BAM Stage 1 - Biodiversity Inventory Report

Lot 1 in DP 1124566, Lot 111 in DP850244 Lot 122 in DP1165184, Part Lot 300 in DP1248134

Prepared for

Belford Land Pty Ltd

Final / 5th April 2023

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Approval for use:

Matt Doherty

Accredited BAM Assessor # BAAS17044

5th April 2023

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EXECUTIVE SUMMARY

MJD Environmental has been engaged by Belford Land to prepare a Stage 1 BAM - Biodiversity Inventory Report (BIR) to be submitted with the Planning Proposal application for the rezoning of an 81.97 hectare parcel of land at Lot 1 in D 1124566 (94 Alma Rd), Lot 111 in DP850244 (285 Elderslie Rd), Lot 122 in DP1165184 (225 Elderslie Rd) & Part Lot 300 in DP1248134, Branxton NSW.

The Planning Proposal aims to rezone the 81.97 hectares of RU1 Primary production zoned land located at the above lots to R5 Large Lot Residential.

The proposed rezoning will occur over land containing a mosaic of cleared land and remnant native vegetation in various condition, including 24.25 ha of native vegetation comprising of grassland, forest and woodland.

This Stage 1 BAM - Biodiversity Inventory Report (BIR) has been prepared for submission with the aforementioned Planning Proposal for gateway determination. As such this BIR has been produced in a manner which is consistent with the Biodiversity Assessment Methodology (BAM) in order to satisfy later stages of the biodiversity planning process, post gateway.

The BAM was used as the assessment method, to establish impacts on threatened species and threatened ecological communities in the locality under the *Biodiversity Conservation Act* 2016.

In addition, preliminary assessment was also undertaken having regard to those threatened entities listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The proposed study area is zoned as RU1 Primary Production and is currently a series of grazing paddocks containing unsealed roads, fences, a creek and native vegetation. The land has undergone historic clearing and ongoing grazing, evident by the large areas without tree cover, pasture condition and weed invasion, and disturbed nature of native vegetation. The overall native woody vegetation is in poor to moderate condition comprising low species diversity and simple structure.

Field surveys carried out as part of the biodiversity assessment identified two Plant Community Types (PCT).

- 1600 – Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter (in several forms, including association with BC Act listed Endangered *Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions*; and association with BC Act listed Endangered *Central Hunter Ironbark—Spotted Gum—Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions*
- 1731 – Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley (not commensurate with the BC Act listed Endangered Ecological Community (EEC) *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*

A preliminary assessment under the EPBC Act indicated that no threatened species or communities listed as MNES occur on the site or are likely to be impacted by any future development at the time of assessment.

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GLOSSARY OF TERMS AND ABBREVIATIONS

Term/ Abbreviation	Meaning
BAM	Biodiversity Assessment Method
BDAR	Biodiversity Development Assessment Report
BC Act	Biodiversity Conservation Act 2016
BS Act	Biosecurity Act 2016
Council	Singleton Shire Council
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DPE	NSW Department of Planning and Environment
DPI Water	NSW Department of Primary Industries – Water
EP&A Act	NSW Environmental Planning and Assessment Act 1979
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
ha	hectare
LGA	Local Government Area
LLS Act	Local Land Services Act
OEH	Former NSW Office of Environment and Heritage

1 Introduction

MJD Environmental has been engaged by Belford Land to prepare a Stage 1 BAM - Biodiversity Inventory Report (BIR) to be submitted with the Planning Proposal application for the rezoning to R5 Large Lot Residential of an 81.97 hectare parcel of RU1 land at Lot 1 in D 1124566, Lot 111 in DP850244, Lot 122 in DP1165184 & Part Lot 300 in DP1248134, Branxton NSW (herewith referred to as the Study Area).

1.1 Aims & Objectives

The aims and objectives of this Biodiversity Inventory Report (BIR) was to provide an overall description of biodiversity attributes occurring within the Study Area, and in so doing produce a Biodiversity Assessment Method Stage 1 inventory of potential biodiversity values in the study area for subsequent assessment pending gateway determination.

The scope of this biodiversity inventory is to:

- identify vascular plant species occurring within the Study Area, including any threatened species listed under the BC Act and/or EPBC Act;
- identify and map the extent of vegetation communities within the Study Area, including any Threatened Ecological Communities (TEC) listed under the BC Act or EPBC Act;
- identify any fauna species including threatened and migratory species, populations or their habitats, occurring within the study area and are known or likely to occur within 10 km of the study area (locality);

The BIR aims to provide preliminary advice in relation to a Planning Proposal over the Study Area. This BIR recognises the relevant requirements of the EP&A Act 1979 as amended by the *NSW Environmental Planning and Assessment Amendment Act 1997*. Preliminary appraisal was also undertaken having regard to those threatened entities listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

In addition to survey work within the Study Area, consideration has been afforded to habitats within the wider area in order to appreciate the broader environmental context. This includes assessment of potential direct and indirect impacts

1.2 Planning Proposal Biodiversity Pathway

The objective of the Planning Proposal is to amend the Singleton Local Environmental Plan 2013 to facilitate a proposed development adjoining the existing residential subdivision known as the "Radford Park Estate" for the purpose of residential development and environmental conservation purposes.

Following Gateway determination, any future proposal will be assessed for development impacts affecting threatened entities. In accordance with Part 7 of the Biodiversity Conservation Act 2016 a development or activity is likely to significantly affect threatened species if –

- *it is likely to significantly affect threatened species or ecological communities, or their habitats, according to the Test of Significance (5-Part Test); or*
- *if the development exceeds the biodiversity offsets scheme threshold if the biodiversity offsets scheme applies to the impacts of the development on biodiversity value; or*
- *it is carried out in a declared area of outstanding biodiversity value*.

The study area is not a declared area of outstanding biodiversity value, however any proposal will be subject to the Biodiversity Offsets Scheme if any of the following thresholds are met:

- The clearing of native vegetation of an area declared by clause 7.2 (BC Regulation 2017) as exceeding the threshold, or
- the clearing of native vegetation, or other action prescribed by clause 6.1, on land included on the *Biodiversity Values Map* (BVM) published under clause 7.3. (BC Reg).

No land in the study area is mapped at the time of writing on the BVM. However the clearing threshold applying to the land in association with the smallest minimum lot size (40 ha) on the land is 1 hectare of native vegetation clearing. Under the proposed minimum lot size of 4,000sqm, the clearing threshold would be reduced to 0.25 hectares.

The following biodiversity assessment pathway was selected to ensure all works relating to biodiversity to be present in the Planning Proposal for Gateway Determination can be utilised for subsequent stages of the planning and development process such as rezoning determination and development application. It is the intention of the proponent to produce a Biodiversity Development Assessment Report (BDAR) to assess impacts and enable future development. It is the intention of the BIR to demonstrate the survey works carried out for preliminary appraisal of the PP which are required to satisfy Stage 1 of the BAM (2020), and to facilitate the assessment of impacts on Biodiversity Values on the subject land.

A biodiversity inventory investigation path was performed under the BAM (2020), involving:

Stage 1 – Biodiversity Assessment.

Refer to **Figure 1** for a site and location map and **Appendix A** for a plan of the proposed zoning boundaries.

Commonwealth Environmental Protection and Biodiversity Conservation Act 1999

Under the EPBC Act assessment an approval is required for actions that are likely to have a significant impact on matters of national environmental significance (MNES). Environmental approvals under the EPBC Act may be required for an 'action' that is likely to have a significant impact on MNES being:

- World Heritage Areas.
- National Heritage Places.
- Ramsar wetlands of international importance.
- Nationally listed threatened species and ecological communities.
- Listed migratory species.
- Commonwealth marine areas.
- Nuclear actions.
- Great Barrier Reef Marine Park.
- A water resource in relation to coal seam gas development and large coal mining development.

Of potential relevance to the Study area are MNES which include nationally listed threatened species, ecological communities and listed migratory species. Where there is the potential for a proposed activity to have a significant impact on any MNES a Referral under the EPBC Act is submitted to Department of Climate Change, Energy, the Environment and Water (DCCEEW) for approval.

Preliminary assessment was also undertaken having regard to those threatened entities listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

1.3 Site Particulars

The following nomenclature has been used in this report (Refer to **Figure 1**):

- Study Area – Refers to the lots under investigation (Lot 1 in DP1124566, Lot 111 in DP850244, Lot 122 in DP1165184, Part Lot 300 in DP1248134, Branxton NSW.)

Locality	The Study Area is located in Branxton, NSW
Land Title	Lot 1 in DP1124566 Lot 111 in DP850244 Lot 122 in DP1165184 Part Lot 300 in DP1248134
LGA	Singleton Council
Area	Study Area – 81.97
Zoning	The Study Area is currently zoned RU1 Primary Production (NSW Planning & Environment 2023).
Boundaries	The Study Area is situated north of the recently established residential precinct of Radford Park Estate with large-lot residential lots under construction adjoining the Study Area to the east and south. The Study Area is bound by frontage (east) to Elderslie Road and (south) to Alma Road, Branxton.
Current Land Use	The lot is currently primary production land running grazing cattle.
Topography	The highest point of Study Area is a ridge in the south-western part peaking at 90m AHD, sloping away to the south and towards the north-east. The north-eastern slope reaches a 40m AHD gully near the boundary of the two largest subject lots before climbing again to 70m at the western boundary with Elderslie Road. The southern slope continues gradually to the southern boundary with Alma Road at 40m AHD.

RADFORD PARK

FIGURE 1: SITE LOCATION

Legend

- Study Area
- Cadastral Boundary
- Cessnock LGA
- Singleton LGA
- Land Zoning - RU1

0 250 500 750 1,000

Metres

1:16000

N W E S

MJD Environmental

Aerial: Nearmap (2022) | Data: MJD Environmental (2023), NSW Spatial Services, NSW Department of Planning, Industry & Environment, ADW Johnson (2022) | Datum/Projection: GDA2020 / MGA zone 56 | Date: 05/04/2023 | Version: 2 | Z:\21020 - Radford Park Sewer | This plan should not be relied upon for critical design dimension.

STAGE 1 BIODIVERSITY ASSESSMENT

2 Landscape Context

2.1 Landscape Features

The following section provides a description of the landscape features within the Study Area and surrounding 1,500m buffer as outlined in Section 4 of the BAM (2020)

2.1.1 Interim Biogeographic Regionalisation of Australia (IBRA)

Bioregion

The study area occurs wholly within the Sydney Basin Bioregion. The Sydney Basin Bioregion comprises of Mesozoic sandstones and shales; dissected plateaus: forest, woodlands and heaths: The soils are primarily skeletal soils, sands and podzolics (Thackway & Cresswell 1995).

This Bioregion borders NSW North Coast to the north: Nandewar and Brigalow Belt south and the South Eastern Highlands in the south.

Subregion

The Study Area occurs wholly within the Hunter subregion.

2.1.2 Mitchell Landscapes

The Study Area occurs wholly within *Central Hunter Foothills* Mitchell Landscape (Chf) - Undulating lowlands, rounded to steep hills with rock outcrop on ridges on Permian lithic sandstone, conglomerate, shale and coal, general elevation 40 to 300m with a few higher peaks, local relief 30 to 120m. Red-brown to yellow brown harsh texture-contrast soils on slopes, dark coloured clays in valleys and limited accumulations of sand and gravel in streams. Woodlands to open forest of Spotted Gum (*Corymbia maculata*), Forest Red Gum (*Eucalyptus tereticornis*), Narrow-Leaved Ironbark (*Eucalyptus crebra*), Red Ironbark (*Eucalyptus sideroxylon*), White Box (*Eucalyptus albens*), Slaty Gum (*Eucalyptus dawsonii*), Rough-Barked Apple (*Angophora floribunda*) with Kangaroo Grass (*Themeda triandra*) and Wallaby Grass (*Austrodanthonia* sp).

2.1.3 Rivers, Streams, Estuaries and Wetlands

The Study Area is located within the Hunter River catchment in the Hunter region. The Study Area is located approximately 3km south of the Hunter River at Elderslie.

The hydrology of the study area is typified by a series of mapped ephemeral 1st order streams draining farm dams, ultimately tributary to Black Creek. A 2nd order stream runs from the Radford Park Estate through the northern lots of the study area, incorporating the catchment of most 1st order streams in the study area. The 2nd order stream runs in a coarsely south-north direction, connecting with Black Creek approximately 1km from its junction with the Hunter River. The remaining 1st order streams are mapped within the south western corner of the study area, directly tributary to Black Creek.

