards NSW 2065
PO Box 21
St Leonards NSW 1590

Executive Summary

ES1 Introduction

Darkinjung Local Aboriginal Land Council (Darkinjung) is lodging a planning proposal for the rezoning of Lot 481 DP 1184693, Reeves St, Somersby NSW (the site). The proposal includes the rezoning of the lot from C2 (Environmental Conservation) and RU2 (Rural Landscape), to C4 (Environmental Living) and C2.

ES2 Location of the project

The study area is located on the southern side of Reeves Street, Somersby, to the east of the Pacific Motorway in the Central Coast Local Government Area. The study area covers an area of 19.76 ha, and sits within an area of intact native vegetation, with some rural landholdings to the north. The site is within a corridor of native vegetation connected to Strickland State Forest in the north. To the south, Debenham Road and the Central Coast Highway separate the site from Brisbane Waters National Park.

ES3 Purpose of this assessment

This Flora and Fauna Assessment (FFA) has been prepared by EMM on behalf of Darkinjung to accompany the planning proposal. It assesses the potential biodiversity impacts of the rezoning on biodiversity values present within and adjacent to the study area. This report is presented in the format of a Biodiversity Certification Assessment Report (BCAR) and follows assessment methods outlined in the Biodiversity Assessment Method (BAM) (DPIE 2020). The information contained in this report will be used to inform an application for biodiversity certification (Biocertification) and will be used to inform the Biodiversity Certification Assessment Report (BCAR).

ES4 Process

This assessment combines the work completed by Umwelt (Australia) Pty Limited (Umwelt) on the site from 2018–2020 with additional assessments recently completed by EMM. The study area used by Umwelt has since been revised. Data collected by Umwelt has only been applied to the new study area where appropriate.

ES5 Results

ES5.1 Native vegetation

Field surveys identified four Plant Community Types (PCTs) within the development footprint, in varying conditions, outlined in Table 1.1.

Table 1.1 PCTs and vegetation zones within the development footprint

PCT	Condition	Area (ha)
PCT 3586 – Northern Sydney Scribbly Gum Woodland	High	3.64
PCT 3593 – Sydney Coastal Sandstone Bloodwood Shrub Forest	High	9.06
	Moderate	0.25
	Low	0.78
	Total	10.09
PCT 3807 – Northern Sydney Heath-Mallee	High	1.43
PCT 3924 – Sydney Coastal Upland Swamp Heath	High	4.48

ES5.2 Threatened ecological communities

One threatened ecological community (TEC) was identified within the study area: Coastal Upland Swamp in the Sydney Basin Bioregion (Coastal Upland Swamp), with all areas of PCT 3924 considered to be consistent with the community. The TEC is listed as endangered under both the BC Act and the EPBC Act. A total of 4.48 ha of the TEC has been mapped within the study area. This TEC was a key driver for the avoidance and minimisation measures taken for the site.

ES5.3 Threatened species

Five threatened species were recorded within the study area during surveys completed by Umwelt, and one species is assumed to be present:

- Glossy Black Cockatoo (foraging only)
- Giant Burrowing Frog
- Squirrel Glider
- Red-crowned Toadlet
- Spreading Guinea Flower
- Somersby Mintbush (assumed present).

One threatened species is deemed likely to occur but will be confirmed after further survey is completed, and a further seven species have potential to occur in portions of the study area where targeted surveys have not been completed or where Umwelt was not able to undertake surveys. These areas will be subjected to further survey as a part of the Biocertification process.

ES6 Avoidance and minimisation measures

Through redesigning of the development, Darkinjung have sought to avoid impacts to the key biodiversity values present in the site. The main driver of the avoidance measures has been the areas of the Coastal Upland Swamps TEC. The current design of the development footprint avoids 5.93 ha of the TEC compared to the previous iteration. Additionally, the design has focused on preserving the larger and more intact areas of Coastal Upland Swamp at the western end of the site.

As a consequence of the redesign process, the current design also avoids 10.98 ha of native vegetation overall that was included in the previous footprint. Avoidance and minimisation measures are outlined in more detail in Chapter 6 of this report.

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1 Introduction

1.1 Background

1.1.1 Project description

Darkinjung Local Aboriginal Land Council (Darkinjung) is seeking to lodge a planning proposal to rezone Lot 481 DP 1184693, Reeves St, Somersby NSW (the site) for a mix of residential housing development and conservation.

The majority of the lot is currently zoned RU2 Rural Landscape with C2 Environmental Conservation along the eastern boundary (Figure 1.1). The planning proposal will seek to rezone land subject to future development to Environmental Living (C4) while remaining land will be rezoned to Environmental Conservation (C2) (Figure 1.2). The planning proposal will also seek to amend the minimum lot size control to allow additional rural residential lots.

The proposed C4 zoning, where residential development will occur, has taken into account the key biodiversity constraints of the site, and has been sited to minimise impacts to the Coastal Upland Swamps in the Sydney Basin Bioregion endangered ecological community (EEC).

Darkinjung intends to seek biodiversity certification (Biocertification) of the C4 portion of the site in parallel with this planning proposal, with a view to having land proposed for future development Biocertified prior to any future application for subdivision. Biocertification will include preparation of a Biodiversity Certification Assessment Report (BCAR) and application to the Biodiversity Conservation Division (BCD) of the Department of Planning and Environment (DPE) for Biocertification. Biodiversity values in the remainder of the lot (outside the current study area and land proposed to be Biocertified) will be considered as part of the conservation measures proposed in the BCAR.

The biodiversity values of the site are outlined in Chapters 4 and 5 of this report, and measures taken to avoid them are detailed in Chapter 6.

1.1.2 Site location and project components

The site is located on the southern side of Reeves Street, Somersby, to the east of the Pacific Motorway in the Central Coast Local Government Area (LGA) (Figure 1.1).

The study area for this assessment comprises the area proposed for rezoning to C4, which includes the proposed residential lots and the asset protection zones (APZs) and a proposed track along the southern boundary; an indicative layout is shown in Figure 1.2. The study area covers an area of approximately 19.76 hectares (ha) and is surrounded by a mix of intact native vegetation and rural landholdings. The native vegetation within the site is connected to Strickland State Forest in the north. To the south, Debenham Road and the Central Coast Highway separate the site from Brisbane Water National Park.

1.2 Key terminology

Table 1.1 Key terms used in this report

Term	Definition
The project	The proposed rezoning and subdivision of Lot 481 Reeves St, Somersby.
The site	Used in this report to refer to Lot 481 Reeves St, Somersby, specifically in reference to previous works completed prior to this assessment. Includes the current study area, previous iterations of the study area, and surrounding areas within the lot.
Study area/development footprint	Area being assessed in this report. Includes proposed residential lots and asset protection zone (APZ).
APZ	Asset protection zone, as shown in Figure 1.2. Complete clearing is assumed within the APZ for the purposes of this report.
Proposed lots	Proposed residential lots after subdivision, as shown in Figure 1.2.
Dwelling areas	Areas within each lot that will be available for construction of dwellings, shown in Figure 1.2.

1.3 Purpose of this report

This Flora and Fauna Assessment (FFA) has been prepared to accompany the planning proposal and assesses the potential biodiversity impacts of the rezoning. As outlined in Section 1.1.1, an application for Biocertification will be progressed in parallel with the planning proposal.

For this reason, this report is presented in the format of a BCAR and follows assessment methods outlined in the Biodiversity Assessment Method (BAM) (DPIE 2020) as the information contained in this report will be applied to the subsequent BCAR.

The report combines the work completed by Umwelt (Australia) Pty Limited (Umwelt) on the site from 2018–2020, with the recent assessments completed by EMM. The study area used by Umwelt has since been revised, so the data collected by Umwelt has only been applied to the new study area where appropriate.

1.4 Information sources

1.4.1 Publications and databases

In order to provide context for the project, information about flora and fauna species, populations, communities and habitats from the locality was obtained from the following publications and databases:

- NSW BioNet for:
  - Atlas of NSW Wildlife for threatened species records
  - threatened species profiles
  - threatened biodiversity data collection (TBDC)
  - Vegetation Classification database for information on plant community types (PCTs)

- Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) Protected Matters Search Tool (PMST) for Matters of National Environmental Significance (MNES) protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) likely to occur within the study area
- Commonwealth DCCEEW Species Profile and Threats Database
- Interactive Flying-fox web viewer (DCCEEW 2021)
- New South Wales Flora Online (PlantNET)
- Register of Areas of Outstanding Biodiversity Value (AOBV) (DPE 2022a)
- NSW WeedWise (DPI 2023).

1.4.2 Other relevant reports

This assessment has been prepared with reference to the previous work and reports completed by Umwelt, prepared in earlier stages of this project and for other similar projects in the region, including:

- *Biodiversity Certification Assessment Report – Reeves Street, Somersby* (Umwelt 2020)
- *Biodiversity Assessment Report, Lake Munmorah* (Umwelt 2022).

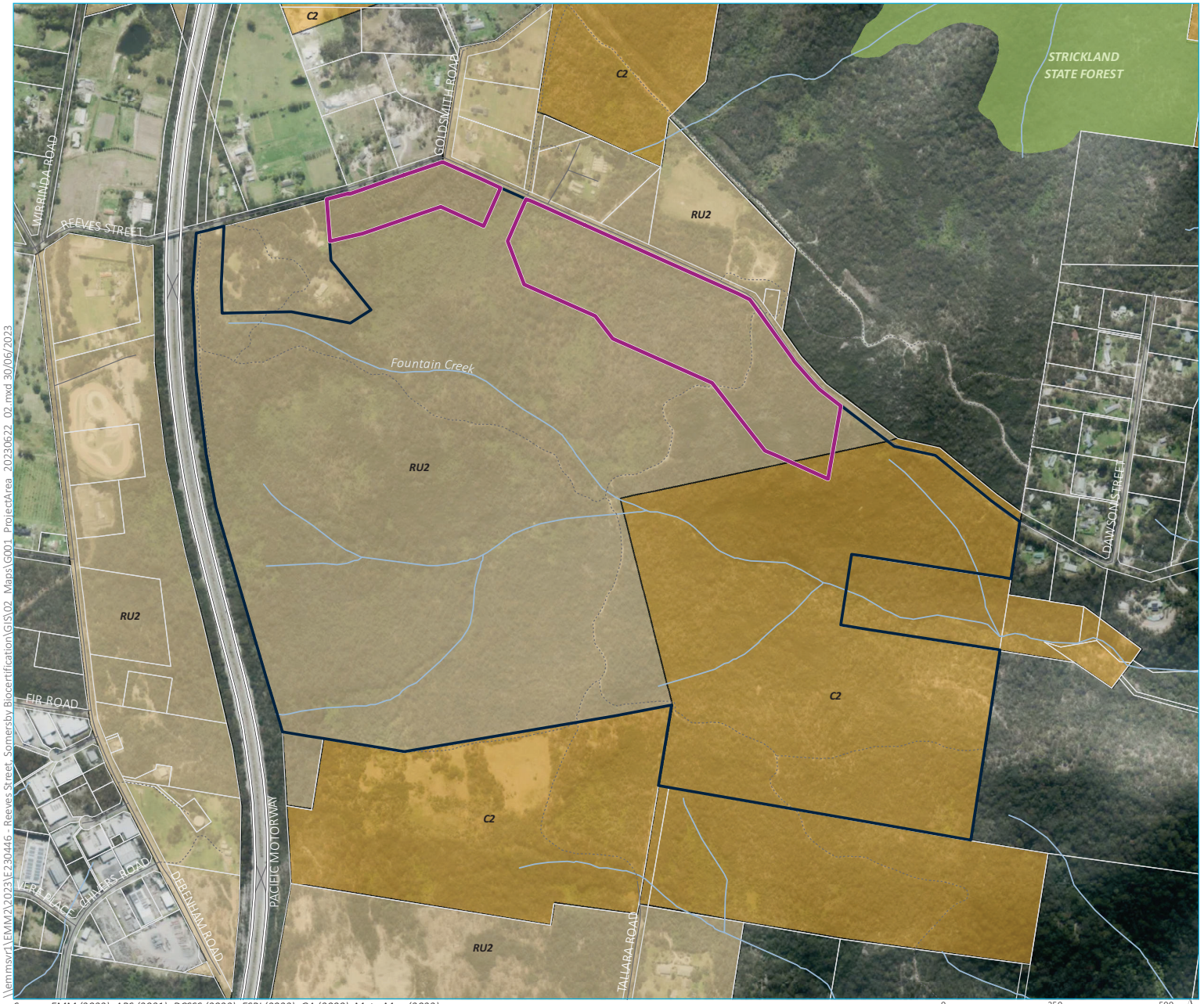
1.4.3 Spatial data

Spatial data encompassing the study area, including the proposed rezoning, lot layout, APZ locations et cetera, was obtained from Darkinjung and Coastal Planning and Consulting Pty Ltd. Data on previous flora and fauna surveys, including survey locations and records of threatened species, was obtained from Umwelt.

The following spatial datasets were reviewed in the development of this report:

- Mitchell Landscapes Version V3.1 (OEH 2017)
- Interim Biogeographic Regionalisation of Australia (IBRA) Version 7 (DoEE 2018)
- NSW State Vegetation Type Map vC1.1.M1 (DPE 2022b)
- Directory of important wetlands in Australia (DIWA) (DAWE 2021)
- Australian Ramsar Wetlands (DAWE 2022)
- LiDAR derived canopy height data (client supplied).

Mapping undertaken during the site assessment was conducted using a hand-held GPS unit, mobile tablet computers running ArcGIS Field Maps™ and Survey123 for ArcGIS™ and aerial photo interpretation. Accuracy is subject to accuracy of GPS devices, generally ± 5 m. Mapping has been produced using a Geographic Information System (GIS; ArcGIS 10.8.1).



KEY

- Lot boundary (Site)
- Study area

Existing environment

- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Cadastral boundary
- State Forest

Current zoning –

Gosford Local Environmental Plan 2014

- C2 | Environmental Conservation
- RU2 | Rural Landscape

INSET KEY

- Major road
- NPWS reserve
- State forest

Project area

Source: EMM (2023); ABS (2021); DCSSS (2023); ESRI (2023); GA (2009); MetroMap (2023)

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Figure 1.1

EMM
creating opportunities

KEY

- Study area

Project components

- Proposed lot boundaries
- Proposed dwelling area
- Proposed asset protection zone
- Proposed track

Existing environment

- Minor road
- Vehicular track
- Watercourse/drainage line
- Cadastral boundary

Current zoning –

Gosford Local Environmental Plan 2014

- C2 | Environmental Conservation
- RU2 | Rural Landscape

Proposed future zoning –

Central Coast Local Environmental Plan 2022

- C2 | Environmental Conservation
- C4 | Environmental Living

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Source: EMM (2023); DCSSS (2023); MetroMap (2023); Coastal Planning and Consulting (2023)

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GDA2020 MGA Zone 56

N

Project components

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Figure 1.2

EMM
creating opportunities

2 Legislation

2.1 Commonwealth

The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, heritage places and water resources which are defined as Matters of National Environmental Significance (MNES) under the EPBC Act. These are:

- World Heritage properties
- places listed on the National Heritage Register
- Ramsar wetlands of international significance
- threatened flora and fauna species and ecological communities
- migratory species
- Commonwealth marine areas
- the Great Barrier Reef Marine Park
- nuclear actions (including uranium mining)
- water resources, in relation to coal seam gas or large coal mining development.

Under the EPBC Act, an action that may have a significant impact on a MNES is deemed to be a 'controlled action' and can only proceed with the approval of the Commonwealth Minister for the Environment. An action that may potentially have a significant impact on a MNES is to be referred to DCCEEW for determination as to whether or not it is a controlled action. If deemed a controlled action, the project is assessed under the EPBC Act and a decision made as to whether or not to grant approval.

An assessment of the project against the EPBC Act is provided in Chapter 8.

2.2 State

2.2.1 Environmental Planning and Assessment Act 1979

The NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) was enacted to encourage the consideration and management of impacts of proposed development or land-use changes on the environment and the community. The EP&A Act is administered by the NSW Department of Planning, Industry and Environment (DPIE).

The EP&A Act provides the overarching structure for planning in NSW; however, it is supported by other statutory environmental planning instruments (EPIs) including State Environmental Planning Policies (SEPPs). As the project does not involve a development application, no EPIs are relevant to this report.