2.1.4 Ground Water Dependent Ecosystems

Groundwater plays an important ecological role in directly and indirectly supporting terrestrial and aquatic ecosystems. Groundwater sustains terrestrial and aquatic ecosystems by supporting vegetation and providing discharge to channels, lacustrine and palustrine wetlands, and both the estuarine and marine environment.

The degree of groundwater dependence of ecosystems in terms of three broad categories:

- **Non-dependent ecosystems** that occur mostly in recharge areas and have no connection with groundwater.
- **Facultative GDEs** that require groundwater in some locations but not in others, particularly where an alternative source of water can be accessed to maintain ecological function. Minor changes to the groundwater regime in facultative GDEs with proportional or opportunistic groundwater dependence may not have any adverse impacts but these ecosystems can be damaged or destroyed if a lack of access to groundwater is prolonged.
- **Obligate GDEs** that are restricted to locations of groundwater discharge and ecosystems located within aquifers (e.g. subterranean cave and stygofauna communities (Kuginis et al. 2012). Aquifer ecosystems are inherently groundwater dependent (Bureau of Meteorology, 2017).

Groundwater dependant ecosystems have been classified into seven types under two broad categories as follows (Kuginis et al. 2012):

- Subsurface ecosystems – Underground ecosystems
- Karst systems and caves (limestone geology)
- Subsurface aquifer (phreatic) ecosystems
- Baseflow streams (hyporheic or subsurface component)
- Surface ecosystems – Above ground ecosystems
- Groundwater dependent wetlands
- Baseflow surface streams (surface/free-water component)
- Estuarine and near shore marine ecosystems
- Groundwater dependent terrestrial ecosystems; dependent on subsurface groundwater (phreatophytic).

The Bureau of Meteorology Atlas of Groundwater Dependant Ecosystems (GDEs) for the Hunter River catchment has not identified areas of aquatic GDEs within the study area. The mapped vegetation communities within the study area are identified as low potential terrestrial GDE – from regional studies (Bureau of Meteorology, 2017). The watercourse to the south of the subject land contains mapped vegetation communities that are identified as high potential GDE – from regional studies (Bureau of Meteorology, 2017). This GDE is related to the Strahler 4th order Anvil Creek which forms a tributary of Black Creek to the west. This mapped GDE does not have tributaries within the study area and therefore is not associated within the proposal.

The project does not include the extraction of groundwater; however, contamination from construction operations, could impact on the quality of groundwater if adequate mitigation measures are not taken. See **Section 12** for recommended mitigation measures.

2.1.5 Connectivity

The Study Area lies in the primarily cleared western extent of a highly fragmented patch of remnant native vegetation over an area of approximately 2000 ha. The patch is bounded by large buffers of heavily cultivated land adjoining the Hunter River in the north and east. In the south it is bounded by the developed areas of Branxton and Greta, and the Hunter Expressway. Highly marginal connectivity exists southward to the larger remnant vegetation patch associated with North Rothbury. To the west, it is bounded by heavily cultivated land adjoining Black Creek, and the nearest connectivity to a larger regional patch of remnant native vegetation is approximately 2 km. This larger patch is contiguous with the North Rothbury vegetation, notwithstanding the hostile connections of the Main Northern Railway, New England Highway and Hunter Expressway, and includes Belford National Park.

Within the sector of this 2000 ha patch in the north of Branxton occupied by the Study Area, the vast majority of native vegetation exists east of Elderslie Road, with the exception of an area of primarily riparian land north-west of the intersection of Elderslie Road and Rusty Lane. Approximately 22 ha of this approximately 150 ha area occurs on the study area lands, in the form of the vegetated riparian zone of a 2nd order stream and an area of scattered canopy on grazing land in the north-east of the study area.

The study area contains other small areas of retained or regenerated native vegetation, however no intact or contiguous patches that expand the habitat provided by those areas described. To the south of the study area is ongoing development, which itself has been carried out on predominantly cleared land. To the west the land is completely cleared, improved or cropped until the banks of Black Creek approximately 1 - 1.5 km away. The study area therefore provides no local or regional connectivity between patches of native vegetation as habitat for native flora and fauna, and the study area itself contains very limited areas of marginal habitat, being situated as described on the extreme western extent of a 2000 ha area of fragmented remnant native vegetation in an otherwise very heavily cleared and cultivated landscape.

2.1.6 Areas of Geological significance and soil hazard features

No karsts, caves, crevices or cliffs or other areas of geological significance occur in or adjacent to the study area.

A review of the Acid Sulphate Soils Risk mapping (Naylor et al 1998) records indicate the site has not been assessed for ASS.

2.1.7 Areas of Outstanding Biodiversity Value

There are no Areas of Outstanding Biodiversity Values within the 1,500m buffer or in the general locality of the study area.

2.2 Site Context

The site context was assessed for the Study Area via desktop assessment of Aerial Photograph Interpretation (API) using GIS Software and site assessment. Site context considerations included native woody cover and patch size in accordance with section 3.2 & 4.3.2 of the BAM (2020)

2.2.1 Native Vegetation Cover

The native vegetation cover of the subject land and 1,500m buffer was carried out by API of high-quality aerial photography using GIS Software (Map Info), and State Vegetation Type Map (DPE 2022) mapping data.

Native vegetation cover has been assessed as 25%

Refer to **Figure 2**.

2.2.2 Patch Size

A patch is defined in the BAM as:

an area of intact native vegetation that occurs on the subject land. The patch may extend onto adjoining land beyond the footprint of the subject land, and for woody ecosystems, includes native vegetation separated by ≤100 metres from the next area of intact native vegetation. For non-woody vegetation, this gap is reduced to ≤30 metres.

Patch size for the Study Area has been assessed using the methods outlined above in Section 4.3.2 and it has been determined that the patch size is greater than 100ha.

RADFORD PARK

FIGURE 2: NATIVE VEGETATION EXTENT

Legend

- Study Area
- 1500m Buffer from Site
- Cadastral Boundary
- Cessnock LGA
- Singleton LGA
- Native Vegetation

Mitchell Landscape

- Central Hunter Alluvial Plains
- Central Hunter Foothills

Watercourse (Strahler Stream Order)

- 1st Order Stream
- 2nd Order Stream
- 3rd Order Stream
- 4th Order Stream
- 6th Order Stream

Riparian Corridor (*Water Management Act 2000*)

- 20m
- 40m
- 60m
- 80m

0 250 500 750 1,000

Metres

1:16000

IBRA Region: Sydney Basin
IBRA Sub-region: Hunter

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Aerial: Nearmap (2022) | Data: MJD Environmental (2023), NSW Spatial Services, NSW Department of Planning, Industry & Environment, ADW Johnson (2022), NSW Department of Planning and Environment (2016) | Datum/Projection: GDA2020 / MGA zone 56 | Date: 05/04/2023 | Version: 1 | Z:\21020 - Radford Park Sewer | This plan should not be relied upon for critical design dimension.

3 Methodology

The BIR has been prepared in accordance with the following guidelines to ensure compliance with future Biodiversity Offset Scheme requirements that are likely to be triggered should the planning proposal go through the Gateway Determination. The Biodiversity Assessment Method (2020) outlines all studies required that will allow for the Planning Proposal to be submitted for determination of the rezoning and thereafter development application.

All vegetation survey methods have been carried in accordance with the following documentation and methods:

- *Biodiversity Assessment Methodology (BAM):* Office of Environment and Heritage (OEH), October 2020;
- *Biodiversity Assessment Method Operational Manual - Stage 1* Office of Environment and Heritage (OEH), December 2020; and
- *Surveying threatened plants and their habitats - NSW survey guide for the Biodiversity Assessment Method* Office of Environment and Heritage (OEH), April 2020.

In addition, all Fauna survey methods have been carried out in accordance with the following documentation and methods:

- *Threatened Biodiversity Data Collection* (DPE 2023)
- *NSW Survey Guide for Threatened Frogs - A guide for the survey of threatened frogs and their habitats for the Biodiversity Assessment Method* (DPE 2020)
- *'Species credit' threatened bats and their habitats - NSW survey guide for the Biodiversity Assessment Method* (OEH 2018)
- *Threatened reptiles - Biodiversity Assessment Method survey guide* (DPE 2022)

3.1 Qualifications & Licencing

Qualifications

This BIR has been prepared by Chris Spraggon under the guidance of Matt Doherty (BAAS#17044) accredited BAM Assessor.

Field Work for the BIR was carried out by David Russel, Chris Spraggon, Coral Pearce, Maddy Walsh, Simone-Louise Yasui, Ali Bragg, Robert Fay, Max Manion-Sharrock, Mathew Grassi, Nixon Jowett, Laura Smith, Tom Fletcher and Josh Smart of MJD Environmental Pty Ltd.

Refer to **Appendix E** for personnel qualifications.

Licencing

Research was conducted under the following licences:

- NSW National Parks and Wildlife Service Scientific Investigation Licence SL101684 (Valid 31 March 2023).
- Animal Research Authority (Trim File No: 16/170) issued by NSW Department of Primary Industries (Valid 8 February 2024).
- Animal Care and Ethics Committee Certificate of Approval (Trim File No: 16/170) issued by NSW Department of Primary Industries (Valid 8 February 2024).

3.2 Desktop Assessment

A review of biodiversity information was undertaken to provide context and understanding of biodiversity values occurring within the study area.

Information reviewed included:

- Online database searches involving a 10-km buffer around the Study Area to provide potentially occurring threatened flora and fauna and migratory species under both the BC Act and EPBC Act:
    - NSW Bionet (accessed 27th February 2023 and continually during BIR production)
    - Commonwealth Protected Matters of National Significance search tool (accessed 7th February 2023)
- BioNet Vegetation Classification – Threatened species associated with known PCTs to occur within the Study Area; and

3.2.1 Preliminary Vegetation Review

A desktop analysis of vegetation within the Study Area and its surrounds were informed by large-scale vegetation mapping projects and aerial photography to determine potential Plant Community Types (PCT) occurring within the Study Area, they include:

- *State Vegetation Type Map* (NSW DPE 2022);
- GIS analysis including - Aerial Photograph Interpretation (API) and consultation of topographic map (Scale 1:25,000) layers for the Study Area; and
- OEH VIS Classification Database.

3.3 Vegetation and Flora Survey Methodology

3.3.1 Field Survey

Field assessments of the vegetation were carried out within the subject land on 13 April, 13 October 2021, 20 & 31 January, 1 & 9-10 February, 12-13 May, 6 December 2022 and 2 March 2023 by David Russel, Chris Spraggon, Coral Pearce, Maddy Walsh, Simone-Louise Yasui, Ali Bragg, Robert Fay, Max Manion-Sharrock, Mathew Grassi, Nixon Jowett, Laura Smith, Tom Fletcher and Josh Smart. The field surveys were carried out in accordance with the BAM (2020) with additional assessment methods to assist in gaining an overview of study areas biodiversity values.

The following methods were used to inform the vegetation survey associated with the BIR:

- Broad vegetation identification, delineation and stratification into vegetation zones carried out by detailed random meander methods (Cropper 1993);
- Collection of sixteen (16) plots based full floristic data as per Table 3 Section 4.3.4 of the BAM, recording the following;
    - Identification of all flora species to genus where identification attributes were present
    - Composition, Structure attributes within a 20x20 m plot; and
    - function attributes within a 20X50 m plot
- Collection of study area landscape attributes that included, landform, aspect, soil type, detailed descriptions of the vegetation condition, current land use and the current impacts.

Refer to **Figure 3** for Plant Community Types and BAM Plot locations.

RADFORD PARK

FIGURE 3: PCT & BAM PLOT LOCATIONS

Legend

- Study Area
- Cadastral Boundary
- Endangered Ecological Community
- Cleared
- Excluded under Part 5 Approval
- Waterbody
- Survey Transects
- BAM Plot
- Hollow Bearing Tree

Plant Community Types & Vegetation Zones

- VZ1 - PCT 1600 - Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrubgrass open forest of the lower Hunter (LowerHunterEEC)
- VZ2 - PCT 1600 - Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrubgrass open forest of the lower Hunter (GrasslandLow)
- VZ3 - PCT 1731 - Swamp Oak - Weeping Grass grassy riparianforest of the Hunter Valley (Moderate)
- VZ4 - PCT 1600 - Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrubgrass open forest of the lower Hunter (CentralHunterEEC)
- VZ5 - PCT 1600 - Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrubgrass open forest of the lower Hunter (Exotic)
- VZ6 - PCT 1731 - Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley (Grassland)

0 100 200 300 400

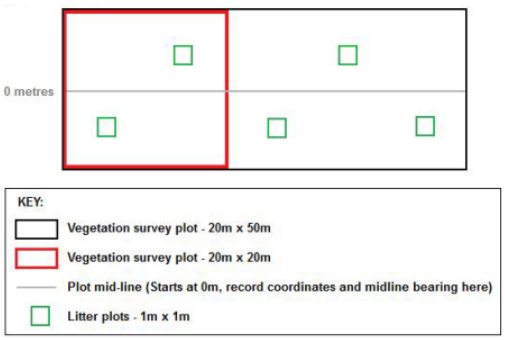
Metres

1:5500

N W E S

MJD Environmental

Aerial: Nearmap (2022) | Data: MJD Environmental (2023), NSW Spatial Services, ADW Johnson (2022) | Datum/Projection: GDA2020 / MGA zone 56 | Date: 05/04/2023 | Version: 2 | Z:\21020 - Radford Park Sewer | This plan should not be relied upon for critical design dimension.



Plot Lay out (BAM Satge 1 Operational Manual Dec 2020)

3.3.2 Threatened Flora Survey

Targeted threatened flora surveys were carried out over a range of seasons between 2021 and 2023, detailed in **Table 1**. targeting flora species that could not be conclusively ruled out from occurring on site due to suitable habitat occurring on site.

Threatened flora surveys were undertaken in accordance with *Surveying Threatened Plants and their habitats* (DPE 2022). The following techniques were employed:

- Parallel field-transverse survey technique. One ecologist walking at a distance of 5-20m depending on density of the vegetation was at time of survey
- Surveys conducted in suitable habitat for each of the targeted species
- Transects were recorded using a hand-held GPS unit

Refer to **Figures 4**, **5** & **6** for seasonal survey transect locations and **Table 5** provides the survey schedule for species credit species.

3.3.3 Hollow Bearing Tree Survey

A hollow bearing tree survey was undertaken (14th April 2022) across the study area with the following information collected:

- Location (D-GPS);
- Tree species;
- Tree DBH;
- Presences of hollows (including potential hollows) and class;
- Habitat suitability for large Forest Owls; and
- Any observational information.

RADFORD PARK

FIGURE 4: FLORA SURVEYS – OCTOBER 2021

Legend

- Study Area
- Cadastral Boundary
- Endangered Ecological Community
- Cleared
- Excluded under Part 5 Approval
- Waterbody

Plant Community Types & Vegetation Zones

- VZ1 - PCT 1600 (LowerHunterEEC)
- VZ2 - PCT 1600 (GrasslandLow)
- VZ3 - PCT 1731 (Moderate)
- VZ4 - PCT 1600 (CentralHunterEEC)
- VZ5 - PCT 1600 (Exotic)
- VZ6 - PCT 1731 (Grassland)

Survey Transects - October 2021

Species surveyed for:

Callistemon linearifolius
Diuris tricolor
Grevillea parviflora subsp. *parviflora*
Ozothamnus tesselatus
Persoonia pauciflora
Prostanthera cineolifera
Pterostylis chaetophora

0 100 200 300 400

Metres

1:5500

N W E S

MJD Environmental

Aerial: Nearmap (2022) | Data: MJD Environmental (2023), NSW Spatial Services, ADW Johnson (2022) | Datum/Projection: GDA2020 / MGA zone 56 | Date: 05/04/2023 | Version: 2 | Z:\21020 - Radford Park Sewer | This plan should not be relied upon for critical design dimension.

RADFORD PARK

FIGURE 5: FLORA SURVEYS – MAY 2022

Legend

- Study Area
- Cadastral Boundary
- Endangered Ecological Community
- Cleared
- Excluded under Part 5 Approval
- Waterbody

Plant Community Types & Vegetation Zones

- VZ1 - PCT 1600 (LowerHunterEEC)
- VZ2 - PCT 1600 (GrasslandLow)
- VZ3 - PCT 1731 (Moderate)
- VZ4 - PCT 1600 (CentralHunterEEC)
- VZ5 - PCT 1600 (Exotic)
- VZ6 - PCT 1731 (Grassland)

Survey Transects - May 2022

Species surveyed for:

Acacia bynoeana
Cynanchum elegans
Eucalyptus castrensis
Eucalyptus glaucina
Eucalyptus parramattensis subsp. *decadens*
Eucalyptus pumila
Persicaria elatior
Pomaderris queenslandica
Rutidosis heterogama

0 100 200 300 400

Metres

1:5500

N W E S

MJD Environmental

Aerial: Nearmap (2022) | Data: MJD Environmental (2023), NSW Spatial Services, ADW Johnson (2022) | Datum/Projection: GDA2020 / MGA zone 56 | Date: 05/04/2023 | Version: 2 | Z:\21020 - Radford Park Sewer | This plan should not be relied upon for critical design dimension.

RADFORD PARK

FIGURE 6: FLORA SURVEYS – DECEMBER 2022

Legend

- Study Area
- Cadastral Boundary
- Endangered Ecological Community
- Cleared
- Excluded under Part 5 Approval
- Waterbody

Plant Community Types & Vegetation Zones

- VZ1 - PCT 1600 (LowerHunterEEC)
- VZ2 - PCT 1600 (GrasslandLow)
- VZ3 - PCT 1731 (Moderate)
- VZ4 - PCT 1600 (CentralHunterEEC)
- VZ5 - PCT 1600 (Exotic)
- VZ6 - PCT 1731 (Grassland)

- Survey Transects - December 2022

Species surveyed for:

Cryptostylis hunteriana

Monotaxis macrophylla

Thesium australe

0 100 200 300 400

Metres

1:5500

N W E S

MJD Environmental

Aerial: Nearmap (2022) | Data: MJD Environmental (2023), NSW Spatial Services, ADW Johnson (2022) | Datum/Projection: GDA2020 / MGA zone 56 | Date: 05/04/2023 | Version: 2 | Z:\21020 - Radford Park Sewer | This plan should not be relied upon for critical design dimension.

3.4 Fauna Survey Methods

A desktop assessment of the potential use of the site by threatened fauna species (as listed under the BC Act and EPBC Act) identified from the vicinity was undertaken prior to the commencement of field surveys (Refer to **Section 3.2**).

Targeted surveys for fauna species recognised to have potential to occur within the Study Area were carried out by MJD Environmental as part of the works informing this BIR.

All fauna surveys have been carried out in accordance with the requirements and guidelines in the Threatened Biodiversity Data Collection (TBDC) managed by Department of Planning and Environment (DPE). In addition, targeted amphibian surveys were undertaken in accordance with *NSW Survey Guide for Threatened Frogs. A guide for the survey of threatened frogs and their habitat for the Biodiversity Assessment Method (2020)* (DPIE 2020).

Microchiropteran bat surveys were undertaken in accordance with *'Species credit' threatened bats and their habitats – NSW survey guide for the Biodiversity Assessment Method* (OEH 2018).

Refer to **Figures 7** through **10** for all targeted fauna surveys, and **Table 7** provides the survey effort and timing for each threatened fauna species.

Arboreal Mammals

Arboreal mammal surveys were undertaken using Scout Guard remote wildlife cameras. Cameras were mounted to trees via a bracket or strap and set to record images in bursts of three photos, with a three-minute delay before the next photo sequence would be triggered (Refer to **Figure 7**).

To attract fauna to the camera, a bait station was attached to a tree within 1- 1.5m of the camera. The bait station was filled with a bait containing a mixture of sardines, oats, honey, and peanut butter. The tree in which the bait station was attached also was sprayed with an attractant of honey / sugar water to increase the chance of arboreal fauna.

A total of 960 camera trap nights were undertaken to target arboreal mammals within the Study Area.

Arboreal mammal surveys were also undertaken by nocturnal spotlighting using headtorches and 6W LED reflector lens handheld searchlights (1 LUX @ 334m) (Refer to **Figure 10**).

Terrestrial Mammals

Terrestrial mammal surveys were undertaken within the study area by deploying pitfall traps and drift fence arrays. Pitfalls were installed 8m apart with a 10m drift fence crossing both traps. Traps were closed in daylight hours and checked daily prior to sunrise (Refer to **Figure 7**).

A total of 80 pitfall trap nights were undertaken within the study area.

The presence of mammals was also assessed via opportunistic observations during other diurnal fieldwork and nocturnal surveys. The surveys undertaken are outlined in detail below under Spotlighting survey techniques.

Avifauna

The observation of avifauna within the Study Area was undertaken via targeted diurnal census supplemented by opportunistic observations during other diurnal fieldwork (Refer to **Figure 3**). The diurnal census surveys were undertaken at dusk and dawn (early morning being a peak activity period for birds.

Nocturnal bird surveys were undertaken, and detail of methods employed is outlined in below under Spotlighting and call playback survey techniques.

Herpetofauna

Opportunistic reptile searches were conducted during fauna surveys with a focus on suitable habitat areas. Known occurrences of threatened reptile species from the locality were taken into account during assessment of onsite habitat, to determine the potential for the Study Area to support such species. Searches in likely habitat such as among thick leaf litter, under rocks and fallen timber were undertaken. These searches were carried out during peak activity periods, generally during the warmer parts of the day. Stockpiles and/ or dumped rubbish was also checked for sheltering reptiles.

Terrestrial reptile surveys were undertaken using funnel traps and drift fence arrays deployed in likely habitat. Funnels were placed in pairs either side of 15m drift fence, 6 traps in total per array, evenly spaced along the fence. Traps were closed in daylight hours and checked daily in the early morning (Refer to **Figure 7**).

A total of 24 funnel trap array nights were undertaken within the study area.

Arboreal reptile surveys were undertaken using nocturnal spotlighting with headtorches and 6W LED reflector lens handheld searchlights (1 LUX @ 334m).

Nocturnal listening and call playback surveys were conducted over two nights for amphibian species. Frogs were identified by call, and species occurring on site were noted during spotlighting transects across the study area. In addition, one 2000m transect through suitable potential habitat over two nights were undertaken covering waterbodies and associated creeklines (Refer to **Figure 8**).

Microchiropteran Bats

Microbat surveys were undertaken by recording echolocation calls using two Anabat Express Detector units set to remotely record for 4 nights (civilian sunset to sunrise). This recording and assessment of the study area habitat and surrounds will inform whether further surveys will be required in accordance with *Species Credit Threatened Bats and their habitats NSW Survey guide for the Biodiversity Assessment Method* (2018). A total of 8-night recording was made over the study area. The Anabat units were placed with an emphasis on those areas deemed likely to provide potential foraging and flyway sites for microbats.

Bat call analysis was undertaken by Amanda Lo Cascio who is experienced in the analysis of bat echolocation calls. Each call sequence ('pass') was assigned to one of five categories, according to the confidence with which an identification could be made, being:

- Definite - Pass identified to species level and could not be confused with another species;
- Probable - Pass identified to species level and there is a low chance of confusion with another species;
- Possible - Pass identified to species level but short duration or poor quality of the pass increases the chance of confusion with another species;
- Species group - Pass could not be identified to species level and could belong to one of two or more species. Occurs more frequently when passes are short or of poor quality.

Two Harp Traps were placed at likely flyways for 4 nights each over two separate survey periods for a total of 16 trap nights to sample microbat species for identification in hand and assessment of reproductive status. Traps were checked prior to dawn each day and catch bags removed during daylight hours.

Appendix D contains the Anabat reports with all results, and the location of the Anabat and Harp Trap locations are shown in **Figure 7**.

Spotlighting

Spotlighting was undertaken with the use of a Lightforce Enforcer 140mm LED (1 LUX @ 334m) hand-held spotlight and head torch whilst traversing the study area. Areas of mature remnant vegetation were targeted, however, tracks around the site were also spotlighted whilst entering and exiting the vegetation.

A total of 10 person hours of spotlighting was conducted over four nights for mammals, herpetofauna and nocturnal birds.

Nocturnal Call Playback

The use of pre-recorded calls of Forest Owl and Amphibian species that may occur within the Study Area and surrounding area were broadcast during the nocturnal surveys in an effort to receive a vocal response or to attract the species to the playback site. The calls were broadcast through an amplification system (25W megaphone) designed to project the sound for at least 1 km under still night conditions.

As described by Kavanagh and Peake (1993) and Debus (1995), the call of each species was broadcast for at least five minutes, followed by five minutes of listening, and stationary spotlighting. Following the final broadcast and listening, the area was spotlighted on foot.

A total of five call playback sessions were undertaken over five separate nights. The location of the call playback sites is shown in **Figures 8** & **9**.