2.3 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) is the legislation responsible for the conservation of biodiversity in NSW through the protection of threatened flora and fauna species, populations and ecological communities. The BC Act, together with the Biodiversity Conservation Regulation 2017 (BC Regulation), established the Biodiversity Offsets Scheme (BOS).

The BOS includes establishment of the BAM (DPIE 2020) for use by accredited persons in biodiversity assessment under the scheme. The purpose of the BAM is to assess the impact of actions on threatened species and threatened ecological communities, and their habitats and determine offset requirements.

The BAM sets out the requirements for a repeatable and transparent assessment of terrestrial biodiversity values on land in order to:

- identify the biodiversity values on land subject to proposed development area
- determine the impacts of a proposed development, following all measures to avoid, minimise and mitigate impacts
- quantify and describe the biodiversity credits required to offset the residual impacts of proposed development on biodiversity values.

This biodiversity assessment has been undertaken in accordance with the requirements of the BAM.

Part 8 of the BC Act sets out a method for Biocertification of land, with the effect of Biocertification being that:

> A consent authority, when determining a development application in relation to development on biodiversity certified land under Part 4 of the *Environmental Planning and Assessment Act 1979*, is not required to take into consideration the likely impact on biodiversity of the development carried out on that land
>
> (Section 8.4 of the BC Act).

As outlined above, Darkinjung intends to seek Biocertification of the land proposed for rezoning to C4.

3 Landscape context

The identification of landscape features was undertaken in accordance with Section 3 of the BAM (DPIE 2020), and results are summarised in Table 3.1 below.

Table 3.1 Landscape features

Landscape feature	Presence within the study area
IBRA bioregion	Sydney Basin
IBRA subregion	Pittwater
BioNet NSW landscapes (formerly Mitchell landscapes)	Somersby Plateau
Rivers, streams and estuaries	The study area does not support any waterways. Fountain Creek is located within the site, to the south of the study area. The creek flows west to east, starting as a first order stream at the western edge of the lot, and is mapped as second order at the eastern boundary of the lot.
Wetlands	Brisbane Water estuarine wetland is located approximately 3.5 km south-east of the study area.
Connectivity of different areas of habitat	The native vegetation within the site is connected to Strickland State Forest in the north and Brisbane Water National Park to the south. Debenham Road and the Central Coast Highway fragment the site from the National Park.
Areas of geological significance and soil hazard	None identified
Areas of outstanding biodiversity value	None identified

4 Native vegetation

4.1 Background review

A review of desktop information was undertaken to obtain a broad understanding of the regional vegetation types within the locality of the study area. This included a review of the following data sources and reference literature:

- PCT mapping completed by Umwelt (2020)
- NSW State Vegetation Type Map vC1.1.M1 (DPE 2022b)
- Bionet PCT Lineage History Data for conversion of former PCTs to revised PCTs and associated threatened Ecological Communities (TECs).

Native vegetation at the site was assessed by Umwelt in 2020. Umwelt's assessment included BAM plots and the development of a PCT map. Three PCTs were identified by Umwelt within the study area, split into four vegetation zones to include a range of condition states.

Revised PCTs for eastern NSW have been introduced since the completion of Umwelt's assessments. EMM converted the PCTs mapped by Umwelt to the revised PCTs using lineage information in the Bionet Vegetation Classification database (see above). The potential new PCTs present in the study area align with the PCTs identified in the State Vegetation Type Map, although extent and boundaries between PCTs are different. PCTs were validated during field surveys (methods described in more detail in Section 4.2.2).

4.2 Methods

4.2.1 Field survey dates and tasks

Vegetation surveys were conducted on the dates outlined in Table 4.1.

Table 4.1 Vegetation surveys

Dates	Surveys completed
27 to 29 August 2018	Floristic and vegetation integrity surveys (Umwelt)
31 October 2018	Floristic and vegetation integrity surveys (Umwelt)
22 and 23 January 2019	Floristic and vegetation integrity surveys (Umwelt)
27 March 2019	Floristic and vegetation integrity surveys (Umwelt)
2 and 4 April 2019	Floristic and vegetation integrity surveys (Umwelt)
27 and 28 November 2019	Floristic and vegetation integrity surveys (Umwelt)
24 and 25 March 2020	Floristic and vegetation integrity surveys (Umwelt)
11 November 2022	Vegetation mapping and RDP surveys (EMM)
15 and 16 May 2023	Vegetation mapping and RDP surveys (EMM)

4.2.2 Vegetation mapping and stratification

i Survey effort by Umwelt

Initial vegetation surveys were undertaken by Umwelt between August 2018 and March 2020, and included mapping of PCTs and vegetation zones, rapid vegetation assessments and collection of plot data in accordance with the BAM (Umwelt 2020).

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
- ground-truthing of the vegetation map based on survey effort
- 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.

Each of the vegetation communities recorded were aligned with an equivalent PCT as detailed in the VIS Classification Database. For each vegetation community, 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.

Plot data was collected from the study area by Umwelt. At each plot location the following was undertaken:

- one 20 x 20 m plot, for assessment of composition and structure
- one 20 x 50 m plots for assessment of function, including a series of five 1 x 1 m plots to assess average leaf litter cover.

The assessment of composition and structure, based on a 20 x 20 m plot, recorded species name, stratum, growth form, cover and abundance rating for each species present within the plot. Cover (foliage cover) was estimated for all species rooted in or overhanging the plot, and recorded using decimals (if less than 1%, rounded to whole number (1–5%) or estimated to the nearest 5% (5–100%). Abundance was counted (up to 20) and estimated above 20, and recorded using the following intervals: 1, 2, 3, 4, 5, 10, 20, 50, 100, 500, 1,000, 1,500, 2,000 et cetera.

The assessment of function recorded the number of large trees, the presence of tree stem size class, tree regeneration, number of trees with hollows and length of fallen logs, as well as leaf litter cover within the 20 x 50 m plot and five 1 x 1 m subplots. The minimum number of plots and transects per vegetation zone was determined using Table 3 of the BAM (DPIE 2020). A total of nine plots were undertaken within the former development footprint with seven now within the revised study area.

ii Survey effort by EMM

An initial field survey by EMM noted that the mapping of the Coastal Upland Swamps by Umwelt across the study area and broader site did not conform to the distribution of this community on the ground. This, combined with the introduction of the revised PCTs for eastern NSW, resulted in additional surveys being undertaken by EMM between November 2022 and May 2023.

To more reliably determine the potential extent of the Coastal Upland Swamps, a canopy Height model (CHM) was developed using Light Detection and Ranging (LiDAR) data. The potential extent of Coastal Upland Swamps was determined by mapping areas without any canopy where the extent exceeded 0.1 ha.

This existing PCT mapping and mapping of potential Coastal Upland Swamps was used as the basis for vegetation validation and mapping surveys undertaken by EMM. During these surveys, PCT classification and linework were updated, where required, as informed by a combination of aerial photograph interpretation, ground truthing in the field, and potential Coastal Upland Swamps mapping derived from the CHM. Vegetation validation and mapping surveys were undertaken across the study area on 15 and 16 May 2023. Vegetation was mapped using the following techniques:

- meander surveys on foot to ground-truth PCT boundaries and collect rapid data (or vegetation validation) points
- delineation of boundaries of Coastal Upland Swamps by streaming swamp edges on foot, using a GPS-enabled tablet computer using ArcGIS Field Maps™
- rapid data point (RDP) assessments to collect information on dominant floristic composition and structure and other relevant observations such as landscape position and soil type
- review of BAM plot data collected by Umwelt to inform the vegetation mapping and stratification
- desktop refinement of boundaries and PCT allocations, using BAM plot and RDP data, aerial imagery and potential Coastal Upland Swamps derived from the CHM.

Each of the vegetation communities was aligned with an equivalent PCT as detailed in the BioNet Vegetation Classification database. For each community, the dominant and characteristic species were compared to those listed in the potential PCTs identified for the site. The profiles for each of the possible PCTs were then interrogated and the most appropriate match assigned based on floristics, vegetation structure, soil, landform, and distribution details.

PCTs were stratified into vegetation zones based on broad condition states. As a guide, the descriptions in Table 4.2 were used to identify vegetation zones for each PCT.

Table 4.2 Description of broad condition states

Condition class	Description
High	Vegetation is largely intact with all strata present and minimal disturbance.
Moderate	Vegetation is largely intact with all strata present, but with some disturbance such as invasive species or evidence of previous clearing activities.
Low	Vegetation is disturbed with some strata missing or highly disturbed, due to the presence of invasive species or other disturbances.

4.2.3 Identification of TECs

PCTs recorded in the study area and broader site were compared to TECs listed under the EPBC Act or BC Act. The following approach was used:

- a review of PCT and TEC associations based on the PCT-Threatened Ecological Communities (TEC) associations data in the BioNet Vegetation Classification
- a review of TECs predicted to occur based on the BioNet Atlas of NSW Wildlife
- a review of relevant NSW Scientific Committee Final Determinations or Commonwealth Threatened Species Scientific Committee Listing and Conservation Advice.

Two threatened ecological communities were identified as potentially occurring in the study area. An assessment of these PCTs against the TEC listings is provided in Section 4.3.4.

4.3 Results

4.3.1 Vegetation description

The study area contains a mix of shrubby woodland and heath vegetation communities, on a gentle southeast-facing slope. The study area is located in an area of Hawkesbury sandstone, with higher elevation areas containing exposed ironstone. Soils vary from deeper sandy loam soils on the upper slopes, to shallow sandy soils on lower sandstone shelves, and sandy peat soils in swampy areas where the hydrology is impeded.

The higher elevation areas occur near Reeves Street, along the norther boundary of the site. In these areas, the canopy of the woodland community is taller and with a mix of eucalypt species including Red Bloodwood (*Corymbia gummifera*), Scribbly Gum (*Eucalyptus haemastoma*), Silvertop Ash (*Eucalyptus sieberi*), Sydney Red Gum (*Angophora costata*) and Stringybark species (*Eucalyptus agglomerata* and *Eucalyptus capitellata*). There is a dense and diverse shrub layer in these areas.

Further down the slope in areas with sandy soil, the canopy thins out into a more open woodland community with a canopy dominated by Scribbly Gum (*Eucalyptus haemastoma*) with the occasional Red Bloodwood (*Corymbia gummifera*) and Dwarf Apple (*Angophora hispida*). These areas have a lower and less dense canopy and lower shrub heights.

In low lying areas of the site and along drainage lines where hydrology is impeded, there are upland swamp heath communities, with little to no canopy cover and a dense ground cover of mesic species such as sedges and ferns.

The vegetation in the study area is generally in good condition with minimal disturbance evident. In the western corner of the site, near Reeves Street, the introduction of Radiata Pines (*Pinus radiata*) has shaded out the understorey and disturbed the structure and composition of the native vegetation. The pines are spreading east into more intact native vegetation, in an area that maintains a predominantly native canopy and midstorey. In this area there is also evidence of previous clearing, with mature trees pushed over and the shell of a car within dense shrubs, suggesting it was once open enough to drive through. Further to the east, there is an area of disturbed vegetation associated with a drain that runs under Reeves St to the south. The drain has affected the hydrology of the area such that there are tree ferns present and a high proportion of invasive species immediately downhill of the drain.

4.3.2 Plant community types and vegetation zones

Four PCTs are identified within the study area:

- PCT 3586 – Northern Sydney Scribbly Gum Woodland
- PCT 3593 – Sydney Coastal Sandstone Bloodwood Shrub Forest
- PCT 3807 – Northern Sydney Heath-Mallee
- PCT 3924 – Sydney Coastal Upland Swamp Heath.

The vegetation mapping is broadly consistent with the mapping produced by Umwelt (2020), but PCTs have been converted to the revised PCTs for eastern NSW, and linework has been reviewed and refined based on the CHM and additional field surveys (see Section 4.2.2ii).

The PCTs outlined above were stratified into six vegetation zones, aligning with the different condition classes present in the study area (Table 4.3).

Table 4.3 PCTs and vegetation zones mapped in the study area

PCT ID	PCT Name	Condition	Extent within study area (ha)
3586	Northern Sydney Scribbly Gum Woodland	High	3.64
3593	Sydney Coastal Sandstone Bloodwood Shrub Forest	High	9.06
		Moderate	0.25
		Low	0.78
3807	Northern Sydney Heath-Mallee	High	1.43
3924	Sydney Coastal Upland Swamp Heath	High	4.48

The PCTs identified are described in the following tables and shown in Figure 4.1.

Table 4.4 PCT 3586 – Northern Sydney Scribbly Gum Woodland

Attribute	Description
PCT ID	3586
Common name	Northern Sydney Scribbly Gum Woodland
Vegetation formation	Dry Sclerophyll Forests (Shrubby sub-formation)
Vegetation class	Sydney Coastal Dry Sclerophyll Forests
Description	This community is a sclerophyll woodland found on Hawkesbury sandstone ridgetops of the Hornsby plateau to the north of Sydney. The community occurs on lower sandstone shelves within the study area with shallow sandy soils. Sandstone capping is exposed in some areas. The canopy is stunted and low- to mid-density, comprising mostly Scribbly Gum (*Eucalyptus haemastoma*), but also containing Red Bloodwood (*Corymbia gummifera*) and Dwarf Apple (*Angophora hispida*). The mid-stratum contains a diverse and dense shrub layer, including Heath-leaved Banksia (*Banksia ericifolia*), Fern-leaved Banksia (*Banksia oblongifolia*) Old Man Banksia (*Banksia serrata*), Sweet Wattle (*Acacia suaveolens*), *Platysace linearifolia*, Conesticks (*Petrophile pulchella*), Slender Tea-tree (*Leptospermum trinervium*), Sunshine Wattle (*Acacia terminalis*) and multiple other species from the genera Pimelea, Boronia, Darwinia and Persoonia. The ground layer contains a mix of grasses, forbs and sedges, including Lesser Flannel Flower (*Actinotus minor*), Wiry Panic (*Entolasia stricta*), Curly Wig (*Caustis flexuosa*), *Bossiaea scolopendria* and *Dampiera stricta*.
Location	PCT 3586 occurs on lower areas of the study area with shallow sandy soils (Figure 4.1). In some areas, it appears to be an intergrade between taller Red Bloodwood (*Corymbia gummifera*) woodland and upland swamps, in areas with shallow and drier soils, leading to a heath-mallee formation.
Extent within study area	3.64 ha
Survey effort	Two BAM plots completed by Umwelt, with additional RDP data collected by EMM.
Condition description	This community is relatively undisturbed throughout the study area and has only been mapped as one condition state – High. All vegetation strata are intact and floristically diverse, with little to no weed incursions.
Justification of evidence and species used to identify the PCT	This community fits the description for PCT 3586 in the BioNet Vegetation Classification database, being a mid-high sclerophyll woodland with a diverse heathy shrub layer. The community contains a high proportion of the characteristic species listed in the PCT description and is located on a sandstone ridgetop of the Hornsby Plateau as per the description. The canopy layer is dominated by Scribbly Gum (*Eucalyptus haemastoma*) with the occasional Red Bloodwood (*Corymbia gummifera*). The canopy occurs at a lower density and height than the taller shrubby woodland further up the slopes in the study area (PCT 3593). Characteristic species such as Dwarf Apple (*Angophora hispida*) were recorded within this community and not in adjacent areas. The midstorey contains many of the characteristic species listed in BioNet, such as Heath-leaved Banksia (*Banksia ericifolia*), Fern-leaved Banksia (*Banksia oblongifolia*), Old Man Banksia (*Banksia serrata*), Slender Tea-tree (*Leptospermum trinervium*), and Conesticks (*Petrophile pulchella*). This community was mapped as distinct from the adjacent PCT 3593 based on its lower and more open canopy, and less diverse canopy species composition containing largely Scribbly Gum (*Eucalyptus haemastoma*), and its position at lower elevations of the site with shallow sandy soil.
Status	Not a TEC. This PCT is not associated with any TECs.
Estimate of percent cleared value of PCT	14.99%

Photograph 4.1 PCT 3586 within the study area

Table 4.5 PCT 3593 – Sydney Coastal Sandstone Bloodwood Shrub Forest

Attribute	Description
PCT ID	3593
Common name	Sydney Coastal Sandstone Bloodwood Shrub Forest
Vegetation formation	Dry Sclerophyll Forests (Shrubby sub-formation)
Vegetation class	Sydney Coastal Dry Sclerophyll Forests
Description	This community is a tall, heathy sclerophyll woodland found on coastal plateaus around Sydney. It is known to occur on exposed residual ironstone and Hawkesbury sandstone crests and slopes. The canopy contains a mix of Eucalypt species, dominated by Red Bloodwood (*Corymbia gummifera*), Scribbly Gum (*Eucalyptus haemastoma*) and Silvertop Ash (*Eucalyptus sieberi*), as well as Stringybark species (*E. agglomerata* and *E. capitellata*) and Sydney Red Gum (*Angophora costata*). The mid-stratum contains a mix of small trees such as Old Man Banksia (*Banksia serrata*) and Slender Tea-tree (*Leptospermum trinervium*) as well as a layer of smaller shrubs including Sweet Wattle (*Acacia suaveolens*), Broad-leaved Geebung (*Persoonia levis*), Needlebush (*Hakea sericea*), Heath-leaved Banksia (*Banksia ericifolia*), Tantoon (*Leptospermum polygalifolium*) and multiple other species from the genera Isopogon, Pimelea, Petrophile, and Epacris. The ground layer contains a sparse mix of grasses and forbs, including Lesser Flannel Flower (*Actinotus minor*), Screw fern (*Lindsaea linearis*), *Lepyrodia scariosa* and *Baloskion* sp.
Location	PCT 3593 is found on more elevated sections of the study area with deeper sandy soils, along the length of Reeves Street (see Figure 4.1).
Extent within study area	10.09 ha
Survey effort	Three BAM plots completed by Umwelt, additional RDP data collected by EMM.
Condition description	This PCT occurs in four condition states across the study area (see Figure 4.1). The majority of the PCT is in good condition, with low disturbance levels, and every stratum intact. These areas have been mapped as High condition. In the western corner of the study area, adjacent to Reeves Street, there is an area that contains large Radiata Pines (*Pinus radiata*) in the canopy. In the far western section, there is a higher proportion of pines in the canopy, although characteristic species such as Scribbly Gum (*Eucalyptus haemastoma*), Red Bloodwood (*Corymbia gummifera*) and Silvertop Ash (*Eucalyptus sieberi*) are also present. The diversity of the midstorey and ground layer are reduced due to shading effects, but native species such as Tantoon (*Leptospermum polygalifolium*), Sweet Pittosporum (*Pittosporum undulatum*), Conesticks (*Petrophile pulchella*), Heath-leaved Banksia (*Banksia ericifolia*), and Narrow-leaved Geebung (*Persoonia linearis*) are present. The ground layer is largely covered in needles, although some native species are present. This area is mapped as Low condition. Between the area dominated by pines in the west, and more intact vegetation to the east, is an area mapped as Moderate condition. This area contains Radiata Pines (*Pinus radiata*) in the canopy layer but at a much lower density. There is evidence of past disturbance with the canopy of Eucalyptus spp. generally lacking, but there is a more intact midstorey, with a high density of native shrubs dominated by Tantoon (*Leptospermum polygalifolium*). A drain running under Reeves St has introduced invasive species and altered the hydrology of an area that has been mapped as Low condition. Invasive species including Pampas Grass, Lantana and Crofton Weed are prevalent, and the canopy layer is reduced, potentially due to the change in hydrology.

Table 4.5 PCT 3593 – Sydney Coastal Sandstone Bloodwood Shrub Forest

Attribute	Description
Justification of evidence and species used to identify the PCT	The areas of PCT 3593 within the study area are a good fit for the community described in the BioNet Vegetation Classification database, being a tall heathy sclerophyll open forest, located on a coastal plateau of Hawkesbury sandstone with exposed residual ironstone present. The PCT is known to occur on the margins of the Somersby Plateau. The canopy contains all the key species mentioned in BioNet, comprising a high proportion of Red Bloodwood (*Corymbia gummifera*), as well as a mix of Scribbly Gum (*Eucalyptus haemastoma*), stringybarks, Sydney Red Gum (*Angophora costata*) and Silvertop Ash (*Eucalyptus sieberi*). The community has a diverse mid storey, again including all the key species described in BioNet, such as Old Man Banksia (*Banksia serrata*), Slender Tea-tree (*Leptospermum trinervium*), Mountain Devil (*Lambertia formosa*) and Broad-leaved Geebung (*Persoonia levis*). This community was mapped as distinct from the adjacent PCT 3586 based on its taller and denser canopy, more diverse canopy species composition containing a higher proportion of Red Bloodwood (*Corymbia gummifera*), and its position at higher elevations of the site with deeper soil.
Status	Not a TEC. The community is associated with Duffy's Forest Ecological Community in the Sydney Basin Bioregion, listed as endangered under the BC Act. However, vegetation in the study area is not considered to form part of the TEC (see Section 4.3.4b).
Estimate of percent cleared value of PCT	19.25%

Photograph 4.2 PCT 3593: Low condition

Photograph 4.3 PCT 3593: High condition

Table 4.6 PCT 3807 – North Sydney Heath Mallee

Attribute	Description
PCT ID	3807
Common name	North Sydney Heath Mallee
Vegetation formation	Heathlands
Vegetation class	Sydney Coastal Heaths
Description	This community can be a tall heathland or closed heathland, mallee shrubland or low sclerophyll woodland with a dense heathy mid stratum, known from across the Hornsby Plateau. Within the study area, the community is a tall, closed heath community dominated by Heath-leaved Banksia (*Banksia ericifolia*). The community is known from exposed skeletal sandstone soils along ridges, outcrops and pavements. Within the study area, it has been mapped on a low lying sandstone pavement with shallow sandy soils. The community is mapped adjacent to areas of upland swamp, but the soils are too thin and are not wet enough to support a more mesic swamp community. There is no canopy layer except for the occasional emergent Scribbly Gum (*Eucalyptus haemastoma*) and Red Bloodwood (*Corymbia gummifera*). In the mid storey, Heath-leaved Banksia (*Banksia ericifolia*) is dominant and extremely dense, leading to a decrease in species complexity in lower layers.
Location	PCT 3807 is mapped in lower lying areas of the study area with sandy soils, adjacent to swamps but without the appropriate soil hydrology (Figure 4.1).
Extent within study area	1.43 ha
Survey effort	No plots completed by Umwelt, RDPs only.
Condition description	The extent of this community within the study area is relatively undisturbed and has only been mapped as one condition state – High. There is no evidence of disturbance and little to no weed incursions.
Justification of evidence and species used to identify the PCT	This community fits the description for PCT 3807 in the BioNet Vegetation Classification database, being a tall, closed heathland with emergent eucalypts on the Hornsby Plateau. It is known to grade into both PCT 3586 and PCT 3593 (both mapped on site) with changes in soil and hydrology. This community was mapped as distinct from the adjacent PCT 3593 based on the changes in vegetation strata. PCT 3807 has no dominant eucalypt canopy, and an extremely dense layer of Heath-leaved Banksia (*Banksia ericifolia*) (see Photograph 4.4). As outlined above, this community has been differentiated from PCT 3924 on the basis of its occurrence on drier, shallow, sandy soils in areas where hydrological conditions are not conducive to the formation of Coastal Upland Swamps. These areas generally lack the sedges and rushes seen in PCT 3924.
Status	Not a TEC. This PCT is not associated with any TECs.
Estimate of percent cleared value of PCT	5.1%

Photograph 4.4 PCT 3807

Table 4.7 PCT 3924 – Sydney Coastal Upland Swamp Heath

Attribute	Description
PCT ID	3924
Common name	Sydney Coastal Upland Swamp Heath
Vegetation formation	Freshwater Wetlands
Vegetation class	Coastal Heath Swamps
Description	This community is a tall heathland or closed heathland with a dense cover of sedges and little to no eucalypt emergents. It occurs on lower lying areas of the site with damp, sandy peat soils on that can support mesic species. Within the study area the canopy layer is largely absent, with only the occasional emergent Eucalypt. In some areas, the midstorey is dominated by Heath-leaved Banksia (*Banksia ericifolia*) with other midstorey species including Tantoon (*Leptospermum polygalifolium*), Mountain Devils (*Lambertia formosa*), Conesticks (*Petrophile pulchella*) and Dagger Hakea (*Hakea teretifolia*). The ground layer contains a mix of ferns, sedges and rushes, such as Pouched Coral Fern (*Gleichenia dicarpa*), Spreading Rope-rush (*Empodisma minus*), *Lepyrodia scariosa*, Screw Fern (*Lindsaea linearis*) and *Cassytha glabella*.
Location	PCT 3924 is found in the low-lying areas of the study area and sandy peat soils (Figure 4.1). The PCT occurs where hydrology has been impeded, leading to damp soils that can support the characteristic species.
Extent within study area	4.48 ha
Survey effort	Two BAM plots completed by Umwelt, additional RDP data collected by EMM.
Condition description	The extent of this community within the study area is relatively undisturbed and has only been mapped as one condition state – High. There is no evidence of disturbance and little to no weed incursions. There is some variation in the species composition of this PCT within the study area and broader site, likely driven by soil moisture and depth. In some areas, on shallower soils and lower moisture levels, this PCT occurs as a mosaic with surrounding woodlands. In these areas boundaries are difficult to differentiate, likely with a dynamic boundary depending on prevailing climatic conditions. In other areas, with deeper soils and higher moisture content, the boundaries between this PCT and surrounding woodlands is stark and clear.
Justification of evidence and species used to identify the PCT	This community was identified based on the structure of vegetation (little to no canopy), the presence of key mid- and understorey species such as Heath-leaved Banksia (*Banksia ericifolia*), Dagger Hakea (*Hakea teretifolia*) and Spreading Rope-rush (*Empodisma minus*), soil texture and moisture content, hydrology, and position within the landscape.
Status	Associated with Coastal Upland Swamp in the Sydney Basin Bioregion, listed as endangered under the BC Act and the EPBC Act. Vegetation in the study area is consistent with the TEC (see Section 4.3.4a).
Estimate of percent cleared value of PCT	2.95%

Photograph 4.5 PCT 3924: High condition

Photograph 4.6 PCT 3924: boundary of swamp and woodland

4.3.3 Exotic vegetation

While no areas have been mapped as exotic vegetation, some areas of the site contain exotic species. The vegetation zones adjacent to Reeves Street contain mature Radiata Pine (*Pinus radiata*) as part of the canopy layer. A number of weeds recorded within the study area are classed as High Threat Weed species under the BAM, including:

- Radiata Pine (*Pinus radiata*)
- Crofton Weed (*Ageratina adenophora*)
- Pampas Grass (*Cortaderia* sp.)
- Blackberry (*Rubus fruticosus* species aggregate)
- Whiskey Grass (*Andropogon virginicus*).

4.3.4 Threatened ecological communities

Two threatened ecological communities (TECs) are associated with the PCTs identified within the study area.

PCT 3924 is associated with the Coastal Upland Swamp in the Sydney Basin Bioregion. This community is listed as endangered under the BC Act and the EPBC Act. An assessment of PCT 3924 against the BC Act and EPBC Act communities is provided in Section 4.3.4a. This assessment determined that areas of PCT 3924 are consistent with the Coastal Upland Swamp EEC (Table 4.8).

Table 4.8 TECs within the study area

TEC name	BC Act status	EPBC Act status	Associated vegetation zones within the study area	Area within study area (ha)
Coastal Upland Swamp in the Sydney Basin Bioregion	Endangered	-	3924_High	4.48
Coastal Upland Swamps in the Sydney Basin Bioregion	-	Endangered	3924_High	4.48

PCT 3593 is associated with the Duffy's Forest Ecological Community in the Sydney Basin Bioregion. This community is listed as Endangered under the BC Act only. An assessment of PCT 3593 against the BC Act listed community is provided in Section 4.3.4b (DPE 2021a). Although PCT 3593 is associated with this TEC, the study area is outside the known distribution of the community and does not contain the correct geology for the TEC to occur (NPWS 2004).

a Coastal Upland Swamp in the Sydney Basin Bioregion

PCT 3924 is associated with Coastal Upland Swamp in the Sydney Basin Bioregion (Coastal Upland Swamp), listed as endangered under the BC Act and the EPBC Act. The criteria for the BC Act listing and the EPBC Act listing are very similar and have been combined and analysed in Table 4.9 (DPE 2021b, DoE 2014). This analysis determined that all areas mapped as PCT 3924 are representative of the Coastal Upland Swamp TEC as listed under both the BC Act and EPBC Act.

Table 4.9 Criteria for determining presence of Coastal Upland Swamp in the Sydney Basin Bioregion

Criteria from Conservation advice	Discussion
Located on Somersby-Hornsby Plateaux in the north to the Woronora plateau and Robertson in the south.	The study area is located on the Somersby plateau.
Occurs on sandstone plateaus, in headwater valleys of streams on a sandstone bench.	The study area consists of a sandstone plateau with the Coastal Upland Swamps mapped on a series of low relief sandstone benches.
Occurs at 200–450 metres above sea level.	The study area is located at 230 m to 160 m ASL.
Areas of impeded hydrology and evidence of waterlogged soil.	Areas mapped as PCT 3924 occur on low relief sandstone benches were flow of water is likely to be impeded by this low relief. This has led to the build-up of organic material in the soil, increasing impediment of drainage.
Mostly treeless, with the occasional scattered individual or isolated clumps of eucalypts.	Vegetation in the study area is treeless with only occasional emergent Eucalypts.
An indicative list of vascular plant species characteristic of the Coastal Upland Swamps is given in Table 1 of the Conservation Advice (DoE 2014).	At least 12 characteristic species were recorded in the plots completed by Umwelt in mapped areas of Coastal Upland Swamps. Key species within the swamp are absent /uncommon in the surrounding landscape (e.g., *Gleichenia* sp., Spreading Rope-rush (*Empodisma minus*)).

b Duffy's Forest Ecological Community in the Sydney Basin Bioregion

PCT 3593 is associated with Duffy's Forest Ecological Community in the Sydney Basin Bioregion (Duffy's Forest), listed as endangered under the BC Act.

An assessment was undertaken of species recorded across PCT 3593 during plot surveys undertaken by Umwelt (2020) to the list of diagnostic species identified in Smith and Smith (2000) for the Duffy's Forest EEC and associated Sandstone Ridgetop Woodland. This analysis found that only six of the 95 species recorded in the plots were either positively or negatively diagnostic for Duffy's Forest EEC or Sandstone Ridgetop Woodland (Table 4.10). A Duffy's Forest Index (DFI) was calculated using the equation from Smith and Smith (2000), which is replicated below.

$$DFI = \frac{100(x + (20 - y))}{40}$$

Notes: x = number of positive diagnostic species

y = number of negative diagnostic species

The same value was calculated for Sandstone Ridgetop Woodland and the "vegetation community that a particular stand of vegetation most closely resembles is then indicated by which of the three indices has the highest value" (Smith and Smith 2000, p. 16).

Table 4.10 Diagnostic assessment for Duffy's Forest EEC (in accordance with Smith and Smith 2000)

	Duffy's Forest EEC	Sandstone Ridgetop Woodland
Positive species	3	1
Negative species	2	1
Duffy's Forest Index	52.5	50

Given the small number of diagnostic species recorded and relatively similar DFI numbers, this test is considered non-conclusive. In their assessment, Smith and Smith (2000) placed one site with similar results (Site 40 LY) into Sandstone Ridgetop Woodland rather than Duffy's Forest EEC. In their assessment Smith and Smith (2000) also looked at vegetation in Somersby. They found that the vegetation they assessed in Somersby "has closer affinity with Sydney Sandstone Ridgetop Woodland than with Duffy's Forest" (Smith and Smith 2000, p. 35).

Although the species composition within the study area somewhat aligns with the diagnostic species in Smith and Smith (2000), further analysis was undertaken against the criteria from the final determination (DPE 2021a). Details of the criteria used are included in Table 4.11.