3.4.1 Habitat Survey

An assessment of the relative habitat value present within the study area was undertaken. This assessment focused primarily on the identification of specific habitat types and resources in the study area favoured by known threatened species from the locality. The assessment also considered the potential value of the study area (and surrounds) for all major guilds of native flora and fauna. Habitat assessment included:

- presence, size and types of tree hollows within the Study Area;
- survey for trees containing suitable hollows for Large Forest Owls within 100m of all impact areas;
- presence of rocks, logs, caves, rocky outcrops, leaf litter, overhangs and crevices;
- vegetation complexity, structure and quality;
- presence of freshwater or estuarine aquatic habitats, noting permanency;
- connectivity to adjacent areas of habitat;
- extent and types of disturbance;
- foraging opportunities (flowering eucalypts, fruits, seeds or other nectar bearing native plants)
- presence and abundance of various potential prey species.

Habitat assessment was based on the specific habitat requirements of each threatened fauna species with regard to home range, feeding, roosting, breeding, movement patterns and corridor requirements. Consideration was given to contributing factors including topography, soil, light and hydrology for threatened flora and assemblages.

Secondary Indications and Incidental Observations

Opportunistic sightings of secondary indications (scratches, scats, diggings, tracks etc.) of resident fauna were noted. Such indicators included:

- Distinctive scats left by mammals;
- Scratch marks made by various types of arboreal animals;

- Nests made by various guilds of birds;
- Feeding scars on Eucalyptus trees made by Gliders;
- Whitewash, regurgitation pellets and prey remains from Owls;
- Aural recognition of bird and frog calls;
- Skeletal material of vertebrate fauna; and
- Searches for indirect evidence of fauna (such as scats, nests, burrows, hollows, tracks, and diggings).

3.5 Limitations

Limitations associated with this assessment report are presented herewith. The limitations have been taken into account specifically in relation to threatened species assessments, results and conclusions.

In these instances, a precautionary approach has been adopted; whereby 'assumed presence' of known and expected threatened species, populations and ecological communities has been made where relevant and scientifically justified to ensure a holistic assessment.

Seasonality & Conditions

The flowering and fruiting plant species that attract some nomadic or migratory threatened species, often fruit or flower in cycles spanning a number of years. Furthermore, these resources might only be accessed in some areas during years when resources more accessible to threatened species fail. As a consequence, threatened species may be absent from some areas where potential habitat exists for extended periods and this might be the case for nomadic and opportunistic species.

Data Availability & Accuracy

The collated threatened flora and fauna species records provided by NSW BioNet are known to vary in accuracy and reliability. This is usually due to the reliability of information provided to the National Parks and Wildlife Service (NPWS) for collation and/or the need to protect specific threatened species locations. During the review of threatened species records sourced from OEH BioNet Atlas of NSW, consideration has been given to the date and accuracy of each threatened species record in addition to an assessment of habitat suitability within the study area.

Similarly, EPBC Protected Matters Searches provide a list of threatened species and communities that have been recorded within 10 km of the Study Area, or which have suitable habitat within the wider area, and are subject to the same inherent inaccuracy issues as the State derived databases.

In order to address these limitations in respect to data accuracy, threatened species records have only been used to provide a guide to the types of species that occur within the locality of the Study Area. Consequently, BAM assessment and the results of surveys conducted within the study area and surrounds have been used to assess the likelihood of occurrence of threatened species, populations and ecological communities to occur therein.

3.6 Weather Conditions

Field surveys were undertaken by MJD Environmental between the April 2021 and March 2023. The prevailing weather conditions during the survey are presented in a **Table 1** below.

Table 1 Prevailing Weather Conditions

Date	Min Temp (°C)	Max Temp (°C)	Rain (mm)	Wind (km/h)	Sunrise-Sunset
13-Apr-21	*no data available*	*no data available*	*no data*	*no data available*	0615-1736
13-Oct-21	*no data available*	*no data available*	*no data*	*no data available*	0617-1905
17-Nov-21	*no data available*	*no data available*	*no data*	*no data available*	0544-1935
14-Apr-22	11.8	23.9	2.4	WSW 6 – W 13	0616-1734
23-May-22	11	19.7	17	SSE 9 - 20	0642-1700
24-May-22	9.1	18.9	3	Calm - SSE 11	0643-1700
22-Jun-22	6.3	18.2	0.2	WNW 13 - WSW 11	0656-1657
23-Jun-22	3.1	18	0	WNW 17	0657-1657
29-Jun-22	3.9	17.3	0	WNW 11 -NNW 6	0657-1659
17-Aug-22	5.8	*no data available*	0.2	WNW 19 - S 11	0630-1728
18-Aug-22	*no data available*	21.7	0	NW 20	0629-1728
22-Aug-22	3.6	21.5	0	NW 13 - NNW 31	0624-1731
23-Aug-22	6.9	23.5	0	SE 7 - WNW 24	0623-1731
30-Aug-22	9.3	23.6	0	WNW 4 - 15	0615-1736
31-Aug-22	7.2	21.9	0	WNW 11 – SSE 20	0613-1737
5-Sep-22	7.9	19.7	2.0	NW15 – SSE 22	0607-1740
4-Oct-22	6.1	24.4	0	NW 11 – E 9	629-1858
6-Oct-22	13.9	21.9	20	SE 7 – NNE 15	626-1900
1-Nov-22	16.6	23.6	12.4	WNW 39 – 31	556-1920
2-Nov-22	10.2	20.4	2.0	NW 33 – W 28	555-1921
5-Nov-22	7.4	24.3	0	E 9 – ESE 24	553-1924
6-Nov-22	8.4	25.7	0	N 4 – E 20	552-1924
9-Nov-22	10.2	25.2	0	E 11 – 24	550-1927
15-Nov-22	13.7	27.1	0	WNW 17 – SW 13	546-1933
6-Dec-22	19.2	26.7	0	SSE 13 – ESE 24	540-1951
14-Dec-22	10.8	26.6	*no data*	NW 17 – WNW 24	541-1957
16-Jan-23	16.0	30.1	0	E 15 – SE 24	0603-2005
17-Jan-23	15.5	30.4	0	ESE 7 – E 20	0604-2005
18-Jan-23	14.6	34.4	0	NW 9 – ENE 9	0605-2005
19-Jan-23	20.4	21.7	3.0	NW 6 – S 17	0606-2004

Sources: http://www.bom.gov.au/climate/dwo/IDCJDW2079.latest.shtml
http://www.ga.gov.au/bin/geodesy/run/sunrisenset

RADFORD PARK

FIGURE 5: FLORA SURVEYS – MAY 2022

Legend

- Study Area
- Cadastral Boundary
- Endangered Ecological Community
- Cleared
- Excluded under Part 5 Approval
- Waterbody

Plant Community Types & Vegetation Zones

- VZ1 - PCT 1600 (LowerHunterEEC)
- VZ2 - PCT 1600 (GrasslandLow)
- VZ3 - PCT 1731 (Moderate)
- VZ4 - PCT 1600 (CentralHunterEEC)
- VZ5 - PCT 1600 (Exotic)
- VZ6 - PCT 1731 (Grassland)

Survey Transects - May 2022

Species surveyed for:

Acacia bynoeana
Cynanchum elegans
Eucalyptus castrensis
Eucalyptus glaucina
Eucalyptus parramattensis subsp. *decadens*
Eucalyptus pumila
Persicaria elatior
Pomaderris queenslandica
Rutidosis heterogama

0 100 200 300 400

Metres

1:5500

N W E S

MJD Environmental

Aerial: Nearmap (2022) | Data: MJD Environmental (2023), NSW Spatial Services, ADW Johnson (2022) | Datum/Projection: GDA2020 / MGA zone 56 | Date: 05/04/2023 | Version: 2 | Z:\21020 - Radford Park Sewer | This plan should not be relied upon for critical design dimension.

RADFORD PARK

FIGURE 6: FLORA SURVEYS – DECEMBER 2022

Legend

- Study Area
- Cadastral Boundary
- Endangered Ecological Community
- Cleared
- Excluded under Part 5 Approval
- Waterbody

Plant Community Types & Vegetation Zones

- VZ1 - PCT 1600 (LowerHunterEEC)
- VZ2 - PCT 1600 (GrasslandLow)
- VZ3 - PCT 1731 (Moderate)
- VZ4 - PCT 1600 (CentralHunterEEC)
- VZ5 - PCT 1600 (Exotic)
- VZ6 - PCT 1731 (Grassland)

- Survey Transects - December 2022

Species surveyed for:

Cryptostylis hunteriana

Monotaxis macrophylla

Thesium australe

0 100 200 300 400

Metres

1:5500

N W E S

MJD Environmental

Aerial: Nearmap (2022) | Data: MJD Environmental (2023), NSW Spatial Services, ADW Johnson (2022) | Datum/Projection: GDA2020 / MGA zone 56 | Date: 05/04/2023 | Version: 2 | Z:\21020 - Radford Park Sewer | This plan should not be relied upon for critical design dimension.

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FIGURE 7: FAUNA SURVEYS – STATIC

Legend

- Study Area
- Cadastral Boundary
- Endangered Ecological Community
- Cleared
- Excluded under Part 5 Approval
- Waterbody
- Structure

Plant Community Types & Vegetation Zones

- VZ1 - PCT 1600 (LowerHunterEEC)
- VZ2 - PCT 1600 (GrasslandLow)
- VZ3 - PCT 1731 (Moderate)
- VZ4 - PCT 1600 (CentralHunterEEC)
- VZ5 - PCT 1600 (Exotic)
- VZ6 - PCT 1731 (Grassland)

Survey Type

- Pitfall
- Funnel Trap
- Harp Trap
- Anabat
- Brush-tailed Phascogale Camera

0 100 200 300 400

Metres

1:5500

N E S W

MJD Environmental

Aerial: Nearmap (2022) | Data: MJD Environmental (2023), NSW Spatial Services, ADW Johnson (2022) | Datum/Projection: GDA2020 / MGA zone 56 | Date: 05/04/2023 | Version: 2 | Z:\21020 - Radford Park Sewer | This plan should not be relied upon for critical design dimension.

RADFORD PARK

FIGURE 8: FAUNA SURVEYS – DYNAMIC (AMPHIBIANS)

Legend

- Study Area
- Cadastral Boundary
- Endangered Ecological Community
- Cleared
- Excluded under Part 5 Approval
- Waterbody

Plant Community Types & Vegetation Zones

- VZ1 - PCT 1600 (LowerHunterEEC)
- VZ2 - PCT 1600 (GrasslandLow)
- VZ3 - PCT 1731 (Moderate)
- VZ4 - PCT 1600 (CentralHunterEEC)
- VZ5 - PCT 1600 (Exotic)
- VZ6 - PCT 1731 (Grassland)

- Survey Transects
- Frog Call Playback (*Litoria aurea, Litoria brevipalmata*)

0 100 200 300 400

Metres

1:5500

N E S W

MJD Environmental

Aerial: Nearmap (2022) | Data: MJD Environmental (2023), NSW Spatial Services, ADW Johnson (2022) | Datum/Projection: GDA2020 / MGA zone 56 | Date: 05/04/2023 | Version: 2 | Z:\21020 - Radford Park Sewer | This plan should not be relied upon for critical design dimension.

RADFORD PARK

FIGURE 9: FAUNA SURVEYS – DYNAMIC (AVES)

Legend

- Study Area
- Cadastral Boundary
- Endangered Ecological Community
- Cleared
- Excluded under Part 5 Approval
- Waterbody

Plant Community Types & Vegetation Zones

- VZ1 - PCT 1600 (LowerHunterEEC)
- VZ2 - PCT 1600 (GrasslandLow)
- VZ3 - PCT 1731 (Moderate)
- VZ4 - PCT 1600 (CentralHunterEEC)
- VZ5 - PCT 1600 (Exotic)
- VZ6 - PCT 1731 (Grassland)

- Survey Transects
- Gang Gang and Raptor Survey
- Owl Call Playback

0 100 200 300 400

Metres

1:5500

N W E S

MJD Environmental

Aerial: Nearmap (2022) | Data: MJD Environmental (2023), NSW Spatial Services, ADW Johnson (2022) | Datum/Projection: GDA2020 / MGA zone 56 | Date: 05/04/2023 | Version: 2 | Z:\21020 - Radford Park Sewer | This plan should not be relied upon for critical design dimension.