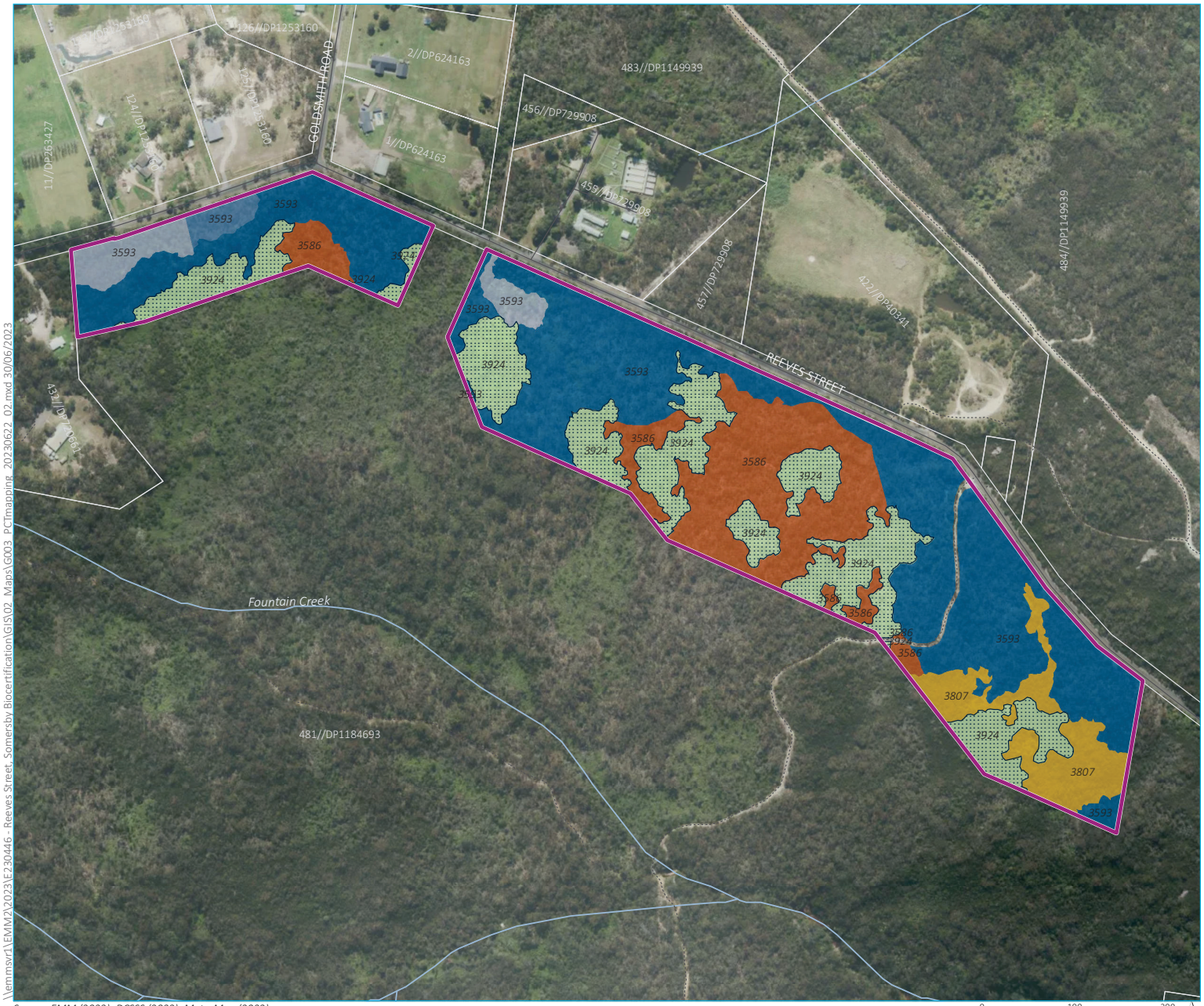
Table 4.11 Criteria for determining presence of Duffy's Forest

Criteria from final determination	Discussion
Occurs on ridgetops, plateaus, upper slopes and occasionally mid slopes on Hawkesbury sandstone geology, typically in association with laterite soils and soils derived from shale and laminite lenses.	The study area is located in Hawkesbury sandstone. There is no evidence of laminite or shale lens within the disturbance footprint. Some areas contain exposed ironstone and lateritic soils occur more broadly across the Somersby site, outside the disturbance footprint.
Reported from the Warringah, Pittwater, Ku-ring-gai, Hornsby and Manly Local Government Areas, although it may occur elsewhere in the Sydney Basin Bioregion.	The study area is not located within the listed Local Government Areas. The study area is not included in the extent of Duffy's Forest mapped by NPWS (2004).
Characteristic assemblage of vascular plants.	45 of the 73 species listed in the determination were recorded in areas of PCT 3593 in the study area.

Based on the above, it is considered unlikely that the TEC is present at the site for the following reasons:

- Vegetation is characteristic of a transitional zone, representing characteristics of both Duffy's Forest EEC and adjacent sandstone ridgetop woodland.
- Soils in the disturbance footprint do not show any evidence of shale or laminate lenses.
- Laterites do occur more broadly across the site, and Duffy's Forest EEC may occur elsewhere.

It is noted that more floristic data is required to more definitively assess the presence of Duffy's Forest. This item will be further assessed in the BCAR.



KEY

- Study area

Plant community type

PCT 3586 | Northern Sydney Scribbly Gum Woodland
- High

PCT 3593 | Sydney Coastal Sandstone Bloodwood Shrub Forest
- High
- Moderate
- Low

PCT 3807 | Northern Sydney Heath-Mallee
- High

PCT 3924 | Sydney Coastal Upland Swamp Heath
- High

Threatened ecological community
- Coastal Upland Swamps in the Sydney Basin Bioregion

Existing environment
- Minor road
- Vehicular track
- Watercourse/drainage line
- Cadastral boundary

Source: EMM (2023); DCSSS (2023); MetroMap (2023)

0 100 200 m

GDA2020 MGA Zone 56

N

Plant community types and vegetation zones within the study area

Darkinjung Local Aboriginal Land Council
Reeves Street, Somersby
Flora and Fauna Assessment
Figure 4.1

EMM
creating opportunities

5 Threatened species

5.1 Threatened species assessment process

The presence of threatened species within the study area was assessed according to Section 5.2 of the BAM (DPIE 2020). The following steps were undertaken:

- Step 1: Identify which threatened species need to be considered for assessment. This was completed based on review of the following data sources:
  - a list of species associated with the PCTs mapped within the study area formed by generating a vegetation associations report in the Threatened Biodiversity Data Collection (TBDC), specific to the IBRA subregion where the study area is located; this step was completed in lieu of setting up a case in the Biodiversity Assessment Method Calculator (BAM-C)
  - threatened species that have been previously recorded in the locality
  - species predicted to occur by the EPBC Act Protected Matters Search Tool (PMST).
- Step 2: Assess geographic and habitat constraints listed for each species in the TBDC based on field assessment of habitat constraints present and eliminate species:
  - where the study area does not match the geographic constraints
  - for which the habitat constraints do not occur in the study area
  - that are vagrant in the IBRA subregion.

  This step results in a list of ecosystem credit species to be assessed for impacts, referred to as 'predicted species' (Table 5.1) and a list of candidate species credit species (Table 5.2) that require further assessment under Step 3 to 6 below.
- Step 3: Further assess habitat for candidate species credit species. After a field assessment of the habitat present in the study area, the probability of each threatened species occurring on the study area is assessed, based on the quality of habitat and the presence of microhabitats required by each species. Species without suitable microhabitat or for which habitat is degraded do not require further assessment. The Step 3 assessments are outlined in Table 5.2.
- Step 4: Determine the presence of candidate species through targeted surveys, assumption of presence, or expert reports. Survey methods are summarised in Section 5.4.2. Targeted surveys were completed by Umwelt in 2018, 2019 and 2020, based on a previous iteration of the study area (see Figure 6.1). The surveys completed to date have been used for initial assessments of candidate species presence, noting that further survey will be required as part of the Biocertification process for the site.
- Steps 5–6 of the BAM (defining species polygons for species present on the site and determining habitat condition within species polygons) have not been completed for this Flora and Fauna Assessment, as no offset calculations are required.

5.2 Habitat description

The study area contains a range of habitats, from shrubby woodland to areas of heath and swamp, which are expected to support a range of threatened and non-threatened species.

In the woodland areas of the site, several tree hollows have been recorded, which provide potential breeding and roosting habitat for arboreal mammals, owl species, and cockatoos. The forested areas provide habitat for a range of woodland birds, and there is fallen timber throughout the study area, providing cover for ground-dwelling mammals and potentially reptiles.

The shrub layer contains an abundance of flowering species that provide foraging habitat for small mammals and birds, as well as shelter and roosting habitat.

The low-lying areas of the site support areas of upland swamps with a dense ground layer and emergent shrubs. This swamp habitat provides habitat for invertebrates such as the Giant Dragonfly, mammals such as the Long-nosed Potoroo and the Eastern Pygmy-possum, as well as a range of amphibians, bird species, and mesic flora species such as sedges and ferns.

5.3 Ecosystem credit species

Ecosystem credits species are threatened species that can be reliably predicted to use an area of land based on habitat surrogates. For the purposes of the BAM (DPIE 2020), ecosystem credit species are deemed to be offset through the habitat surrogates (PCTs) in which they occur.

A list of ecosystem credit species predicted to occur within the study area is provided in Table 5.1. No species have been excluded for this assessment, as there will be no data entered into the BAM-C to generate offset requirements.

Some threatened species are listed as both ecosystem credit species and species credit species. In these cases, those species will also be addressed in Section 5.4.

Table 5.1 Predicted ecosystem credit species within the study area

Scientific name	Common name	Sensitivity to gain	Habitat/geographic constraint	Assessment of constraint
Artamus cyanopterus cyanopterus	Dusky Woodswallow	Moderate	-	-
Callocephalon fimbriatum	Gang-gang Cockatoo (Foraging)	Moderate	-	-
Calyptorhynchus lathami	Glossy Black-Cockatoo (Foraging)	High	Presence of Allocasuarina and casuarina species.	The habitat constraint is present with Black She-oak (*Allocasuarina littoralis*) present in PCT 3593.
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	High	-	-
Daphoenositta chrysoptera	Varied Sittella	Moderate	-	-
Dasyurus maculatus	Spotted-tailed Quoll	High	-	-
Falsistrellus tasmaniensis	Eastern False Pipistrelle	High	-	-

Table 5.1 Predicted ecosystem credit species within the study area

Scientific name	Common name	Sensitivity to gain	Habitat/geographic constraint	Assessment of constraint
Glossopsitta pusilla	Little Lorikeet	High	-	-
Haliaeetus leucogaster	White-bellied Sea-Eagle (Foraging)	High	Waterbodies: within 1 km of rivers, lakes, large dams or creeks, wetlands and coastlines.	The study area is approximately 2.5 km from upper reaches of Brisbane Waters. Fountain Creek is located within the broader site.
Hieraaetus morphnoides	Little Eagle (Foraging)	Moderate	-	-
Hirundapus caudacutus	White-throated Needletail	High	-	-
Hoplocephalus bungaroides	Broad-headed Snake (Foraging)	High	-	-
Ixobrychus flavicollis	Black Bittern	Moderate	Waterbodies: land within 40 m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation.	No suitable waterbodies occur within or in proximity to the site.
Lathamus discolor	Swift Parrot (Foraging)	Moderate	-	-
Lophoictinia isura	Square-tailed Kite (Foraging)	Moderate	-	-
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	Moderate	-	-
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	High	-	-
Miniopterus australis	Little Bent-winged Bat (Foraging)	High	-	-
Miniopterus orianae oceanensis	Large Bent-winged Bat (Foraging)	High	-	-
Neophema pulchella	Turquoise Parrot	High	-	-
Ninox connivens	Barking Owl (Foraging)	High	-	-
Ninox strenua	Powerful Owl (Foraging)	High	-	-
Pandion cristatus	Eastern Osprey (Foraging)	Moderate	-	-
Petroica boodang	Scarlet Robin	Moderate	-	-
Petroica phoenicea	Flame Robin	Moderate	-	-
Phoniscus papuensis	Golden-tipped Bat	High	-	-

Table 5.1 Predicted ecosystem credit species within the study area

Scientific name	Common name	Sensitivity to gain	Habitat/geographic constraint	Assessment of constraint
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	High	-	-
Pseudomys novaehollandiae	New Holland Mouse	High	-	-
Pteropus poliocephalus	Grey-headed Flying-fox (Foraging)	High	-	-
Ptilinopus superbus	Superb Fruit-Dove	Moderate	-	-
Rostratula australis	Australian Painted Snipe	Moderate	-	-
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	High	-	-
Scoteanax rueppellii	Greater Broad-nosed Bat	High	-	-
Tyto longimembris	Eastern Grass Owl	Moderate	-	-
Tyto novaehollandiae	Masked Owl (Foraging)	High	-	-
Tyto tenebricosa	Sooty Owl (Foraging)	High	-	-
Varanus rosenbergi	Rosenberg's Goanna	High	-	-

5.4 Species credit species

5.4.1 Candidate species assessment (Steps 1–3)

Candidate species that were considered for further assessment are shown in Table 5.2. An assessment of the geographic and landscape constraints has been provided for each species, with a justification provided where species have been excluded, in accordance with Steps 1 to 3 (Section 5.2) of the BAM (DPIE 2020). Species assessed as candidate species here require further consideration and assessment in Steps 4–6 of the BAM (DPIE 2020).

Table 5.2 Candidate species credit species assessment

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Fauna species									
Burhinus grallarius	Bush Stone-curlew	Fallen/standing dead timber including logs.	Yes	Yes	Yes	The study area contains suitable open woodland habitat with fallen timber.	High	E	-
Callocephalon fimbriatum	Gang-gang Cockatoo (breeding)	Hollow bearing trees: Eucalypt tree species with hollows at least 3 m above the ground and with hollow diameter of 7 cm or larger.	Yes	Yes	Yes	Study area contains suitable foraging habitat, with some potential breeding hollows present.	High	V	E
Cercartetus nanus	Eastern Pygmy-possum	N/A	N/A	Yes	Yes	Study area contains suitable woodland and heath habitat for this species.	High	V	-
Chalinolobus dwyeri	Large-eared Pied Bat	Cliffs: Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels.	Yes	Yes	Yes	There is potential for suitable breeding habitat to occur within 2 km of the study area, in Strickland State Forest, and the study area contains suitable open woodland habitat.	Very High	V	V
Dasyornis brachypterus	Eastern Bristlebird	N/A	N/A	Yes	Yes	The study area contains suitable dense vegetation, including open woodland with a heathy understorey.	Moderate	E	E

Table 5.2 Candidate species credit species assessment

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Haliaeetus leucogaster	White-bellied Sea-Eagle (breeding)	Living or dead mature trees within suitable vegetation within 1 km of a rivers, lakes, large dams or creeks, wetlands and coastlines.	Yes	Yes	Yes	Although the study area is approximately 2.5 km from large areas of open water, Fountain Creek occurs within the broader site, to the south of the study area. There is some potential for breeding habitat on site.	High	V	-
Heleioporus australiacus	Giant Burrowing Frog	N/A	N/A	Yes	Yes	The study area contains suitable heath and woodland habitat, including waterways with potential breeding habitat.	Moderate	V	V
Hieraaetus morphnoides	Little Eagle (breeding)	Nest trees – live (occasionally dead) large old trees within vegetation.	Yes	Yes	Yes	The study area contains suitable eucalypt woodland for the species with potential nest trees.	Moderate	V	-
Hoplocephalus bungaroides	Broad-headed Snake (breeding)	Rocky areas: including escarpments, outcrops and pagodas within the Sydney Sandstone geologies	Yes	Yes	Yes	There are some areas of rocky habitat within the study area. Generally, these areas lack exfoliating rock required by the species. However, the species was retained as a candidate species.	Very High	E	V
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	Other: requires dense ground cover in a variety of habitats.	Yes	Yes	Yes	The study area contains suitable heath and open forest habitat with heathy understorey. There is dense groundcover present in some areas of the site.	High	E	E
Lathamus discolor	Swift Parrot (important habitat)	As per important habitat map.	No	N/A	No	Study area is outside the mapped important areas for this species.	Moderate	E	CE

Table 5.2 Candidate species credit species assessment

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Litoria aurea	Green and Golden Bell Frog	Semi-permanent/ ephemeral wet areas: within 1 km of wet area.	No	No	No	The study area lacks semi-permanent or ephemeral wet areas suitable for the species.	High	E	V
Lophoictinia isura	Square-tailed Kite (breeding)	Nest trees	Yes	Yes	Yes	The study area contains suitable woodland habitat with potential nest trees.	Moderate	V	-
Macropus parma	Parma Wallaby	N/A	N/A	Yes	Yes	The study area contains marginal habitat for this species.	High	V	V
Meridolum maryae	Maroubra Woodland Snail	N/A	N/A	Yes	Yes	The study area contains potential heathland habitat for the species.	High	E	-
Miniopterus australis	Little Bent-winged Bat (breeding)	Caves: cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave'; observation type code 'E nest-roost'; with numbers of individuals >500; or from the scientific literature.	No	N/A	No	Although the study area contains foraging habitat for this species, the site lacks the structures required for breeding.	Very High	V	-