RADFORD PARK

FIGURE 10: FAUNA SURVEYS – DYNAMIC (MAMMALS)

Legend

- Study Area
- Cadastral Boundary
- Endangered Ecological Community
- Cleared
- Excluded under Part 5 Approval
- Waterbody

Plant Community Types & Vegetation Zones

- VZ1 - PCT 1600 (LowerHunterEEC)
- VZ2 - PCT 1600 (GrasslandLow)
- VZ3 - PCT 1731 (Moderate)
- VZ4 - PCT 1600 (CentralHunterEEC)
- VZ5 - PCT 1600 (Exotic)
- VZ6 - PCT 1731 (Grassland)

- Survey Transects
- Koala SAT

0 100 200 300 400

Metres

1:5500

N W E S

MJD Environmental

Aerial: Nearmap (2022) | Data: MJD Environmental (2023), NSW Spatial Services, ADW Johnson (2022) | Datum/Projection: GDA2020 / MGA zone 56 | Date: 05/04/2023 | Version: 2 | Z:\21020 - Radford Park Sewer | This plan should not be relied upon for critical design dimension.

4 Vegetation Results

4.1 Native Vegetation Extent

The Study Area is 81.97ha in size, of which 24.25 ha was observed as native vegetation. The extent of native vegetation has been interpreted using API and ground truthing during field survey works. (Refer to **Figure 3**).

The vegetation within the Study Area has been broadly cleared historically for grazing. The historic land use has resulted in a degraded landscape generally devoid of canopy and with a high proportion of high threat exotic species (HTE). Area that remain vegetated with native species include the riparian area in the north and the paddock trees in the north-east.

Identification of PCTs within the study area were determined using:

- Occurrence within the Sydney IBRA bioregion & Hunter Sub-region;
- Vegetation formation and class:
- landscape position; and
- dominant species noted during field data collected from the full floristic plots/transects established in accordance.

Two PCT's were identified within the Study Area:

- **PCT 1600** Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter
- **PCT 1731** Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley

A total of 136 plant species were identified within ten plots comprising 81 native species and 55 exotic species. The results of the plot field data and a flora species list can be found in **Appendix B**.

4.2 Vegetation Integrity Assessment

Native vegetation identified on site has been delineated into PCT 1600 categorised into four vegetation zones, two of which are wooded VZs and two are examples of derived native grasslands (DNG). Native vegetation is also present as PCT 1731, delineated into two VZs; one wooded and one DNG. These vegetation zones were delineated based on the general condition of vegetation, observation of distinct change or variation in the vegetation based on general attributes such as vegetation age, observable disturbance (past and present), exotic species presences and any structural difference in the stratum present.

The subject land has been delineated into five (5) vegetation zones:

- VZ 1: 1600_LowerHunterEEC
- VZ 2: 1600_GrasslandLow
- VZ 3: 1731_Moderate
- VZ 4: 1600_CentralHunterEEC
- VZ 5: 1600_Exotic
- VZ 6: 1731_Grassland

The following table provides a brief description of the vegetation zones justifying the categorisation.

Sixteen (16) full floristic BAM plots were conducted. The number of plots carried out are in accordance with the minimum required plots per area as outlined in Table 3 of the BAM (2020). Refer to **Figure 3** for BAM plot locations.

4.3 Vegetation Zones

Vegetation Zone 1

PCT 1600 *Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter*	
Area within Subject land	14.93 ha
Vegetation Formation	Dry Sclerophyll Forests (Shrub/grass sub-formation)
Vegetation Class	Hunter-Macleay Dry Sclerophyll Forests
Floristic Description	The canopy is characterised by a generally mature but sparse cohort dominated by *Eucalyptus fibrosa* (Red Ironbark) and *Corymbia maculata* (Spotted Gum). The subcanopy and shrub layer is absent across the zone, limited to *Bursaria spinosa* (Blackthorn), *Breynia oblongifolia* (Coffee Bush). Exotic species also occur sporadically in the shrub strata of this zone, generally associated with proximity to canopy trees or dams. Most common are *Olea europaea* subsp. *cuspidata* (African Olive) and *Lantana camara* (Lantana). The groundcover is a mixture of disturbance and pasture species, exotic dominated, with persisting native grasses and forbs. Native grass species occurring most frequently are *Cynodon* dactylon (Couch), *Aristida vagans* (Threeawn Speargrass), *Cymbopogon refractus* (Barb-wire Grass), *Panicum simile* (Two-colour Panic), *Bothriochloa macra* (Red Grass), Entolasia *stricta* (Wiry Panic), *Echinopogon caespitosus* (Hedgehog Grass) and *Themeda triandra* (Kangaroo Grass). Grass-like native species also include *Fimbristylis dichotoma* (Fringe Sedge). Native forbs commonly occurring include *Hibbertia obtusifolia* (Hoary Guinea Flower), *Arthropodium milleflorum* (Pale Vanilla Lily), *Goodenia rotundifolia, Pseuderanthemum variabile* (Pastel Flower), *Commelina cyanea, Einadia nutans* (Climbing Saltbush), *Glycine tabacina* (Variable Glycine), *Murdannia graminea, Pratia purpurascens* (Whiteroot), *Pomax umbellata,* and the fern *Cheilanthes sieberi* (Poison Rock Fern). Exotic grasses and groundcovers are dominant and diverse, with high threat exotic grasses most dominant. These include *Chloris gayana* (Rhodes Grass), *Eragrostis curvula* (African Lovegrass), *Paspalum dilatatum,* and *Cenchrus clandestinus* (Kikuyu). High threat exotic forbs include *Bidens* spp. (Cobblers Pegs) *Senecio madagascariensis* (Fireweed) and *Tecoma stans* (Yellow Bignonia).
Condition	Lower Hunter EEC
BAM Plots	02, 03, 04
Structure	Canopy structure is sparse but reliable throughout with a mature cohort, with effectively absent midstorey and a dense ground strata. Structure is consistent with disturbance due to past underscrubbing and grazing, with loss of vegetation cover, soil compaction, erosion and sedimentation, and firewood collection. Weed invasion is moderate and includes high threat exotics (HTEs). Litter coverage was generally high and with habitat features such as fallen logs and large branches, and standing dead stags noted.

PCT 1600 *Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter*	
Justification for PCT Selection	PCT 1600 is consistent with the Vegetation Formation and Class observed within the subject land, and the associated Mitchell Landscape of CHF. PCT determination was driven primarily by dominant canopy species composition, *Eucalyptus fibrosa* and *Corymbia maculata*, with consideration given to the presence of *E. moluccana* and *E. crebra* elsewhere on the study area within a discontinuous landscape formed from the same parent woodland. Canopy species was the primary selection criteria after controlling for IBRA subregion occurrence, formation and class (Hunter Macleay DSF). Shrub species and groundcovers were considered as refinement, however given low weight due to lack of diversity. PCT selection is therefore "best-fit". PCT 1601 was considered, however occurrence of *Cheilanthes sieberi, Breynia oblongifolia* and *Leucopogon juniperinus* and absence of *Lissanthe strigosa* more strongly supported 1600. The study area landscape position on low rises rather than flats further supports PCT 1600.
Status	**BC Act**: **E:** *Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions* This VZ was determined commensurate with the BC Act listed community due to the subject land occurring in appropriate range and soil profile, and the VZ containing a floristic composition in line with the species assemblage listed within the NSW final determination for the community.
	BC Act: **E:** *Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions* The VZ was determined not to be commensurate with the BC Act listed community due to species composition and landscape. This TEC is considered to occur in the study area and has been assessed as a separate VZ.

Vegetation Zone 2

PCT 1600 *Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter*	
Area within Subject land	18.99
Vegetation Formation	Dry Sclerophyll Forests (Shrub/grass sub-formation)
Vegetation Class	Hunter-Macleay Dry Sclerophyll Forests
Floristic Description	Historically cleared, with limited regeneration of *Corymbia maculata* among native and exotic grasses and forbs. The VZ contains a very sparse (near absent) mid stratum, limited to *Acacia parvipinnula* (Silver-stemmed Wattle), *Leucopogon juniperinus* (Prickly Beard Heath) and *Daviesia ulicifolia* (Gorse Bitter Pea) occurring as occasional individuals or small patches. The ground layer is diverse, dominated by grasses. Persistent native forbs include *Wahlenbergia gracilis* (Sprawling Bluebell), *Chrysocephalum apiculatum* (Yellow Buttons), *Laxmannia gracilis* (Slender Wire Lily) and *Haloragis heterophylla* (Variable Raspwort). Dominant native grasses are consistently *Themeda triandra* and *Panicum simile*. *Cynodon dactylon* also occurs reliably. Other species reliably encountered included *Chloris ventricosa*, *Cymbopogon refractus*, *Microlaena stipoides*, *Dichelachne micrantha*, *Aristida vagans*, and *Bothriochloa macra*. Among the grasses, high threat exotic *Paspalum dilatatum* was codominant in some areas. *Axonopus fissifolius* (Narrow leaved carpet grass) and *Briza subaristata* also common. HTE forbs were limited to *Senecio madagascariensis*, and no HTE shrubs were recorded.
Condition	Grassland
BAM Plots	08, 09, 11, 13
Structure	Historically cleared, with some Eucalypt regeneration but no functional canopy or mid stratum. Grazing has resulted in limited litter cover and somewhat reduced the native diversity of grasses and forbs, with exotic species consistently present. No dead or fallen timber. Some loss of vegetation cover, soil compaction and erosion.
Justification for PCT Selection	This VZ occurs as a grassland with no distinguishing canopy species. As a grassland, it is assessed as having the adjacent wooded areas as the parent community. PCT 1600 is applied as a best fit to this VZ on that basis, being applied to those VZs.
Status	This VZ is not commensurate with any TEC as it is a grassland of the parent woodland. No characteristics of a TEC are present. Linking areas have been captured in wooded VZ buffers

Vegetation Zone 3

PCT 1731 *Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley*	
Area within Subject land	4.83
Vegetation Formation	Forested Wetlands
Vegetation Class	Coastal Swamp Forests
Floristic Description	The VZ has been historically partially cleared, with the canopy dominated by *Casuarina glauca,* both as a remnant cohort and regeneration. No other canopy species present. The midstorey is dominated by woody weeds, varying in density depending on the landform from sparse to very dense. Very dense areas are dominated by *Olea europaea*, with sparse areas dominated by a mixture of *Sida rhombifolia* and high threat exotics *Olea europaea* and *Lantana camara.* The ground stratum is relatively diverse, including both native diversity and exotic pasture species and pasture weeds. *Microlaena stipoides*, *Eragrostis brownii, Cynodon dactylon*, and *Oplismenus aemulus* are dominant throughout with the exception of the steepest areas where heavy woody weed cover suppresses the understorey. Native forbs include *Commelina cyanea*, *Lobelia purpurascens*, *Alternanthera denticulata*, *Dichondra repens*, *Arthropodium milleflorum*, and *Veronica plebeia.* Exotic grasses are present consistently but sub-dominant, primarily comprising *Setaria parviflora*, and high threat exotics *Paspalum dilatatum*, and *Chloris gayana*. Exotic forbs include *Cirsium vulgare* (Spear Thistle), and high threat exotics *Bidens* spp. and *Senecio madagascariensis*.
Condition	Moderate.
BAM Plots	14, 15
Structure	The VZ has been historically partially cleared, with *Casuarina glauca* remnant trees and regeneration dominating the canopy over a midstorey dominated by woody weeds. Ongoing disturbance from grazing, tracks, informal residence (caravan) and recreational areas (fireplaces). In the north, where the watercourse is narrower, midstorey becomes dense and closed. In the south, the midstorey is open as the watercourse is wider and less defined. Grasses are present in the understorey, a mixture of native and exotic. Significant erosion is evident, with areas of exposed subsoil and near-vertical banks in places.
Justification for PCT Selection	PCT has been determined on a best-fit basis, predominantly in association with canopy species dominance, and occurrence in a riparian area. Ground strum floristics are generally consistent with PCT 1731, though disturbance has impacted the composition.
Status	**BC Act**: **E:** *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* This VZ is not found to be commensurate with the BC Act listed community. The VZ lacks floristic diversity in accordance with the Determination and is situated on an ephemeral waterline on hillslopes rather than floodplains. Current and historic land management practices are likely to prevent regeneration from its current state.

Vegetation Zone 4

PCT 1600 *Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter*	
Area within Subject land	2.71
Vegetation Formation	Dry Sclerophyll Forests (Shrub/grass sub-formation)
Vegetation Class	Hunter-Macleay Dry Sclerophyll Forests
Floristic Description	The VZ contains a canopy dominated by *C. maculata* with *E. moluccana* and *E. crebra*. The canopy is present as a mixed age cohort, with limited mature trees interspersed with maturing and regenerating timber. The midstratum is sparse, comprised of *Bursaria spinosa* (Blackthorn), *Leucopogon juniperinus, Acacia parvipinnula, Enchylaena tomentosa* (Ruby Saltbush), *Daviesia ulicifolia, Eremophila debilis* (Amulla) and *Phyllanthus gunnii.* A diverse forb assemblage is present, dominated by *Portulaca oleracea, Solanum prinophyllum,* and *Chrysocephalum apiculatum.* Many other species present in low numbers, encountered occasionally. Native grass species dominating included *Aristida vagans, Cymbopogon refractus* and *Panicum simile.* Sub-dominant, but commonly occurring species included *Cynodon dactylon, Rytidosperma pumilum, Chloris ventricosa, Bothriochloa macra* and *Paspalidium distans.* Exotic species were common but never dominant. High threat woody species were limited to *Lantana camara* and *Olea europaea*. Pear cactus, *Opuntia* spp. also occurred. HTE grasses included *Cenchrus clandestinum* and Paspalum dilatatum. HTE forbs were limited to *Senecio madagascarensis.*
Condition	Central Hunter EEC
BAM Plots	10, 12
Structure	The canopy structure is sparse, but unlike VZ1 is not generally mature. Large trees are limited, and this may be attributable in part to the steep landform as well as historic clearing. Mid stratum present sporadically, unreliable, with an open understorey dominated by native grasses and forb species with tussock habitat. Some fallen timber observed within the VZ. Litter cover good due to minimal management. Generally disconnected from surrounding vegetated patches and grazed. Erosion common, soil loss to B horizon in places.
Justification for PCT Selection	Species composition, lithology and spatial elements consistent with other VZs in 1600 over the study area. While *E. fibrosa* absent, this VZ is a very small area of the site and a poor sample size for species dominance. The landform and assemblage support consistent assignation with related woodland on the lots, and no alternative PCT fit is sufficiently supported.
Status	**BC Act**: **E:** *Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions* The VZ was determined not to be commensurate with the BC Act listed community due to species composition and landscape. This TEC is considered to occur in the study area and has been assessed as a separate VZ.
	BC Act: **E:** *Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions* This VZ was determined commensurate with the BC Act listed community due to the subject land occurring in appropriate range and soil profile, and the VZ containing a floristic composition in line with the species assemblage listed within the NSW final determination for the community.

Vegetation Zone 5

PCT 1600 *Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter*	
Area within Subject land	33.81
Vegetation Formation	Dry Sclerophyll Forests (Shrub/grass sub-formation)
Vegetation Class	Hunter-Macleay Dry Sclerophyll Forests
Floristic Description	No tree or shrub species present. Native groundcover limited to *Cynodon dactylon* and occasional *Themeda triandra,* with sporadic occurrence of *Juncus usitatus, Lachnagrostis filiformis, Eragrostis brownii,* and *Chrysocephalum semipapposum.* Groundcover dominated by exotics, including high threat exotics *Paspalum dilatatum, Cenchrus clandestinum, Sporobolus fertilis,* and *Chloris gayana.* A very high diversity of exotic pasture species present.
Condition	Exotic Pasture
BAM Plots	01, 05, 06, 07
Structure	Cleared pasture. Tussocks (exotic) exist in areas with lower grazing pressure. No fallen timber or debris.
Justification for PCT Selection	PCT association with adjacent woodland
Status	**BC Act**: **E:** *Central Hunter Ironbark—Spotted Gum—Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions* This VZ is not found to be commensurate with the BC Act listed community. The VZ is void of a canopy and mid stratum and contains a ground stratum dominated of exotic grasses.
	EPBC Act: **CE:** *Central Hunter Valley eucalypt forest and woodland* This VZ is not found to be commensurate with the BC Act listed community. The VZ is void of a canopy and mid stratum and contains a ground stratum dominated of exotic grasses.

Vegetation Zone 6

PCT 1731 *Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley*	
\Area within Subject land	1.79
Vegetation Formation	Forested Wetlands
Vegetation Class	Coastal Swamp Forests
Floristic Description	Historically cleared, with evidence of intermittent grazing. No canopy present. Low regeneration of *Casuarina glauca* (very limited). No shrub layer. Ground layer dense and tall, grazing irregular. Groundcover dominated by *Eriochloa pseudoacrotricha,* with *Cynodon dactylon, Juncus usitatus* and *Sporobolus creber*. Exotics present at low density, primarily high threat exotic *Paspalum dilatatum*.
Condition	Grassland
BAM Plots	16
Structure	Cleared pasture. Woody species limited to regenerating *Casuarina glauca*. Grazing has resulted in limited litter cover and reduced native diversity, with exotic species consistently present. No dead or fallen timber.
Justification for PCT Selection	This VZ occurs as a grassland with no distinguishing canopy cover, although regenerating canopy species occur in the form of *Casuarina glauca*. As a grassland, it is assessed as having the adjacent wooded areas as the parent community. PCT 1731 is applied as a best fit to this VZ on that basis, being applied to those VZs.
Status	**BC Act**: **E:** *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* This VZ is not found to be commensurate with the BC Act listed community. The VZ is void of a canopy and mid stratum. Current and historic land management practices are likely to prevent regeneration from the VZs current state.

4.4 Vegetation Integrity Assessment results

A total of 136 plant species were identified within sixteen plots and adjacent lands comprising 81 native species, and 55 exotic species. The results of the plot field data and a flora species list can be found in **Appendix B.**

The plot data from the vegetation plot was entered into the BAM-C calculator and the results of the vegetation integrity assessment is summarised in **Table 2**.

Table 2 Vegetation Integrity Results

Vegetation Zone	No. of Plots	Composition condition Score	Structure Condition Score	Function Condition score	Vegetation Integrity Score (V.I)	TEC
VZ 1: 1600_LowerHunterEEC	3	36.5	24	25.5	**28.2**	Y
VZ 2: 1600_GrasslandLow	4	37.2	39.5	2.8	**16.1**	N
VZ 3: 1731_Moderate	2	41.5	58.6	50.3	**49.6**	N
VZ 4: 1600_CentralHunterEEC	2	68.3	58	46	**56.7**	Y
VZ 5: 1600_Exotic	4	0.5	0	0.8	**0.2**	N
VZ 6: 1731_Grassland	1	16.9	43	30	**27.9**	N

- As outlined in section 9.2.1 of the BAM, for the purpose of any future assessment of development, biodiversity offset credits are required for impacts affecting native vegetation where the vegetation integrity score:
    - is ≥15 where the PCT is representative of an endangered or critically endangered ecological community; or
    - is ≥17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community: or
    - is ≥20 where the PCT is not representative of a TEC or associated with threatened species habitat.

5 Threatened Species Results

5.1 Desktop Assessment

A review of threatened species information was undertaken to provide context and understanding of biodiversity values occurring within the study area. Information reviewed included:

- Online database searches involving a 10-km buffer around the Study Area to provide potentially occurring threatened flora and fauna and migratory species under both the BC Act and EPBC Act:
  - NSW Bionet (accessed 27 February 2023 and continually during BIR production)
  - Commonwealth Protected Matters of National Significance search tool (accessed 7 February 2023)
- BioNet Vegetation Classification – Threatened species associated with known PCTs to occur within the Study area.

5.1.1 Ecosystem Credit Species

Ecosystem Credit Species (in accordance with the BAM) are reliably predicted to occur by vegetation surrogates and landscape features. An assessment of the habitat suitability for each predicted species was undertaken to determine the presences or potential utilisation of the study area as part of their home range. These species are presented in **Table3**.

Table 3 Ecosystem Credit Species

Scientific Name	Common Name	BC Act	EPBC Act	PCT 1600	PCT 1731	Habitat Present
Anthochaera phrygia	Regent Honeyeater	CE	CE	Y		Yes
Callocephalon fimbriatum	Gang-gang Cockatoo	V	E	Y	Y	Yes
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Y		Yes
Chthonicola sagittata	Speckled Warbler	V	-	Y		Yes
Circus assimilis	Spotted Harrier	V	-		Y	Yes
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-	Y		Yes
Daphoenositta chrysoptera	Varied Sittella	V	-	Y	Y	Yes
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Y	Y	Yes
Glossopsitta pusilla	Little Lorikeet	V	-	Y		Yes
Grantiella picta	Painted Honeyeater	V	V	Y		No
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	-	Y	Y	No
Hieraaetus morphnoides	Little Eagle	V	-	Y	Y	Yes
Hirundapus caudacutus	White-throated Needletail	-	V	Y	Y	Yes
Lathamus discolor	Swift Parrot	E	CE	Y		Yes
Lophoictinia isura	Square-tailed Kite	V	-	Y		Yes
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	Y		Yes
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	Y		Yes
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V	-	Y		Yes

Scientific Name	Common Name	BC Act	EPBC Act	PCT 1600	PCT 1731	Habitat Present
Miniopterus australis	Little Bent-winged Bat	V	-	Y		Yes
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	Y		Yes
Neophema pulchella	Turquoise Parrot	V	-	Y		Yes
Ninox connivens	Barking Owl	V	-	Y	Y	Yes
Ninox strenua	Powerful Owl	V	-	Y		Yes
Petroica boodang	Scarlet Robin	V	-	Y		Yes
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	Y		Yes
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Y		Yes
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Y		Yes
Stagonopleura guttata	Diamond Firetail	V	-	Y		Yes
Tyto longimembris	Eastern Grass Owl	V	-		Y	Yes
Tyto novaehollandiae	Masked Owl	V	-	Y		Yes

Key:

V = Vulnerable E = Endangered CE = Critically Endangered * Dual Credit Species

The vegetation within the study area has been assessed to provide marginal suitable habitat for 28 of the 30 species listed above. It is therefore assumed that these species may utilise the study area frequently for foraging opportunities.

Table 4 Ecosystem Credit species assessed as not having habitat within the study area

Scientific Name	Common Name	Habitat Assessment
Grantiella picta	Painted Honeyeater	No mistletoes are present in the study area; mistletoe at a density of at least 5 per hectare is required for this species to be considered to have habitat on the assessed land. No Bionet records from previous surveys exist within 10km of the study area.
Haliaeetus leucogaster	White-bellied Sea-Eagle	No large waterbodies on or within 1km of the study area; this species forages over large water bodies including lakes, rivers, and large dams. While a dam exists in the study area, it is too small to support this species.

5.1.2 Species Credit Species

Species Credit Species are species that cannot be reliably predicted to use an area based on habitat surrogates. These species are presented in **Table 5**. Species credit species that are likely to occur within the Study Area must be surveyed to determine presences/absence or provide an expert report. In the absence of either of these the species will be presumed to be present within the Study Area.

The conditions of vegetation and habitat within the Study Area can be assessed by an accredited assessor (BAM Accredited) to have sufficient site degradation of the key habitat constraints associated with species credits species to negate any likelihood of the species utilising the study area, and therefore not requiring further assessment. A habitat assessment for species credit species is found in **Table 6**.