Table 5.2 Candidate species credit species assessment

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Miniopterus orianae oceanensis	Large Bent-winged Bat (breeding)	Caves: Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC – in cave;" observation type code "E nest-roost;" with numbers of individuals >500.	No	N/A	No	Although the study area contains suitable foraging habitat for this species, the site lacks the structures required for breeding.	Very High	V	-
Mixophyes iteratus	Giant Barred Frog	Land within 50 m of semi permanent and permanent drainages.	Yes	Yes	Yes	The study area contains some suitable woodland habitat for the species, including permanent drainage lines.	Moderate	E	E
Myotis macropus	Southern Myotis	Waterbodies: Waterbodies with permanent pools/stretches 3 m or wider, including rivers, large creeks, billabongs, lagoons, estuaries, dams and other waterbodies, on or within 200 m of the site.	No	N/A	No	There are no waterways or dams within 200 m of the study area that would provide potential foraging habitat for the species. Fountain Creek passes within approximately 202 m of the southeast corner of the study area, but this creek is unlikely to support pools that are wider than 3 m.	High	V	-

Table 5.2 Candidate species credit species assessment

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Nettapus coromandelianus	Cotton Pygmy-Goose	Waterbodies: deep permanent fresh waters on floodplains with floating and submergent vegetation.	No	N/A	No	The study area does not contain suitable freshwater habitats for the species.	Moderate	E	-
Ninox connivens	Barking Owl (breeding)	Hollow bearing trees: living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground.	Yes	Yes	Yes	The study area contains suitable woodland habitat with one potential nest tree recorded (Umwelt 2020).	High	V	-
Ninox strenua	Powerful Owl (breeding)	Hollow bearing trees: Living or dead trees with hollow greater than 20 cm diameter.	Yes	Yes	Yes	The study area contains suitable woodland habitat with one potential nest tree recorded (Umwelt 2020).	lookup	V	-
Pandion cristatus	Eastern Osprey (breeding)	Presence of stick-nests in living and dead trees (>15 m) or artificial structures within 100 m of a floodplain for nesting.	No	N/A	No	The study area is too far from floodplain areas to provide suitable breeding habitat.	Moderate	V	-
Petalura gigantea	Giant Dragonfly	Swamps: within 500 m of swamps.	Yes	Yes	Yes	The study area contains suitable swamp habitat for this species.	Very High	E	-
Petauroides volans	Southern Greater Glider	N/A	N/A	Yes	Yes	The study area contains suitable woodland habitat for this species.	High	E	E

Table 5.2 Candidate species credit species assessment

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Petaurus norfolcensis	Squirrel Glider	N/A	N/A	Yes	Yes	The study area contains suitable woodland habitat for this species.	High	V	-
Pezoporus wallicus wallicus	Eastern Ground Parrot	N/A	N/A	Yes	Yes	The study area contains marginal heathland habitat for this species.	High	V	-
Phascolarctos cinereus	Koala	Presence of koala use trees – refer to Survey Comments field in TBDC.	Yes	Yes	Yes	The study area contains suitable eucalypt woodland habitat for Koalas, including Koala use trees identified for the Central Coast, including Red Bloodwood (*Corymbia gummifera*), Blue-leaved Stringybark (*Eucalyptus agglomerata*), Broad-leaved Scribbly Gum (*Eucalyptus haemastoma*), and Silvertop Ash (*Eucalyptus sieberi*). These species are considered rank 3 (significant use (feed or shelter trees)) or rank 4 irregular or (low use (feed or shelter trees)) species for the Central Coast region (DPE 2022c).	High	E	E
Pommerhelix duralensis	Dural Land Snail	N/A	N/A	No	No	Microhabitat of shale derived soils required by this species is unlikely to be present within the study area.	High	E	E
Potorous tridactylus	Long-nosed Potoroo	Dense shrub layer or alternatively high canopy cover exceeding 70% (i.e. to capture populations inhabiting wet sclerophyll and rainforest).	Yes	Yes	Yes	The study area contains potential heath and woodland habitat for this species.	High	V	V

Table 5.2 Candidate species credit species assessment

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Pseudophryne australis	Red-crowned Toadlet	N/A	N/A	Yes	Yes	There is suitable open forest habitat for this species within the study area, as well as drainage lines and small waterways.	Moderate	V	-
Pteropus poliocephalus	Grey-headed Flying-fox (breeding)	Other: breeding camps.	No	N/A	No	There are no breeding camps within the study area.	High	V	V
Turnix maculosus	Red-backed Button-quail	N/A	N/A	Yes	Yes	The study area contains some marginal woodland habitat for this species.	High	V	-
Tyto novaehollandiae	Masked Owl (breeding)	Hollow bearing trees: living or dead trees with hollows greater than 20 cm diameter.	Yes	Yes	Yes	The study area contains suitable eucalypt woodland and one hollow bearing tree (Umwelt 2020).	High	V	-
Tyto tenebricosa	Sooty Owl (breeding)	Caves: caves or clifflines/ledges Hollow bearing trees: living or dead trees with hollows greater than 20 cm diameter.	Yes	Yes	Yes	Although the woodland present on site provides only marginal habitat for this species, there is one suitable breeding hollow present (Umwelt 2020).	Very High	V	-
Vespadelus troughtoni	Eastern Cave Bat	Caves: within 2 km 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	Yes	Yes	The study area contains foraging habitat for this species, and there is potential for breeding habitat on ridges within 2 km, particularly within Strickland State Forest.	Very High	V	-

Table 5.2 Candidate species credit species assessment

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Flora species									
Acacia bynoeana	Bynoe's Wattle	N/A	N/A	Yes	Yes	The study area contains suitable heath and dry sclerophyll forest on sandy soils.	High	E	V
Acacia pubescens	Downy Wattle	N/A	N/A	No	No	The study area lacks the shale-sandstone transition habitat that this species is usually associated with.	High	V	V
Acacia terminalis subsp. Eastern Sydney	Sunshine wattle	N/A	N/A	Yes	Yes	The study area contains suitable woodland habitat on sandy soils.	Moderate	E	E
Ancistrachne maidenii	*Ancistrachne maidenii*	N/A	N/A	Yes	Yes	The study area contains marginal habitat for this species, in dry sclerophyll forest on sandstone-derived soils.	High	V	-
Astrotricha crassifolia	Thick-leaf Star-hair	N/A	N/A	Yes	Yes	The study area contains suitable dry sclerophyll woodland on sandstone.	Very High	V	V
Callistemon linearifolius	Netted Bottle Brush	N/A	N/A	Yes	Yes	The study area contains suitable dry sclerophyll woodland.	Moderate	V	-
Cryptostylis hunteriana	Leafless Tongue Orchid	N/A	N/A	Yes	Yes	The study area contains suitable swamp heath and woodland habitat.	Moderate	V	V
Darwinia biflora	*Darwinia biflora*	N/A	N/A	No	No	The study area lacks the shale-sandstone geology that this species is usually associated with.	High	V	V

Table 5.2 Candidate species credit species assessment

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Darwinia glaucophylla	*Darwinia glaucophylla*	Rocky areas: rocky platforms or within 100 m.	Yes	Yes	Yes	The study area contains suitable sandy heath and woodland habitat, associated with sandstone.	Moderate	V	-
Darwinia peduncularis	*Darwinia peduncularis*	Rocky areas: or within 50 m of rocky areas.	Yes	Yes	Yes	There are some rocky areas within the site, and the study area contains suitable sandy soils over sandstone.	High	V	-
Epacris purpurascens var. *purpurascens*	*Epacris purpurascens* var. *purpurascens*	N/A	N/A	No	No	The study area lacks the shale soil influence that this species is usually associated with.	Moderate	V	-
Eucalyptus camfieldii	Camfield's Stringybark	N/A	N/A	Yes	Yes	The study area contains suitable coastal heath, with sandy soils overlying Hawkesbury sandstone.	High	V	V
Genoplesium baueri	Bauer's Midge Orchid	N/A	N/A	Yes	Yes	The study area contains suitable dry sclerophyll forest on sandstone.	Very High	E	E
Grevillea caleyi	Caley's Grevillea	Other: laterite soils located on ridgetops or within 100 m.	Yes	No	No	Whilst lateritic soils are present on upper slopes, the extent of the population is well known to occur around Terrey Hills.	High	CE	CE
Grevillea parviflora subsp. *supplicans*	*Grevillea parviflora* subsp. *supplicans*	N/A	N/A	Yes	Yes	The study area contains suitable heathy woodland on sandy soils over sandstone.	High	E	-
Grevillea shiressii	*Grevillea shiressii*	N/A	N/A	Yes	Yes	The study area contains marginal habitat for this species.	Moderate	V	V

Table 5.2 Candidate species credit species assessment

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Haloragodendron lucasii	*Haloragodendron lucasii*	Other: seepage zone or within 100 m.	Yes	Yes	Yes	The study area contains suitable dry sclerophyll forest and contains wet areas and seepage zones.	Very High	E	E
Hibbertia procumbens	Spreading Guinea Flower	N/A	N/A	Yes	Yes	The study area contains suitable scrub/heath habitat and associations with swamps.	High	E	-
Hibbertia puberula	*Hibbertia puberula*	N/A	N/A	Yes	Yes	The study area contains suitable sandy soil and dry sclerophyll woodland habitat.	High	E	-
Hibbertia spanantha	Julian's Hibbertia	N/A	N/A	No	No	The study area lacks the shale-sandstone soils the species is associated with.	High	CE	CE
Hibbertia superans	*Hibbertia superans*	N/A	N/A	Yes	Yes	The study area contains marginal habitat for the species, although it usually occurs near a shale/sandstone boundary.	High	E	-
Kunzea rupestris	*Kunzea rupestris*	Rocky areas: Hawkesbury sandstone rock platforms or within 50 m.	Yes	Yes	Yes	The study area contains suitable shrubland habitat on Hawkesbury sandstone.	High	V	V
Lasiopetalum joyceae	*Lasiopetalum joyceae*	N/A	N/A	Yes	Yes	The study area contains suitable heath habitat on sandstone.	Moderate	V	V
Leptospermum deanei	*Leptospermum deanei*	Waterbodies: or within 100 m of freshwater or estuarine streams.	Yes	Yes	Yes	The study area contains drainage lines with sandy soils that may provide suitable habitat for the species.	High	V	V

Table 5.2 Candidate species credit species assessment

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Melaleuca deanei	Deane's Paperbark	N/A	N/A	Yes	Yes	The study area contains suitable woodland habitat.	Very High	V	V
Melaleuca groveana	Grove's Paperbark	N/A	N/A	Yes	Yes	The study area contains suitable heath and shrubland habitat.	High	V	-
Micromyrtus blakelyi	*Micromyrtus blakelyi*	Other: skeletal soil. Rocky areas: Hawkesbury sandstone rock platforms and outcrops or within 50 m.	Yes	Yes	Yes	The study area contains areas of shallow sandy soils with heathland on rock platforms and outcrops.	Moderate	V	V
Microtis angusii	Angus's Onion Orchid	N/A	N/A	No	No	This species is restricted to specific vegetation types located in Duffy's Forest and Terrey Hills.	Moderate	E	E
Persoonia hirsuta	Hairy Geebung	N/A	N/A	Yes	Yes	The study area contains suitable heath and woodland habitat, on Hawkesbury sandstone.	High	E	E
Persoonia mollis subsp. *maxima*	*Persoonia mollis* subsp. *maxima*	N/A	N/A	No	No	This species occurs in sheltered aspects of deep gullies or on the steep upper hillsides of narrow gullies on Hawkesbury Sandstone. These conditions are not present within the study area.	High	E	E
Pimelea curviflora var. *curviflora*	*Pimelea curviflora* var. *curviflora*	N/A	N/A	No	No	This species occurs in areas with shale derived soils, which are not present in the study area.	High	V	V

Table 5.2 Candidate species credit species assessment

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Prostanthera askania	Tranquility Mintbush	N/A	N/A	No	No	The study area lacks the moist sclerophyll forest and warm temperate rainforest communities that this species prefers.	High	E	E
Prostanthera junonis	Somersby Mintbush	N/A	N/A	Yes	Yes	The study area contains suitable woodland and scrub habitat and is located on the Somersby Plateau where the species is restricted.	High	E	E
Prostanthera marifolia	Seaforth Mintbush	N/A	N/A	No	No	This species occurs within localised patches in clay-loam soils that are not present within the study area.	High	CE	CE
Rhizanthella slateri	Eastern Australian Underground Orchid	N/A	N/A	Yes	Yes	The study area contains potentially suitable sclerophyll forest for the species.	High	V	E
Rhodamnia rubescens	Scrub Turpentine	N/A	N/A	No	No	The study area lacks the wet sclerophyll forest and warm temperate rainforest communities that this species prefers.	Very High	CE	CE
Rhodomyrtus psidioides	Native Guava	N/A	N/A	No	No	The study area lacks the wet sclerophyll forest and warm temperate rainforest communities that this species prefers.	Very High	CE	CE

Table 5.2 Candidate species credit species assessment

Scientific name	Common name	Habitat/geographic constraint	Habitat/geographic constraint present in the study area? (Step 2)	Suitable microhabitats present and habitat not degraded? (Step 3)	Candidate species?	Justification	Sensitivity to gain class	BC Act status	EPBC Act status
Tetratheca glandulosa	*Tetratheca glandulosa*	N/A	N/A	No	No	The study area lacks the shale-sandstone transition habitat that this species is associated with.	High	V	-
Zieria involucrata	*Zieria involucrata*	N/A	N/A	Yes	Yes	The study area contains marginal habitat for this species, although it usually prefers more sheltered forests on lower slopes.	High	E	V

1. V = vulnerable, E = endangered, CE = critically endangered, EP = endangered population

5.4.2 Species requiring further assessment (Step 4)

Species listed as Candidate species in Table 5.2 require further assessment under the BAM (after completing Steps 2 and 3). The species are considered to have potential of occurring within the study area, and their presence has been partially assessed through targeted surveys.

Umwelt completed a suite of targeted surveys between August 2018 and March 2020, based on a previous iteration of the study area. The surveys completed do not fully encompass the current study area, so some areas have not yet been surveyed. Figure 5.1 shows the survey effort completed by Umwelt, with the current study area overlaid. The results of those surveys have been considered and included in this report, noting that additional survey effort will be required to meet the requirements of the BAM, now that the study area has changed.

5.4.3 Candidate species survey methods

i Survey effort by Umwelt

Field surveys completed on the site by Umwelt between August 2018 and March 2020 are summarised in Table 5.3 and shown in Figure 5.1. EMM has incorporated the findings of these surveys into the assessments of species presence where appropriate.

Table 5.3 Species credit species surveys

Survey date	Method	Species targeted
August 2018	Spotlighting and call playback	Barking Owl, Masked Owl, Powerful Owl, Sooty Owl
	Habitat assessments (evidence of breeding)	White-bellied Sea-eagle, Little Eagle, Square-tailed Kite, Eastern Osprey
	Habitat assessments	Broad-headed Snake
October 2018	Targeted threatened species transects	Spreading Guinea Flower, Somersby Mintbush, Eastern Underground Orchid, *Tetratheca glandulosa*
January 2019	Targeted threatened species transects	Giant Dragonfly
	Targeted threatened species transects	Bynoe's Wattle, Thick-leaf Star-hair, Netted Bottle Brush, Leafless Tongue Orchid, *Darwinia glaucophylla*, Camfield's Stringybark, Bauer's Midge Orchid, *Grevillea shiressii*, Grove's Paperbark, Hairy Geebung
March 2019	Nocturnal searches, Call-playback, Breeding habitat assessment (Gang-gang cockatoo and Glossy Black-cockatoo), Koala SAT tests, Microhabitat breeding habitat assessment	Bush Stone-curlew, Gang-gang Cockatoo, Glossy Black-Cockatoo, Large-eared Pied Bat, Giant Burrowing Frog, Green and Golden Bell Frog, Giant Barred Frog, Little Bent-winged Bat, Large Bent-winged Bat, Southern Myotis, Koala, Red-crowned Toadlet, Grey-headed Flying-fox, Eastern Cave Bat
March-May 2019	Remote camera	Eastern Pygmy-possum, Parma Wallaby, Squirrel Glider
May 2019	Nocturnal searches, Hollow bearing tree analysis, Call-playback, Stag watching, Breeding habitat assessment (Gang-gang cockatoo and Glossy Black-cockatoo)	Gang-gang Cockatoo, Glossy Black-Cockatoo, Barking Owl, Masked Owl, Powerful Owl, Sooty Owl

Table 5.3 Species credit species surveys

Survey date	Method	Species targeted
November 2019	Targeted threatened species transects	Bynoe's Wattle, Netted Bottle Brush, Camfield's Stringybark, Hairy Geebung, Spreading Guinea Flower, Somersby Mintbush
March 2020	Nocturnal searches, Call-playback, Breeding habitat assessment (Gang-gang cockatoo and Glossy Black-cockatoo), Forest owl tree hollow searches	Eastern Pygmy-possum, Parma Wallaby, Squirrel Glider, Greater Glider, Koala, Green and Golden Bell Frog, Giant Barred Frog, Red-crowned Toadlet, Giant Burrowing Frog, Bush Stone-curlew
	Targeted threatened species transects	Bynoe's Wattle, Netted Bottle Brush, Camfield's Stringybark, Hairy Geebung

ii Survey effort by EMM

EMM completed habitat assessments in May 2023 while conducting vegetation mapping surveys. Additional targeted surveys will be completed as part of assessments for the upcoming Biocertification.