Table 5 Species Credit Species

Scientific Name	Common Name	BC Act	EPBC Act	Survey Period	Requires further assessment	SAII?
Acacia bynoeana	Bynoe's Wattle	E	V	All year	Yes	No
Anthochaera phrygia	Regent Honeyeater	CE	CE	N/A	No	Yes
Aprasia parapulchella	Pink-tailed Legless Lizard	V	V	Sep-Nov	No	No
Burhinus grallarius	Bush Stone-curlew	E	-	All year	Yes	No
Callistemon linearifolius	Netted Bottle Brush	V	-	Oct-Jan	Yes	No
Callocephalon fimbriatum	Gang-gang Cockatoo	V	E	Oct-Jan*	Yes	No
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Jan-Sep*	Yes	No
Cercartetus nanus	Eastern Pygmy-possum	V	-	Oct-Mar	Yes	No
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Nov-Jan	No	Yes
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	Nov-Jan	Yes	No
Cynanchum elegans	White-flowered Wax Plant	E	E	All year	Yes	No
Delma impar	Striped Legless Lizard	V	V	Sep-Dec	No	No
Diuris praecox	Rough Doubletail	V	V	Aug	Yes	No
Diuris tricolor	Pine Donkey Orchid	V	-	Sep-Oct	Yes	No
Eucalyptus castrensis	Singleton Mallee	E	-	All year	Yes	Yes
Eucalyptus glaucina	Slaty Red Gum	V	V	All year	Yes	No
Eucalyptus parramattensis subsp. decadens	Eucalyptus parramattensis subsp. decadens	V	V	All year	Yes	No
Eucalyptus pumila	Pokolbin Mallee	V	V	All year	Yes	Yes
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	V	Aug-Nov	Yes	No
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	-	Jul-Dec*	No	No
Hieraaetus morphnoides	Little Eagle	V	-	Aug-Oct	Yes	No
Hoplocephalus bitorquatus	Pale-headed Snake	V	-	Nov-Mar	Yes	No
Lathamus discolor	Swift Parrot	E	CE	N/A	No	Yes

Scientific Name	Common Name	BC Act	EPBC Act	Survey Period	Requires further assessment	SAII?
Litoria aurea	Green and Golden Bell Frog	E	V	Nov-Mar	Yes	No
Litoria brevipalmata	Green-thighed Frog	V	-	Sep-Apr	Yes	No
Lophoictinia isura	Square-tailed Kite	V	-	Sep-Jan*	Yes	No
Miniopterus australis	Little Bent-winged Bat	V	-	Dec-Feb*	Yes	Yes
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	Dec-Feb*	Yes	Yes
Monotaxis macrophylla	Large-leafed Monotaxis	E	-	Aug-Feb	Yes	No
Myotis macropus	Southern Myotis	V	-	Oct-Mar	Yes	No
Ninox connivens	Barking Owl	V	-	May-Dec*	Yes	No
Ninox strenua	Powerful Owl	V	-	May-Aug*	Yes	No
Ozothamnus tesselatus	Ozothamnus tesselatus	V	V	Sep-Oct	Yes	No
Persicaria elatior	Tall Knotweed	V	V	Dec-May	Yes	No
Persoonia pauciflora	North Rothbury Persoonia	CE	CE	All year	Yes	Yes
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	All year	No	Yes
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	Dec-Jun	Yes	No
Phascolarctos cinereus	Koala	V	E	All year	Yes	No
Planigale maculata	Common Planigale	V	-	All year	Yes	No
Pomaderris queenslandica	Scant Pomaderris	E	-	All year	Yes	No
Prostanthera cineolifera	Singleton Mint Bush	V	V	Sep-Oct	Yes	No
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Oct-Dec*	Yes	No
Pterostylis chaetophora	Pterostylis chaetophora	V	-	Sep-Nov	Yes	No
Rutidosis heterogama	Heath Wrinklewort	V	V	All year	Yes	No
Thesium australe	Austral Toadflax	V	V	Nov-Feb	Yes	No
Tyto novaehollandiae	Masked Owl	V	-	May-Aug*	Yes	No
Vespadelus troughtoni	Eastern Cave Bat	V	-	Nov-Jan	Yes	Yes

Key:

V = Vulnerable E = Endangered CE = Critically Endangered EX = Extinct *breeding survey

Table 6 Species Credit Species assessed as not having habitat within the study area

Scientific Name	Common Name	Habitat requirement	Habitat present on develop-ment site	Species requires further assess-ment
Flora				
Acacia bynoeana	Bynoe's Wattle	Bynoe's wattle is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. The species is currently known from about 30 locations in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple. Two NSW OEH Bionet records exist within a 10 km search area. Marginal habitat present in the form of a dry sclerophyll woodland. Targeted surveys confirmed the absence of the species from the subject land.	Likely	No
Callistemon linearifolius	Netted Bottle Brush	Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Recorded in 2000 at Coalcliff in the northern Illawarra. Grows in dry sclerophyll forest on the coast and adjacent ranges. No NSW OEH Bionet records exist within a 10 km search area. Marginal habitat present in the form of a dry sclerophyll woodland. Targeted surveys confirmed the absence of the species from the subject land.	Likely	No
Cryptostylis hunteriana	Leafless Tongue Orchid	Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*E. sieberi*), Red Bloodwood (*Corymbia gummifera*) and Black Sheoak (*Allocasuarina littoralis*); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (*C. subulata*) and the Tartan Tongue Orchid (*C. erecta*). *Cryptostylis hunteriana* is yet to be recorded in the Hunter subregion of the Sydney Basin IBRA bioregion nor the Upper Hunter subregion of the NSW North Coast IBRA bioregion. Canopy species associated with the presence of the species are not present within the subject land, nor were any associated orchid species. Additionally, experts have stated that habitat similar to that contained within the subject land, described as a canopy dominated by *Corymbia maculata* and Ironbarks, is not known to support populations of the species (Bell 2017). Targeted surveys confirmed the absence of the species from the subject land.	Likely	No

Scientific Name	Common Name	Habitat requirement	Habitat present on develop-ment site	Species requires further assess-ment
Cynanchum elegans	White-flowered Wax Plant	Restricted to eastern NSW where it is distributed from Brunswick Heads on the north coast to Gerroa in the Illawarra region. The species has been recorded as far west as Merriwa in the upper Hunter River valley. The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest. No NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of the species from the subject land.	Likely	No
Diuris praecox	Rough Doubletail	The Rough Doubletail is known from between Bateau Bay and Smiths Lake. Grows on hills and slopes of near-coastal districts in open forests which have a grassy to fairly dense understorey. Species is geographically limited to Newcastle LGA within the Hunter Sub-Region. No NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of the species from the subject land.	Likely	No
Diuris tricolor	Pine Donkey Orchid	Sporadically distributed on the western slopes of NSW, extending from south of Narrandera all the way to the north of NSW. Localities in the south include Red Hill north of Narrandera, Coolamon, and several sites west of Wagga Wagga. Condobolin-Nymagee road, Wattamondara towards Cowra, Eugowra, Girilambone, Dubbo and Cooyal, in the Central West. Pilliga SCA, Pilliga National Park and Bibblewindi State Forest in the north and Muswellbrook in the east. Disturbance regimes are not known, although the species is usually recorded from disturbed habitats. Associated species include Callitris glaucophylla, Eucalyptus populnea, Eucalyptus intertexta, Ironbark and Acacia shrubland. The understorey is often grassy with herbaceous plants such as Bulbine species. The Pine Donkey Orchid grows in sclerophyll forest among grass, often with native Cypress Pine (*Callitris* spp.). It is found in sandy soils, either on flats or small rises. Also recorded from a red earth soil in a Bimble Box community in western NSW. A single NSW OEH Bionet record exists within a 10 km search area. Habitat within the subject land is broadly appropriate, however no associated canopy species are present. Targeted surveys confirmed the absence of the species from the subject land.	Likely	No
Eucalyptus castrensis	Singleton Mallee	Known only from a single dense stand near Singleton in the lower Hunter Valley. Here it is locally dominant stand over about ten hectares with a number of smaller outlying stands over a 2.5 km range. Occurs on a low broad ridgetop on loam over sandstone. The understorey consists of grasses and scattered shrubs, with bare ground and litter. Eucalyptus fibrosa and Corymbia maculata grow adjacent to, but not within, the stand. No NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of the species from the subject land.	Likely	No

Scientific Name	Common Name	Habitat requirement	Habitat present on develop-ment site	Species requires further assess-ment
Eucalyptus glaucina	Slaty Red Gum	Found only on the north coast of NSW and in separate districts: near Casino where it can be locally common, and farther south, from Taree to Broke, west of Maitland. Grows in grassy woodland and dry eucalypt forest. Grows on deep, moderately fertile and well-watered soils. 88 NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of the species from the subject land.	Likely	No
Eucalyptus parramattensis subsp. decadens	Eucalyptus parramattensis subsp. decadens	There are two separate meta-populations of *E. parramattensis* subsp. *decadens*. The Kurri Kurri meta-population is bordered by Cessnock—Kurri Kurri in the north and Mulbring—Abedare in the south. Large aggregations of the subspecies are located in the Tomalpin area. The Tomago Sandbeds meta-population is bounded by Salt Ash and Tanilba Bay in the north and Williamtown and Tomago in the south. Generally occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath understorey. It also occurs as an emergent in dry or wet heathland. Often where this species occurs, it is a community dominant. 3 NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of the species from the subject land.	Likely	No
Eucalyptus pumila	Pokolbin Mallee	Currently known only from a single population west of Pokolbin in the Hunter Valley. Historical records also exist for Wyong and Sandy Hollow, however, has not been recorded recently in these areas. The single known population occupies north-west-facing slopes derived from sandstone. Present as a mid-canopy species to a height of 6 m within dry sclerophyll woodland which has a canopy comprising Eucalyptus fibrosa, Callitris endlicheri and, to a lesser extent, Corymbia maculata. Very little is known about the biology or ecology of this species. No NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of the species from the subject land.	Likely	No

Scientific Name	Common Name	Habitat requirement	Habitat present on develop-ment site	Species requires further assess-ment
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	Grows in sandy or light clay soils usually over thin shales, often with lateritic ironstone gravels and nodules. Sydney region occurrences are usually on Tertiary sands and alluvium, and soils derived from the Mittagong Formation. Soil landscapes include Lucas Heights or Berkshire Park. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. In Sydney it has been recorded from Shale Sandstone Transition Forest and in the Hunter in Kurri Sand Swamp Woodland. however, other communities occupied include *Corymbia maculata - Angophora costata* open forest in the Dooralong area, in Sydney Sandstone Ridgetop Woodland at Wedderburn and in Cooks River / Castlereagh Ironbark Forest at Kemps Creek. No NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of the species from the subject land.	Likely	No
Monotaxis macrophylla	Large-leafed Monotaxis	Large-leafed Monotaxis has a great diversity in the associated vegetation within NSW (less though in Queensland), encompassing coastal heath, arid shrubland, forests and montane heath from almost sea level to 1300 m altitude. Large-leafed Monotaxis is recorded from several highly disjunct populations in NSW: eastern edge of Deua NP (west of Moruya), Bemboka portion of South East Forests National Park, Cobar area (Hermitage Plains), the Tenterfield area, and Woodenbong (near the Queensland border). It is also in Queensland. A recent record from the eastern spur of the Nandewar Range is in the Namoi catchment. No NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of the species from the subject land.	Likely	No
Ozothamnus tesselatus	Ozothamnus tesselatus	Restricted to a few locations north of Rylstone, NSW, in an east-west zone south of Bunnan and between west Bylong and east Ravensworth. Grows in eucalypt woodland. The distribution of this species overlaps with the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland EPBC Act-listed threatened ecological community. No NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of the species from the subject land.	Likely	No
Persicaria elatior	Tall Knotweed	In northern NSW it is known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests). The species also occurs in Queensland. This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance. No NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of the species from the subject land.	Likely	No

Scientific Name	Common Name	Habitat requirement	Habitat present on develop-ment site	Species requires further assess-ment
Persoonia pauciflora	North Rothbury Persoonia	*Persoonia pauciflora* is found in dry open forest or woodland dominated by Spotted Gum (*Corymbia maculata*), Broad-leaved Ironbark (*Eucalyptus fibrosa*) and/or Narrow-leaved Ironbark (*E. crebra*) and supporting a moderate to sparse shrub layer and grassy groundcover. The majority of the population is known to occur on silty sandstone soils derived from the Farley Formation. Extremely restricted distribution; all but one of the plants which make up the only known population occur within a 2.5 km radius of the original specimen at North Rothbury in the Cessnock local government area. >1000 NSW OEH Bionet records exist within a 10 km search area. The subject land is within 10 km of the known population extent. Targeted surveys confirmed the absence of the species from the subject land.	Likely	No
Pomaderris queenslandica	Scant Pomaderris	The Scant Pomaderris is widely scattered but not common in north-east NSW and in Queensland. It is known from several locations on the NSW north coast and a few locations on the New England Tablelands and North West Slopes, including near Torrington and Coolata. Found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks. No NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of the species from the subject land.	Likely	No
Prostanthera cineolifera	Singleton Mint Bush	The distribution of *Prostanthera cineolifera* is uncertain, but it is considered to be restricted to only a few localities near Walcha, Scone and St Albans, NSW. *Prostanthera cineolifera* occurs in sclerophyll forests (Harden, 2002) and open woodlands on exposed sandstone ridges and is often found in association with shallow or skeletal sands No NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of the species from the subject land.	Likely	No