5.4.4 Presence of candidate species

Table 5.4 combines the results of surveys completed on the site to date with habitat assessments completed by EMM to assign a probability of occurrence to each candidate species. In some cases, the survey completed in the previous iteration of the footprint is a good indication of whether the species will be present in the current study area, and for some species more survey is required. This approach is considered conservative for the purposes of this report and the planning proposal. Full targeted surveys for candidate species will be completed as part of the Biocertification.

Four[1] species have been recorded in the study area to date, and one species is assumed to be present:

- Giant Burrowing Frog
- Squirrel Glider
- Red-crowned Toadlet
- Spreading Guinea Flower
- Somersby Mintbush (assumed present).

Threatened species records are shown in Figure 5.2.

[1] Glossy Black Cockatoo was recorded foraging within the site, although is unlikely to breed within the study area (see Section 5.4.4).

Table 5.4 Presence of candidate species

Scientific name	Common name	Probability of presence in the study area	Survey methods completed	Justification
Fauna species				
Burhinus grallarius	Bush Stone-curlew	Unlikely	Cameras, spotlighting, call playback, flushing	Unlikely to be present based on survey effort completed to date.
Callocephalon fimbriatum	Gang-gang Cockatoo (breeding)	Unlikely	Habitat assessment, hollow inspections	Unlikely present based on survey effort completed to date and limited hollows recorded in the previous iteration of the study area by Umwelt (2020). However, any additional hollows recorded will require additional survey. Species usually breeds in mountain regions.
Calyptorhynchus lathami	Glossy Black-Cockatoo (breeding)	Recorded but breeding unlikely	Habitat assessment, hollow inspections	Species has been recorded, but no evidence of breeding has been detected with limited number of suitable hollows (Umwelt 2020). Any additional hollows recorded will require survey for breeding activity.
Cercartetus nanus	Eastern Pygmy-possum	Likely	Cameras, spotlighting	Species likely to occur based on a high number of records in surrounding areas, including one record within the broader site, and presence of suitable habitat. More survey is required.
Chalinolobus dwyeri	Large-eared Pied Bat	Unlikely	Habitat assessment	It is unlikely that the surrounding area contains suitable breeding habitat. However, further survey is required.
Dasyornis brachypterus	Eastern Bristlebird	Unlikely	Not surveyed	The species is known from just three main populations, with the nearest population on the Woronora plateau, south of Sydney. However, the species has not been surveyed within the study area. More survey is required based on presence of suitable heathy habitat.
Haliaeetus leucogaster	White-bellied Sea-Eagle (breeding)	Unlikely	Habitat assessment for large stick nests	The study area is likely too far from open water to provide suitable breeding habitat. No stick nests have been recorded to date, but unsurveyed areas will be checked for large stick nests and breeding activity.
Heleioporus australiacus	Giant Burrowing Frog	Recorded	Targeted searches, spotlighting, call playback	Species has been recorded within and around the study area. Further survey will be conducted in areas not yet surveyed.
Hieraaetus morphnoides	Little Eagle (breeding)	Unlikely	Habitat assessment for large stick nests	No stick nests have been recorded within the study area to date, but unsurveyed areas will be checked for stick nests and breeding activity.
Hoplocephalus bungaroides	Broad-headed Snake (breeding)	Unlikely	Targeted searches, walking transects	Unlikely to occur based on limited rocky habitat within the study area, and species has not been detected through surveys to date.

Table 5.4 Presence of candidate species

Scientific name	Common name	Probability of presence in the study area	Survey methods completed	Justification
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	Unlikely	Not targeted, but camera surveys would detect this species	Species has not been detected on camera surveys conducted to date, although further survey is required as there is suitable habitat present on site.
Lophoictinia isura	Square-tailed Kite (breeding)	Unlikely	Habitat assessments for stick nests.	No stick nests have been recorded within the study area to date, but unsurveyed areas will be checked for stick nests and breeding activity.
Macropus parma	Parma Wallaby	Unlikely	Cameras, spotlighting	Species has not been detected during spotlighting or on camera surveys conducted to date, although further survey is required as there is suitable habitat present on site.
Meridolum maryae	Maroubra Woodland Snail	Unlikely	Not surveyed	The species is unlikely to occur on the site. It has not been recorded north of Sydney for over 20 years, with most records occurring around Botany Bay.
Mixophyes iteratus	Giant Barred Frog	Unlikely	Targeted searches, spotlighting, call playback	Species is unlikely to occur based on not being detected during surveys to date. Habitat within the site is likely not wet enough to be preferable for the species.
Ninox connivens	Barking Owl (breeding)	Unlikely	Habitat assessment, hollow inspections, stag watching, spotlighting, call playback	Suitable hollows are limited, with just one hollow recorded by Umwelt. The species was not detected during surveys undertaken based on a previous iteration of the footprint. Any additional suitable hollows will require survey to detect breeding activity.
Ninox strenua	Powerful Owl (breeding)	Unlikely	Habitat assessment, hollow inspections, stag watching, spotlighting, call playback	Suitable hollows are limited, with just one hollow recorded by Umwelt. The species was not detected during surveys undertaken based on a previous iteration of the footprint. Any additional suitable hollows will require survey to detect breeding activity.
Petalura gigantea	Giant Dragonfly	Potential	Habitat assessments, targeted searches	Although not detected in surveys completed to date, there is potential for this species to occur given the extent of upland swamp habitat within the study area.
Petauroides volans	Southern Greater Glider	Potential	Not targeted, but spotlighting surveys would detect this species	There is potential for this species to occur in the study area based on existing records in surrounding areas. Further surveys will be conducted.
Petaurus norfolcensis	Squirrel Glider	Recorded	Spotlighting, cameras, call-playback	The species has been recorded within the study area. Given the difficulty in visually identifying this species, further surveys will be conducted.

Table 5.4 Presence of candidate species

Scientific name	Common name	Probability of presence in the study area	Survey methods completed	Justification
Pezoporus wallicus wallicus	Eastern Ground Parrot	Potential	Not surveyed	Although the habitat present on the site is only marginal for the species, there is potential for it to occur and more survey will be conducted.
Phascolarctos cinereus	Koala	Potential	Cameras, SATs, spotlighting, call-playback	Possibly present in low densities in and around the site, given existing records in surrounding areas. Habitat is considered marginal, with suitable Koala use trees considered rank 3 and 4 species in the Central Coast region. Further survey is required in accordance with relevant guidelines (DPE 2022c).
Potorous tridactylus	Long-nosed Potoroo	Unlikely	Not targeted, but camera surveys would detect this species	Species has not been detected on camera surveys conducted to date, although further survey is required as there is suitable habitat present on site.
Pseudophryne australis	Red-crowned Toadlet	Recorded	Call playback	Species has been recorded within the study area. Further survey will be conducted in areas of habitat that have not been surveyed.
Turnix maculosus	Red-backed Button-quail	Potential	Transects	There is potential for this species to occur in the study area, based on surrounding records and the potential habitat on site. Further survey will be conducted.
Tyto novaehollandiae	Masked Owl (breeding)	Unlikely	Habitat assessment, hollow inspection, stag watching, spotlighting, call playback	Suitable hollows are limited, with just one hollow recorded by Umwelt. The species was not detected during surveys undertaken based on a previous iteration of the footprint. Any additional suitable hollows will require survey to detect breeding activity.
Tyto tenebricosa	Sooty Owl (breeding)	Unlikely	Habitat assessment, hollow inspection, stag watching, spotlighting, call playback	The species is unlikely to occur as it generally prefers wetter habitats, suitable hollows are limited and has not been detected through surveys to date. Regardless, additional owl surveys will be completed.
Vespadelus troughtoni	Eastern Cave Bat	Unlikely	Habitat assessments	Although the species may occur within the study area, it is unlikely to breed due to the lack of suitable breeding structures available.
Flora species				
Acacia bynoeana	Bynoe's Wattle	Unlikely	Targeted threatened flora transects	The species has not been detected through targeted surveys covering the majority of the study area, completed within the survey period for the species. There is some potential for it to occur in unsurveyed areas.

Table 5.4 Presence of candidate species

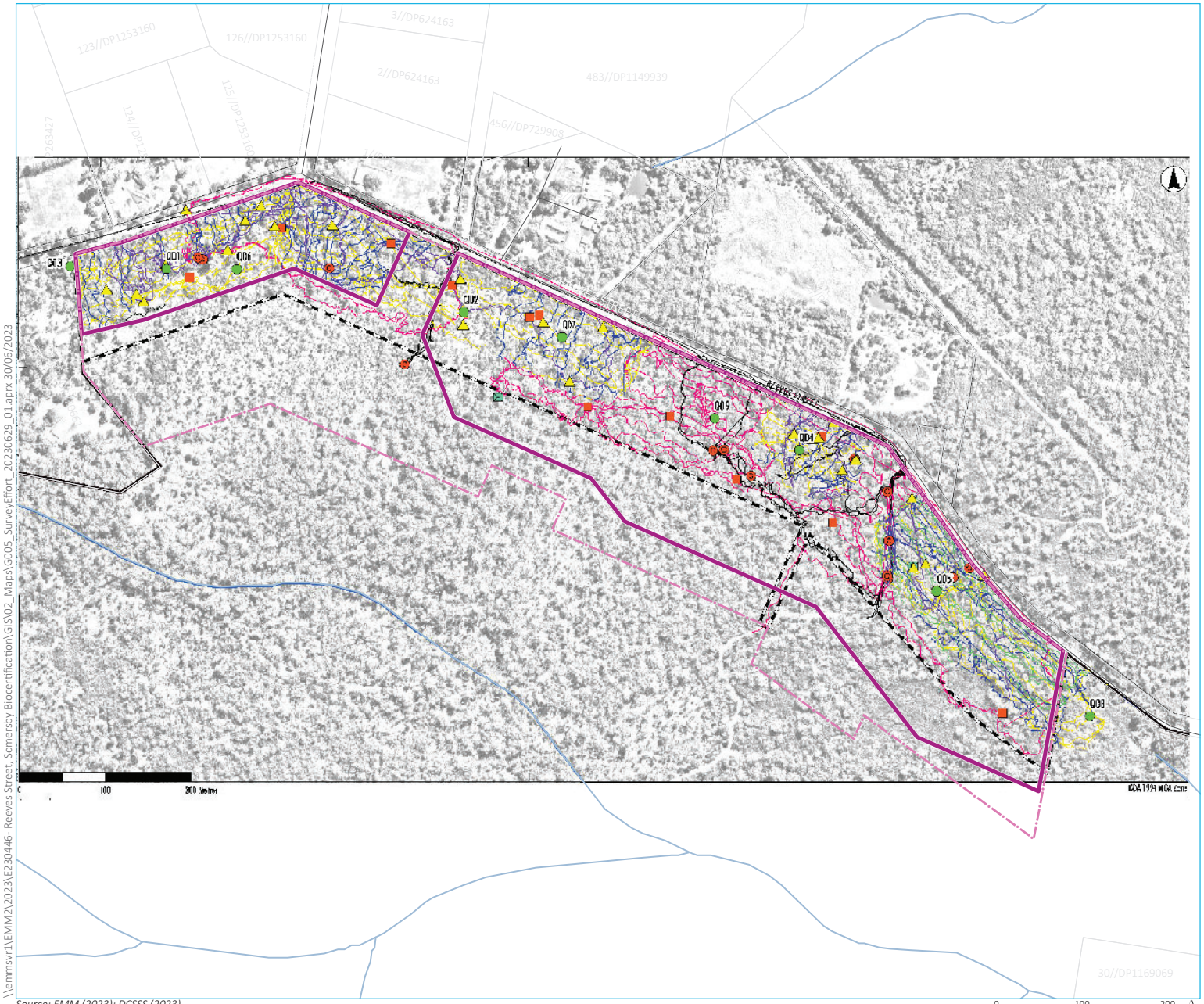
Scientific name	Common name	Probability of presence in the study area	Survey methods completed	Justification
Acacia terminalis subsp. Eastern Sydney	Sunshine wattle	Potential	Not surveyed	This species has not yet been surveyed on the site and has potential to occur due to suitable habitat and distribution. Targeted surveys will be conducted.
Ancistrachne maidenii	*Ancistrachne maidenii*	Unlikely	Not targeted, but surveys were conducted during the species' survey period	This species has not been targeted in surveys to date; however surveys were carried out during the survey period for the species, across the majority of the study area. There is potential for it to occur based on habitat, but the species has specific geological requirements that are only marginally met by the location of the site. Targeted surveys will be conducted in unsurveyed areas.
Astrotricha crassifolia	Thick-leaf Star-hair	Unlikely	Targeted threatened flora transects	The species has not been detected through targeted surveys covering the majority of the study area, completed within the survey period for the species. There is some potential for it to occur in unsurveyed areas.
Callistemon linearifolius	Netted Bottle Brush	Unlikely	Targeted threatened flora transects	The species has not been detected through targeted surveys covering the majority of the study area, completed within the survey period for the species. There is some potential for it to occur in unsurveyed areas.
Cryptostylis hunteriana	Leafless Tongue Orchid	Unlikely	Targeted threatened flora transects	The species has not been detected through targeted surveys covering the majority of the study area, completed within the survey period for the species. There is some potential for it to occur in unsurveyed areas.
Darwinia glaucophylla	*Darwinia glaucophylla*	Unlikely	Targeted threatened flora transects	The species has not been detected through targeted surveys covering the majority of the study area, completed within the survey period for the species. There is some potential for it to occur in unsurveyed areas.
Darwinia peduncularis	*Darwinia peduncularis*	Unlikely	Not targeted, but surveys were conducted during the species' survey period	This species has not been targeted in surveys to date, however surveys were carried out during the survey period for the species, across the majority of the study area. There is potential for it to occur based on suitable habitat. Targeted surveys will be conducted in unsurveyed areas.
Eucalyptus camfieldii	Camfield's Stringybark	Unlikely	Targeted threatened flora transects	The species has not been detected through targeted surveys covering the majority of the study area, completed within the survey period for the species. There is some potential for it to occur in unsurveyed areas.

Table 5.4 Presence of candidate species

Scientific name	Common name	Probability of presence in the study area	Survey methods completed	Justification
Genoplesium baueri	Bauer's Midge Orchid	Unlikely	Targeted threatened flora transects	The species has not been detected through targeted surveys covering the majority of the study area, completed within the survey period for the species. There is some potential for it to occur in unsurveyed areas.
Grevillea parviflora subsp. *supplicans*	*Grevillea parviflora* subsp. *supplicans*	Unlikely	Targeted threatened flora transects	The species has not been detected through targeted surveys covering the majority of the study area, completed within the survey period for the species. There is some potential for it to occur in unsurveyed areas.
Grevillea shiressii	*Grevillea shiressii*	Unlikely	Targeted threatened flora transects	The species has not been detected through targeted surveys to date, and is unlikely to occur in the study area as the species prefers wet sclerophyll forest habitats.
Haloragodendron lucasii	*Haloragodendron lucasii*	Unlikely	Not targeted, but surveys were conducted during the species' survey period	This species has not been targeted in surveys to date, however surveys were carried out during the survey period for the species, across the majority of the study area. There is potential for it to occur based on suitable habitat. Targeted surveys will be conducted in unsurveyed areas.
Hibbertia procumbens	Spreading Guinea Flower	Recorded	Targeted threatened flora transects	The species has been recorded within the study area. Further surveys will be conducted in areas that have not yet been surveyed.
Hibbertia puberula	*Hibbertia puberula*	Unlikely	Not targeted, but surveys were conducted during the species' survey period	This species has not been targeted in surveys to date, however surveys were carried out during the survey period for the species, across the majority of the study area. There is potential for it to occur based on suitable habitat. Targeted surveys will be conducted in unsurveyed areas.
Hibbertia superans	*Hibbertia superans*	Unlikely	Not targeted, but surveys were conducted during the species' survey period	This species has not been targeted in surveys to date, however surveys were carried out during the survey period for the species, across the majority of the study area. It has some potential to occur due to suitable habitat, although it usually occurs near a shale/sandstone boundary. Targeted surveys will be conducted in unsurveyed areas.
Kunzea rupestris	*Kunzea rupestris*	Unlikely	Not targeted, but surveys were conducted during the species' survey period	This species has not been targeted in surveys to date, however surveys were carried out during the survey period for the species, across the majority of the study area. There is potential for it to occur based on suitable habitat. Targeted surveys will be conducted in unsurveyed areas.
Lasiopetalum joyceae	*Lasiopetalum joyceae*	Unlikely	Not targeted, but surveys were conducted during the species' survey period	This species has not been targeted in surveys to date, however surveys were carried out during the survey period for the species, across the majority of the study area. There is potential for it to occur based on suitable habitat. Targeted surveys will be conducted in unsurveyed areas.

Table 5.4 Presence of candidate species

Scientific name	Common name	Probability of presence in the study area	Survey methods completed	Justification
Leptospermum deanei	*Leptospermum deanei*	Unlikely	Not targeted, but surveys were conducted during the species' survey period	This species has not been targeted in surveys to date, however surveys were carried out during the survey period for the species, across the majority of the study area. There is potential for it to occur based on suitable habitat. Targeted surveys will be conducted in unsurveyed areas.
Melaleuca deanei	Deane's Paperbark	Unlikely	Not targeted, but surveys were conducted during the species' survey period	This species has not been targeted in surveys to date, however surveys were carried out during the survey period for the species, across the majority of the study area. There is potential for it to occur based on suitable habitat. Targeted surveys will be conducted in unsurveyed areas.
Melaleuca groveana	Grove's Paperbark	Unlikely	Targeted threatened flora transects	The species has not been detected through targeted surveys covering the majority of the study area, completed within the survey period for the species. There is some potential for it to occur in unsurveyed areas.
Micromyrtus blakelyi	*Micromyrtus blakelyi*	Unlikely	Not targeted, but surveys were conducted during the species' survey period	This species has not been targeted in surveys to date, however surveys were carried out during the survey period for the species, across the majority of the study area. There is potential for it to occur based on suitable habitat. Targeted surveys will be conducted in unsurveyed areas.
Persoonia hirsuta	Hairy Geebung	Unlikely	Targeted threatened flora transects	The species has not been detected through targeted surveys covering the majority of the study area, completed within the survey period for the species. There is some potential for it to occur in unsurveyed areas.
Prostanthera junonis	Somersby Mintbush	Assumed present	Targeted threatened flora transects	Although the species was not detected through targeted surveys, it is assumed to be present within the study area as per advice received by the client from BCD. The species is a post-fire coloniser and can disappear from above ground after regrowth vegetation shades it out. Given the absence of recent fire in the study area, the species may be present in the seed bank but unable to be detected until the next fire event. It will be assumed present in associated PCTs across the study area.
Rhizanthella slateri	Eastern Australian Underground Orchid	Unlikely	Targeted threatened flora transects	The species has not been detected through targeted surveys covering the majority of the study area, completed within the survey period for the species. There is some potential for it to occur in unsurveyed areas.
Zieria involucrata	Zieria involucrata	Unlikely	Not targeted, but surveys were conducted during the species' survey period	This species has not been targeted in surveys to date, however surveys were carried out during the survey period for the species, across the majority of the study area. It is unlikely to occur as it generally grows in more sheltered forests and is only rarely found on upper slopes. Further targeted surveys will be conducted in unsurveyed areas.



KEY

- Study area (current development footprint)
- Previous development footprint
- Area surveyed by Umwelt
- Lot 48 DP118467
- Remote camera location
- Call playback location
- Hollow- bearing tree
- BAM intergrity plot
- Rapid assessment
- Autumn 2020 spotlight survey tracking
- Autumn 2020 flora survey tracking
- Summer 2019 spotlighting survey tracklog
- Summer 2019 flora survey tracklog
- Summer 2019 giant dragonfly survey tracklog
- Spring 2018 flora survey tracklog
- Winter 2018 flora survey tracklog

Existing environment

- Minor road
- Watercourse/drainage line
- Cadastral boundary

Source: EMM (2023); DCSSS (2023)

0 100 200 m

GDA2020 MGA Zone 56

N

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Survey effort (Umwelt 2020)

Darkinjung Local Aboriginal Land Council
Reeves Street, Somersby
Flora and Fauna Assessment
Figure 5.1

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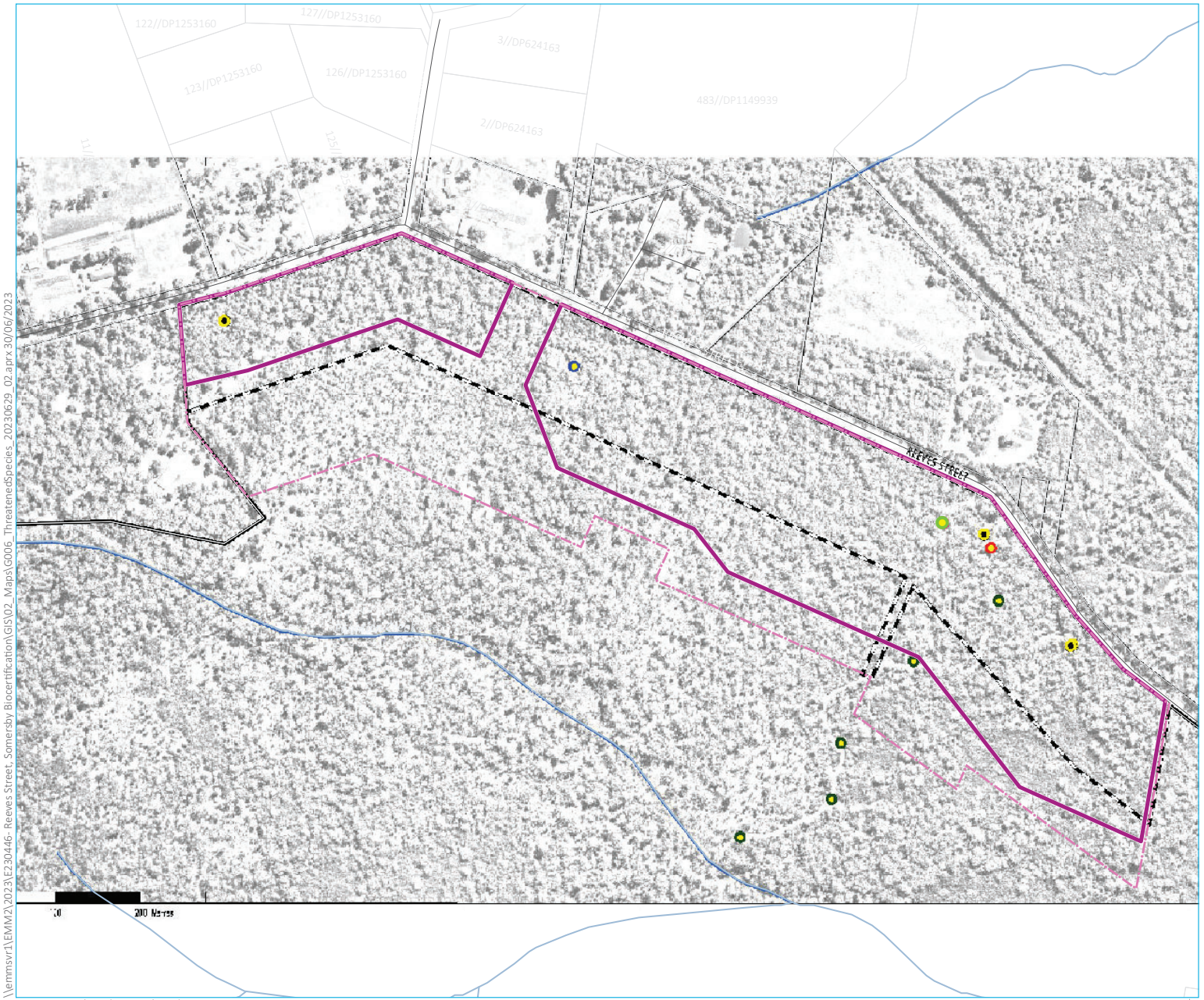

KEY

- Study area (current development footprint)
- Previous development footprint
- Area surveyed by Umwelt
- Lot 48 DP118467
- Red-Crowned Toadlet
- Glossy- Black Cockatoo (heard)
- Giant Burrowing Frog
- Hibbertia procumbens
- Squirrel Glider

Existing environment

- Minor road
- Watercourse/drainage line
- Cadastral boundary

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Source: EMM (2023); DCSSS (2023)

0 100 200 m

GDA2020 MGA Zone 56

N

Threatened species records
(Umwelt 2020)

Darkinjung Local Aboriginal Land Council
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Figure 5.2

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6 Avoidance and minimisation

6.1 Site selection

The *Aboriginal Land Rights Act 1983* (ALR Act) puts in place an Aboriginal land claims system which enables Local Aboriginal Land Councils to make a claim (for ownership) for areas of Crown Land which are not needed for an essential public purpose, or for a range of other reasons set out in the ALR Act. This process has the effect of progressively returning to Aboriginal people the ownership of some of the land from which they were dispossessed.

Darkinjung made a successful land claim for the site and the site was transferred to the ownership of Darkinjung LALC through the Aboriginal land claims process.

The site was subsequently included in Darkinjung's Development Delivery Plan (DDP), prepared in accordance with State Environmental Planning Policy (Planning Systems) 2021 – Chapter 3 Aboriginal Land and in collaboration between DPE. The sites chosen for the DDP were selected through an extensive and considered process which addresses the requirements of the SEPP – including:

- the general objectives of the LALC for the land
- the nature of development proposed for the land
- the basis on which the development is proposed, having regard to applicable economic, social and environmental factors
- strategies, actions and a program for achieving the objectives for the land.

Consideration was also given to the Central Coast Regional Plan 2041.

As part of the preliminary work related to the preparation of a DDP, Darkinjung completed an audit of its land to identify sites that appear suitable to deliver various cultural, economic, social and environmental benefits in-line with its Community, Land and Business Plan. Darkinjung representatives undertook a series of workshops with Department officers to identify priority sites, including profiling opportunities and constraints.

A large proportion of land owned by Darkinjung LALC was considered to have high conservation and cultural importance and has not been proposed for development and is not included in the DDP. Of the approximately 3,700 ha of land that Darkinjung owns, the 31 sites in this DDP cover approximately 1,613 ha. Importantly, the sites included in this DDP also include significant areas of conservation land and those parts of the sites are proposed to be protected.

This process resulted in identification of 31 sites which Darkinjung will prioritise for future development to meet the needs of both the State of NSW and the Darkinjung community.

The Somersby site was identified in both the final DDP and the Interim DDP as a short-term priority site for development. The site is mapped in State Environmental Planning Policy (Planning Systems) 2021 and is identified as a residential investigation area in the Narara district adjacent to the Somersby regionally significant growth area. The site provides an opportunity to develop low-scale rural residential dwellings and secure an east-west regional biodiversity corridor within an appropriate zoning.

6.2 Avoidance and minimisation of impacts to biodiversity values

Through the design of the project, Darkinjung have sought to avoid impacts to key biodiversity values as much as possible. The key driver of the avoidance measures is the presence of the Coastal Upland Swamp EEC within the site and the threatened species associated with this community.

Surveys completed by Umwelt were based on a previous iteration of the development footprint (shown in Figure 6.1). This design iteration included longer, narrower lots, and comprised:

- a dwelling area (for construction of the building and associated ancillary infrastructure)
- an APZ at the rear and sides of the dwelling area
- a proposed vegetated buffer zone at the rear of the lots.

The intent of the vegetated buffer zone was to retain vegetation in this area. However, once approved and rezoned the practical protection of this area would have been problematic and it is likely that this area would have been partially cleared. The biodiversity values in this vegetated buffer zone were not assessed by Umwelt (2020), hence why Umwelt's survey effort does not cover the entirety of the previous development footprint (see Figure 5.1). The buffer zone supported extensive areas of Coastal Upland Swamp, including the largest and most intact area of Coastal Upland Swamp within the site.

EMM has since completed more comprehensive mapping of the extent of Coastal Upland Swamp across the site and has worked with Darkinjung and their designers to redesign the proposed development footprint for the planning proposal. As outlined above, this has been a key driver for avoidance given the importance of this community. This process resulted in a drastically changed and modified layout and development footprint, with shallower lots and a reduction in lot size from 2–3 ha to 1–1.9 ha.

The updated development footprint avoids larger areas of native vegetation (10.98 ha) and excludes significant areas of Coastal Upland Swamp EEC, avoiding 5.93 ha of the EEC, and maximises areas with less swamp mapped (Figure 6.1). Table 6.1 shows the areas of Coastal Upland Swamp in both iterations of the development footprint.

Table 6.1 Areas of vegetation avoided through design

	Previous development footprint (ha)	Current development footprint (ha)	Area avoided (ha)
Native vegetation	30.62	19.64	10.98
Coastal Upland Swamp TEC	10.41	4.48	5.93

In particular, impacts to the largest and most intact patch of swamp at the western end of the site have been minimised through the current design (see Figure 6.1). This patch supports larger areas of wetter, more unique sub-types of the upland swamps. The residual impacts are to drier sub-types which are more marginal.

By avoiding areas of Coastal Upland Swamp, the new development footprint is also avoiding potential habitat for the many species supported by that community, including the:

- Giant Burrowing Frog
- Giant Dragonfly
- Eastern Bristlebird
- Eastern Ground Parrot.
- Eastern Pygmy-possum
- Long-nosed Potoroo.

The new development footprint includes 19.64 ha of native vegetation, compared to the 30.62 ha in the previous footprint, avoiding impacts to 10.98 ha of native vegetation. This avoidance reduces the overall biodiversity impacts of the development by directly avoiding clearing of native vegetation, and hence impacts to the species associated with the vegetation communities.

The planning proposal will rezone over 100 ha from RU2 (Rural Landscape) to C2 (Environmental Conservation). This will remove a number of permitted uses in the RU2 zone that would not be compatible with the biodiversity values of the site.

The placement of the development footprint adjacent to Reeves Street reduces biodiversity impacts by incorporating already disturbed areas into the footprint, reducing edge effects, and maintaining maximum connectivity in remaining vegetation.

The placement of the development footprint also considered the impacts to regional biodiversity corridors as identified in the Central Coast Regional Plan 2041 (DPE 2022d). The current development footprint ensures that the width of a corridor between Ourimbah State Forest and Jilliby State Conservation Area in the north, and Brisbane Water National Park in the south, is largely unaffected. The updated development footprint leaves a corridor of intact vegetation between the two proposed development areas, which will help to maintain connectivity between areas to the north and south of the development footprint (Figure 6.1), in line with the strategies in the regional plan (DPE 2022d).

6.3 Mitigation measures

Minimisation measures will form part of a comprehensive biodiversity impact minimisation strategy for the project during the Biocertification. Darkinjung has committed to the design and implementation of a strategy in order to further mitigate the unavoidable impacts of the project (Umwelt 2020). The following control measures will be included:

- demarcation of approved clearance boundaries
- weed management, including removal of pine wildings during construction
- fencing and access control
- bushfire management
- pre-clearance and tree felling procedures.

Further information is provided in Section 6.4. More detailed information will be provided on these mitigation measures as a part of the Biocertification.

6.3.1 Protection measures for Coastal Upland Swamp EEC

The main potential for indirect impacts to Coastal Upland Swamp EEC will occur due to changes in hydrology at the site, particularly a decrease in run-off leading to drying, or concentration of run-off leading to nick points and erosion. There is also the potential for changes to upland swamps due to invasive species and changes in nutrient loads.

Prevention of runoff from future residential development into intact vegetation downslope will be crucial in maintaining the integrity of the Coastal Upland Swamp EEC. Measures must be taken within the proposed lots to prevent sediment, invasive species and excess nutrients from spreading outside of these lots and into areas of upland swamp.

The Coastal Upland Swamp EEC is easily impacted by changes to surface hydrology and hydrologically transported pollutants that can be contained in urban runoff. An assessment of the surface and groundwater impacts associated with the project will be undertaken at the development application stage and is discussed in more detail in Section 7.1.2.

Building envelopes and wastewater management systems will be placed in areas to reduce impacts to the EEC. Wherever possible, a buffer zone around mapped areas of the EEC should be kept intact, as per the EPBC conservation advice (DoE 2014). A buffer zone will help protect the EEC from altered water flows and unnecessary direct impacts.

Stormwater management of the future individual allotments is proposed onsite in accordance with typical mitigation measures for rural residential developments. With an expected average lot size of greater than 1.3 ha the post-developed impervious fraction is anticipated to be less than 5%. The majority of the 5% impervious fraction introduced by any future dwelling is anticipated to be roof area. Roof water runoff is to be harvested for onsite reuse, with all opportunities for collection to be optimised.

The residual impervious fraction will be due to hardstand areas. This run-off will be controlled on the lot and be returned to sheet flow, being allowed to infiltrate through a vegetated buffer before reaching the lot boundary. These hardstand areas are expected to result in negligible increases in volumetric run-off, with a negligible increase in wetting of upland swamps anticipated. The controlled run-off via sheet flow will ensure nick points and erosion areas do not develop.

The buffer will aid in the removal of suspended pollutants and attached nutrients to adequately treat runoff prior to entering the downstream areas.

6.4 Summary of measures

Table 6.2 summarises the proposed avoidance and minimisation measures.

Table 6.2 Avoidance and minimisation measures

Measure	Timing	Responsibility	Proposed techniques	Outcome
Site selection	Prior to design	Darkinjung	• Darkinjung's landholdings were assessed in consultation with DPE as a part of the DPE – see above.	• Consideration of biodiversity values in the process to identify priority development sites.
Ecological assessment of the site	Prior to design	Darkinjung	• Vegetation mapping. • Threatened species habitat assessment. • Targeted threatened species survey.	• Assessment of biodiversity values of the site, to inform project design and avoidance.
Placement of impacts in existing disturbed areas	Project design	Darkinjung	• Consideration of biodiversity values in design process.	• Focus impacts on areas of lower biodiversity values and avoid impacts to areas of higher value.
Avoidance of areas of high biodiversity value	Project design	Darkinjung	• Reduce area of proposed clearing where possible. • Minimise clearance of Coastal Upland Swamp EEC. • Maintain buffer around EEC where possible.	• Reduce impacts to native vegetation within the development footprint. • Reduce impacts to Coastal Upland Swamp EEC and maintain integrity of remnant areas of the EEC.

Table 6.2 Avoidance and minimisation measures

Measure	Timing	Responsibility	Proposed techniques	Outcome
Pre-clearance and tree felling procedure	Prior to and during clearing activities	Site manager	• Pre-clearance surveys. • Tree felling procedure.	• Minimise impacts to fauna species within the development footprint. • Reduction of impacts to habitat outside of the development footprint.
Demarcation of approved clearance boundaries	Prior to and during clearing activities	Site manager	• Construction fencing or marking tape around areas not proposed or approved for clearing.	• Minimise impacts to surrounding vegetation and habitats.
Weed and runoff management	Construction and ongoing	Site manager and landowner	• Removal of high-threat weed species in accordance with the *NSW Weed Control Handbook* (DPI 2018). • Prevent runoff from development area into surrounding vegetation. • Ensure any material and equipment brough into the site is clean and free of seeds, and clean all equipment used before working in a different location.	• Minimise environmental and noxious weeds in the development footprint. • Minimise weed spread into surrounding habitats and the locality. • Maintain integrity of remnant patches of Coastal Upland Swamp EEC.
Fencing and access controls	Construction and ongoing	Site manager and landowner	• Restrict access to sensitive areas of the site through fencing or signage.	• Minimise impacts to surrounding vegetation and habitats.
Bushfire management	Construction and ongoing	Site manager and landowner	• Conduct hazard reduction to prevent high intensity burning of the site.	• Minimise impacts from bushfire events on retained vegetation.
Protection measures for Coastal Upland Swamp EEC	Construction and ongoing	Site manager and landowner	• Runoff prevention and control. • Retain buffer of intact vegetation around EEC where possible.	• Prevent sedimentation of EEC. • Prevent spread of weeds into EEC. • Prevent changes to hydrology of EEC. • Protect abiotic conditions necessary for the EEC to persist, and maintain the integrity of the EEC.

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Source: EMM (2023); DCSSS (2023); MetroMap (2023)

Biodiversity constraints and impact avoidance measures

Darkinjung Local Aboriginal Land Council
Reeves Street, Somersby
Flora and Fauna Assessment
Figure 6.1

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7 Assessment of impacts

7.1 Impacts on native vegetation and habitat

7.1.1 Direct impacts

The direct impacts of the project will mainly be associated with clearing works within the proposed residential lots and the APZ. The impacts outlined below assume complete clearance within the study area, including complete clearing of all APZs. Direct impacts are summarised in Table 7.1.

Table 7.1 Direct Impacts within the study area

Biodiversity value	Area within the study area (ha)
Plant community types	
PCT 3586: Northern Sydney Scribbly Gum Woodland	3.64
PCT 3593: Sydney Coastal Sandstone Bloodwood Shrub Forest	10.09
PCT 3807: Northern Sydney Heath-Mallee	1.43
PCT 3924: Sydney Coastal Upland Swamp Heath	4.48
Total	**19.64**
Threatened ecological communities	
Coastal Upland Swamp in the Sydney Basin Bioregion	4.48 (equivalent to PCT 3924)
Species credit species habitat[1]	
Giant Burrowing Frog (recorded)	19.64 Species is associated with all PCTs mapped in the study area. A future species polygon would only include a 300 m buffer from the waterway where it is recorded.
Spreading Guinea Flower (recorded)	18.21 Species is associated with PCTs 3586, 3593, and 3924.
Squirrel Glider (recorded)	15.16 Species is associated with all PCTs mapped in the study area. PCT 3924 has been removed from this habitat area estimate due to the lack of eucalypt canopy.
Red-crowned Toadlet (recorded)	19.64 Species is associated with all PCTs mapped in the study area. A future species polygon would only include a 100 m buffer from the waterway where it is recorded.
Somersby Mintbush (assumed present)	18.21 Species is associated with PCTs 3586, 3593, and 3924.
Eastern Pygmy-possum (likely)	19.64 Species is associated with all PCTs mapped in the study area.

1. Note that comprehensive threatened species surveys have not been completed for this assessment. This table shows species recorded so far within the study area, as well as species deemed likely to occur at the site (see Section 5.4.4). Areas of impact are based on the areas of the PCTs with which the species are associated, rather than species polygons defined according to the BAM.

7.1.2 Indirect impacts

The project is not expected to cause substantial indirect impacts to the surrounding area and vegetation due to the implementation of mitigation measures outlined in Section 6.3. No substantial indirect impacts are expected to occur outside of the development footprint in relation to habitat connectivity, corridors, habitat fragmentation or light encroachment.

Indirect impacts that could occur as a result of the project include the following:

- Noise impacts: Noise disturbance is likely to be highest during clearance and construction works and has the potential to impact native species by disturbing roosting and foraging behaviour, causing animals to abandon habitat, and reducing the suitability of areas of existing habitat. Upon completion of the works, noise disturbance is likely to be similar to that already experienced form the nearby Pacific Motorway. Noise from proposed residences is not expected to significantly impact threatened species or communities.

- Dust impacts: Dust impacts will only be a concern during ground disturbance works associated with clearing and construction, and will be a temporary impact only. Potential impacts include dust covering vegetation which can impact the health of flora species, and subsequently impact fauna species. Design of the project should include measures to reduce dust impacts.

- Weeds and pathogens: There is potential for weed species and pathogens to be inadvertently brought into the site with imported materials, equipment, or the establishment of gardens, and can result in the degradation of retained native vegetation and habitat. Mitigation measures outlined in Chapter 6 will be implemented to prevent the spread of weeds into surrounding areas. It is noted that there are some high threat weed species present in the study area and that measures should be taken to prevent these from spreading further.

- Surface and groundwater impacts: A formal assessment of the surface and groundwater impacts associated with the project will be undertaken at the development application stage. Runoff, scouring, erosion and sedimentation can impact retained native vegetation and watercourses. Areas of Coastal Upland Swamp EEC in and around the development footprint are particularly susceptible to changes in surface and groundwater flows. The groundwater assessment will outline the avoidance measures to prevent hydrological impacts to the EEC outside of the development footprint, as well as measure to reduce impacts to the EEC within the development footprint. This will be specifically assessed as part of the development application stage, as acknowledged by Darkinjung.

7.2 Prescribed impacts

Prescribed impacts as laid out in Section 8.3 of the BAM (DPIE 2020) are summarised in Table 7.2. One prescribed impact has been identified, being the potential impacts to hydrological processes.

Table 7.2 Identification of prescribed impacts

Feature	Present on site	Potential impact
Karst, caves, crevices, cliffs, rocks and other geological features of significance	Small rocky areas occur within the development footprint. Note that one of the rock platforms present within the site will not be impacted by the proposed residential development and has been excluded from development plans due to the presence of Aboriginal Heritage Items.	No substantial impact expected given the limited extent of rocky habitat present.
Human-made structures	No	N/A
Non-native vegetation	No areas of non-native vegetation are present within the development footprint. The section of the study area where the canopy is dominated by Radiata Pine has been mapped as PCT 3593 in low condition, as the vegetation is otherwise predominantly native. This area is habitat for Spreading Guinea Flower (*Hibbertia procumbens*).	N/A
Habitat connectivity	The development footprint sits within a corridor of native vegetation approximately 3 km wide, connecting Ourimbah State Forest and Jilliby State Conservation Area in the north to Brisbane Water National Park in the south, as identified in the Central Coast Regional Plan 2041 (DPE 2022d).	Impacts to connectivity are considered to be minor, given that the development footprint is located adjacent to Reeves Street and existing cleared lots. The project proposes to impact a relatively small proportion of this area of native vegetation. The updated development footprint leaves a corridor of intact vegetation between the two proposed development areas, which will help to maintain connectivity between areas to the north and south of the development footprint (Figure 6.1). Impacts to connectivity will likely only affect species that are not particularly mobile such as threatened flora species. There will be no significant loss of fauna movement habitat.
Water bodies, water quality and hydrological processes	No waterbodies or waterways exist within the development footprint. Fountain Creek is mapped to the south of the development footprint. Waterways within the development footprint are limited to drainage lines originating at Reeves Street.	If mitigation measures mentioned in Section 6 are implemented, as well as any recommendations from the future surface and groundwater assessment (Section 7.1.2), no impacts on water quality or hydrological processes are expected to occur beyond the development footprint. The surface and groundwater assessment will contain more information on whether alterations to hydrological processes will occur and future development will be designed to ensure there is no impact to downstream communities. A decrease in available groundwater or surface water seepage could have negative impacts on the integrity and longevity of the Coastal Upland Swamp EEC mapped in and around the study area.
Wind turbine development	No	N/A
Vehicle strikes	Access to the development footprint will occur via Reeves Street. The proposed residences along Reeves St will result in an increase in local vehicle movement. One fire trail will be constructed along the southern boundary of the proposed lots, but this will be rarely used, and traffic will be negligible.	The increase in traffic along Reeves Street has the potential to increase incidence of vehicle strike, but this is expected to be minor and not substantial enough to lead to a decline in any threatened species.

7.3 Serious and Irreversible impacts

One fauna species with potential to occur within the study area (see Section 5.4.4) is listed as potential SAII species: the Giant Dragonfly. A further seven flora species are potential SAII species; however, they are considered unlikely to occur in the study area, based on the assessments in Section 5.4.4. The presence of these species will be determined through further targeted surveys, and they will be assessed for serious and irreversible impacts in the BCAR.

8 Assessment of the project against the *Environment Protection and Biodiversity Conservation Act 1999*

The project has been assessed against the requirements of the EPBC Act. Three species and one community listed under the EPBC Act, were recorded within the study area, and one species has been assumed present:

- Giant Burrowing Frog
- Glossy Black-cockatoo (foraging only)
- Somersby Mintbush (assumed present)
- Coastal Upland Swamps in the Sydney Basin Bioregion.

A further three species are considered to have potential to occur based on suitable habitat, with further targeted surveys required to determine presence:

- Southern Greater Glider
- Koala
- Sunshine wattle.

Assessments of significance have not been prepared for these species and communities. Further assessment of the potential for the project to result in a significant impact to threatened species and communities will be completed as a part of the Biocertification process. If these assessments determine that the project has the potential to result in a significant impact to threatened species or communities, then referral of the project to the Commonwealth Minister for the Environment for assessment will be required.

9 Conclusions

This biodiversity assessment has been undertaken in accordance with the requirements of the BAM (DPIE 2020) with impacts assessed under the BC Act and the EPBC Act.

Field surveys within the study area have been carried out by Umwelt and EMM between 2018 and 2023, comprising vegetation surveys, threatened flora surveys and threatened fauna surveys. These surveys have led to a good understanding of the key biodiversity values present within the study area and broader site and have been carried out in parallel with, and informed the evolution of, the development design. This process has ensured the avoidance and minimisation of biodiversity constraints as far as practicable.

Residual impacts comprise the clearing of 19.64 ha of native vegetation, including impacts to 4.48 ha of the threatened ecological community Coastal Upland Swamp in the Sydney Basin Bioregion, listed as endangered under the BC Act and the EPBC Act. The redesign of the proposal, to reduce the area proposed for rezoning and avoid impacts to the Coastal Upland Swamps EEC, particularly the largest and most intact patch of swamp at the western end of the site, have resulted in a reduction in impacts from the previous design. This has resulted in avoidance of 10.98 of native vegetation, 5.93 ha of Coastal Upland Swamp EEC and consequent reductions in impacts to a variety of threatened species.

Potential indirect and prescribed impacts from the proposed future development of the areas include noise and dust impacts during construction works, the introduction and spread of weed species within and beyond the development footprint, and potential impacts to surface and groundwater flows, which have the potential to impact on areas of Coastal Upland Swamp downstream from the development site. This report identifies a number of measures to mitigate these impacts. Impacts to hydrological processes will be examined in more detail in a surface and groundwater assessment, but mitigation measures are recommended to prevent impacts to the Coastal Upland Swamp EEC.

This assessment has also considered impacts to species and communities listed under the EPBC Act. Three species and one community listed under the EPBC Act, were recorded within the study area, one species is assumed to be present, and a further three species have potential to occur. A more detailed assessment of these species will be undertaken as a part of the Biocertification process, with referral of the proposal to the Commonwealth Minister for the Environment if the project has the potential to result in a significant impact to threatened species or communities.

Darkinjung intends to seek Biocertification of the C4 portion of the site in parallel with this planning proposal, with a view to having land proposed for future development Biocertified prior to any future application for subdivision. This will include preparation of a BCAR and application to BCD for Biocertification. Biodiversity values in the remainder of the lot (outside the current study area) will be considered as part of the conservation measures proposed in the BCAR.

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Australia

SYDNEY
Ground floor, 20 Chandos Street
St Leonards NSW 2065
T 02 9493 9500

NEWCASTLE
Level 3, 175 Scott Street
Newcastle NSW 2300
T 02 4907 4800

BRISBANE
Level 1, 87 Wickham Terrace
Spring Hill QLD 4000
T 07 3648 1200

CANBERRA
Level 2, Suite 2.04
15 London Circuit
Canberra City ACT 2601

ADELAIDE
Level 4, 74 Pirie Street
Adelaide SA 5000
T 08 8232 2253

MELBOURNE
188 Normanby Road
Southbank VIC 3006

PERTH
Level 9, Suite 9.02
109 St Georges Terrace
Perth WA 6831

Canada

TORONTO
2345 Yonge Street, Suite 300
Toronto ON M4P 2E5

VANCOUVER
60 W 6th Ave Suite 200
Vancouver BC V5Y 1K1

linkedin.com/company/emm-consulting-pty-limited

emmconsulting.com.au