Scientific Name	Common Name	Habitat requirement	Habitat present on develop-ment site	Species requires further assess-ment
Pterostylis chaetophora	Pterostylis chaetophora	In NSW it is currently known from 18 scattered locations in a relatively small area between Taree and Kurri Kurri, extending to the south-east towards Tea Gardens and west into the Upper Hunter, with additional records near Denman and Wingen. There are also isolated records from the Sydney region. The preferred habitat is seasonally moist, dry sclerophyll forest with a grass and shrub understorey. The most commonly observed habitat is vegetation characterised by grassy open forests or derived native grasslands of *Eucalyptus amplifolia* and *Eucalyptus moluccana* on gentle flats, or that are dominated by *Corymbia maculata* with any of *Eucalyptus fibrosa*, *Eucalyptus siderophloia* or *Eucalyptus crebra*. 16 NSW OEH Bionet records exist within a 10 km search area. Habitat requirements for the species lacks a level of certainty due to limited data collect on the species. Nonetheless, there is evidence that the species resilience to disturbance is poor, to the extent that native bird and macropod grazers decimate populations (Bell 2020). As such, it is unlikely that the species is able to persist within the subject land owing to past and present land management practices. Regardless, targeted surveys were conducted to confirm the absence of the species from the subject land. It is to be noted that reference populations were not observed to flower in 2022.	Likely	No
Rutidosis heterogama	Heath Wrinklewort	On the Central Coast it is located north from Wyong to Newcastle. Grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides. No NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of the species from the subject land.	Likely	No
Thesium australe	Austral Toadflax	Austral Toad-flax is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Although originally described from material collected in the SW Sydney area, populations have not been seen in a long time. It may persist in some areas in the broader region. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. No NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of the species from the subject land.	Likely	No

Scientific Name	Common Name	Habitat requirement	Habitat present on develop-ment site	Species requires further assess-ment
Birds				
Anthochaera phrygia	Regent Honeyeater	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. Range is between north-eastern Victoria and south-eastern Queensland. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In the last 10 years Regent Honeyeaters have been recorded in urban areas around Albury where woodlands tree species such as Mugga Ironbark and Yellow Box were planted 20 years ago. The Regent Honeyeater is a generalist forager, although it feeds mainly on the nectar from a relatively small number of eucalypts that produce high volumes of nectar. Candidate species as per mapped Important Areas. No part of the subject land is mapped for this species. 5 NSW OEH Bionet records exist within a 10 km search area.	Unlikely	No
Burhinus grallarius	Bush Stone-curlew	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. No NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of the species from the subject land.	Likely	No
Callocephalon fimbriatum	Gang-gang Cockatoo	The Gang-gang Cockatoo is distributed from southern Victoria through south- and central-eastern New South Wales. In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. It occurs regularly in the Australian Capital Territory. It is rare at the extremities of its range, with isolated records known from as far north as Coffs Harbour and as far west as Mudgee. In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas. A single NSW OEH Bionet record exists within a 10 km search area. Targeted surveys confirmed the absence of the species from the subject land.	Likely	No

Scientific Name	Common Name	Habitat requirement	Habitat present on develop-ment site	Species requires further assess-ment
Calyptorhynchus lathami	Glossy Black-Cockatoo	The Glossy Black-Cockatoo is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia. Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Feeds almost exclusively on the seeds of several species of she-oak (*Casuarina* and *Allocasuarina* species), shredding the cones with the massive bill. Dependent on large hollow-bearing eucalypts for nest sites. A single egg is laid between March and May. 4 NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of the species from the subject land. No hollows over 15 cm and 8 m above ground were present within the subject land, therefore no appropriate breeding habitat is present.	Likely	No
Haliaeetus leucogaster	White-bellied Sea-Eagle	The White-bellied Sea-Eagle is distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. It also extends inland along some of the larger waterways, especially in eastern Australia. The habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea and sewage ponds). Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, forest (including rainforest) and even urban areas. Breeding territories are located close to water, and mainly in tall open forest or woodland, although nests are sometimes located in other habitats such as dense forest (including rainforest), closed scrub or in remnant trees on cleared land. A single NSW OEH Bionet records exist within a 10 km search area. No large waterbodies within 1km of the subject lands, therefore this species is unlikely to have habitat on the subject land.	Unlikely	No
Hieraaetus morphnoides	Little Eagle	The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter. A single NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of breeding habitat from the subject land.	Likely	No

Scientific Name	Common Name	Habitat requirement	Habitat present on develop-ment site	Species requires further assess-ment
Lathamus discolor	Swift Parrot	Breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes. Migrates to the Australian south-east mainland between March and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species and lerp infested trees. Return to some foraging sites on a cyclic basis depending on food availability. Following winter they return to Tasmania where they breed from September to January. Candidate species as per mapped Important Areas. No part of the subject land is mapped for this species. 108 NSW OEH Bionet records exist within a 10 km search area.	Unlikely	No
Lophoictinia isura	Square-tailed Kite	The Square-tailed Kite ranges along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. In arid north-western NSW, has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland. A single NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of this species from the subject land.	Likely	No
Ninox connivens	Barking Owl	The Barking Owl is found throughout continental Australia except for the central arid regions and now occurs in a wide but sparse distribution in NSW. Core populations exist on the western slopes and plains (especially the Pilliga) and in some northeast coastal and escarpment forests. Sometimes extend their home range into urban areas, hunting birds in garden trees and insects attracted to streetlights. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile soils. Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. A single NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of this species from the subject land.	Likely	No

Scientific Name	Common Name	Habitat requirement	Habitat present on develop-ment site	Species requires further assess-ment
Ninox strenua	Powerful Owl	The Powerful Owl is endemic to eastern and south-eastern Australia, mainly on the eastern side of the Great Dividing Range, from south-eastern Queensland to Victoria. The Powerful Owl is found in open forests and woodlands, as well as along sheltered gullies in wet forests with dense understoreys, especially along watercourses. Will sometimes be found in open areas near forests such as farmland, parks and suburban areas, as well as in remnant bushland patches. Needs old growth trees to nest. 4 NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of this species from the subject land.	Likely	No
Tyto novaehollandiae	Masked Owl	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution. Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting. A single NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of this species from the subject land.	Likely	No
Bats				
Chalinolobus dwyeri	Large-eared Pied Bat	Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. Found in well-timbered areas containing gullies. 3 NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of breeding habitat from the subject land. No rocky areas containing caves, overhangs, escarpments, outcrops, or crevices occur on the subject lands, nor are the subject lands within two kilometres of old mines or tunnels. The species is unlikely to have habitat on the subject land. Passive ultrasonic recordings did not detect this species.	Unlikely	No

Scientific Name	Common Name	Habitat requirement	Habitat present on develop-ment site	Species requires further assess-ment
Miniopterus australis	Little Bent-winged Bat	East coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. 18 NSW OEH Bionet records exist within a 10 km search area. Review of aerial mapping revealed no extensive cave, escarpments or rocky outcrops within 2 km of the subject land. This species was detecting using passive ultrasonic recording. Additionally, Harp traps were deployed at the beginning of the breeding season. Harp traps were targeting *Myotis macropus,* however the survey would likely detect *Miniopterus australis* given the limited of foraging habitat within the site. The Harp Trap deployment did not detect the species. An abandoned caravan was inspected for potential microbat use, but no signs of roosting were detected. Owing to the lack of suitable breeding habitat and absence of detection during Harp Trap deployments, the subject land unlikely serves as habitat for the species.	Likely	No
Miniopterus orianae oceanensis	Large Bent-winged Bat	Large Bent-winged Bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Maternity caves have very specific temperature and humidity regimes. At other times of the year, populations disperse within about 300 km range of maternity caves. Cold caves are used for hibernation in southern Australia. Breeding or roosting colonies can number from 100 to 150,000 individuals. Hunt in forested areas, catching moths and other flying insects above the tree tops. 43 NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of breeding habitat from the subject land. Review of aerial mapping revealed no extensive cave, escarpments or rocky outcrops within 2 km of the subject land. This species was detecting using passive ultrasonic recording. Additionally, Harp traps were deployed at the beginning of the breeding season. Harp traps were targeting *Myotis macropus,* however the survey would likely detect *Miniopterus orianae oceanensis* given the limited of foraging habitat within the site. The Harp Trap deployment did not detect the species. An abandoned caravan was inspected for potential microbat use, but no signs of roosting were detected. Owing to the lack of suitable breeding habitat and absence of detection during Harp Trap deployments, the subject land unlikely serves as habitat for the species.	Likely	No

Scientific Name	Common Name	Habitat requirement	Habitat present on develop-ment site	Species requires further assess-ment
Myotis macropus	Southern Myotis	The Southern Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers. Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface. 11 NSW OEH Bionet records exist within a 10 km search area. This species was detecting as a "probable" presence using passive ultrasonic recording. Suitable habitat exists on the subject land in the form of waterbodies >3 m wide. Additionally, several hollow-bearing trees are within close proximity to the waterbodies, potentially serving as breeding habitat for the species. An abandoned caravan was inspected for potential microbat use, but no signs of roosting were detected. Harp traps were deployed in appropriate habitat close by to passive ultrasonic recorders. *Myotis macropus* cannot confidently be distinguished by call pattern alone, hence harp traps were deployed to ensure sampling of foraging habitat is accurate. Furthermore, the call recordings do not directly imply the species is interacting with the site. As such, the lack of detection through the harp trapping deployment is feasible evidence that the species is not utilising the subject land as habitat. Therefore, no further assessment is required.	Likely	No
Pteropus poliocephalus	Grey-headed Flying-fox	Grey-headed Flying-foxes are generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. In times of natural resource shortages, they may be found in unusual locations. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. No breeding camps exist on the subject lands, confirmed by survey. The nearest breeding camps are at Maitland and Cessnock, approximately 20km from the subject land. As the species credit species component of the assessment is solely related to breeding habitat, no further assessment is required.	Unlikely	No

Scientific Name	Common Name	Habitat requirement	Habitat present on develop-ment site	Species requires further assess-ment
Vespadelus troughtoni	Eastern Cave Bat	The Eastern Cave Bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally found along cliff-lines in wet eucalypt forest and rainforest. 2 NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of breeding habitat from the subject land. Review of aerial mapping revealed no extensive cave, escarpments or rocky outcrops within 2 km of the subject land. This species was detected as a "probable" presence using passive ultrasonic recording. Additionally, Harp traps were deployed at the beginning of the breeding season. Harp traps were targeting *Myotis macropus,* however the survey would likely detect *Vespadelus troughtoni* given the limited of foraging habitat within the site. The Harp Trap deployment did not detect the species. Owing to the lack of suitable breeding habitat and absence of detection during Harp Trap deployments, the subject land unlikely serves as habitat for the species.	Likely	No
Herpetofauna				
Aprasia parapulchella	Pink-tailed Legless Lizard	There is a concentration of Pink-tailed Legless Lizard populations in the Canberra/Queanbeyan Region. Other populations have been recorded near Cooma, Yass, Bathurst, Albury and West Wyalong. This species is also found in the Australian Capital Territory. Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass (*Themeda australis*). Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. Commonly found beneath small, partially-embedded rocks and appear to spend considerable time in burrows below these rocks; the burrows have been constructed by and are often still inhabited by small black ants and termites. No suitable habitat in the form of rocky outcrops or scattered rocks occurs on the subject land, an essential structural component to the species ecology. A single record exists in a 10 km Bionet search, which is not in close proximity to the subject land.	Unlikely	No

Scientific Name	Common Name	Habitat requirement	Habitat present on develop-ment site	Species requires further assess-ment
Delma impar	Striped Legless Lizard	The Striped Legless Lizard occurs in the Southern Tablelands, the South West Slopes and possibly on the Riverina. Populations are known in the Goulburn, Yass, Queanbeyan, Cooma and Tumut areas. Found mainly in Natural Temperate Grassland but has also been captured in grasslands that have a high exotic component. Habitat is where grassland is dominated by perennial, tussock-forming grasses such as Kangaroo Grass *Themeda australis*, spear-grasses *Austrostipa* spp. and poa tussocks *Poa* spp., and occasionally wallaby grasses *Austrodanthonia* spp. Sometimes present in modified grasslands with a significant content of exotic grasses. Usually found where soils are predominantly basalt with a high clay content and a propensity for cracking. Favoured habitat typically contains little bare ground, with plant litter to a depth of approximately 3 cm. The known population within the Upper Hunter exists approximately 55 km north-east of the site, near Muswellbrook. The population has only recently been recorded within the expansion of projects within the Hunter Valley Operation (HVO). The population exists within a large continuous stretch of partially cleared land, sitting predominantly on the Red Clays of Brays Hill soils. The substrate is characterised by soils derived from olivine basalts, with surface horizons prone to cracking with seasonality. Populations within southern NSW/ACT and VIC sit on volcanic clays and basalt surface rock/derived basalt soils. The subject land lies on siltstones and silty sandstones. Disturbed grassy pastures are present within the subject land, predominantly comprising of exotic grass species. The species can persist in areas dominated by exotic grasses however, must contain the dense leafy structure demonstrated in preferred native tussock grasses. Disturbance activities such as ploughing, slashing and extensive grazing or burning remove crucial habitat requirements allowing the species to persist within the landscape (Howland et al 2016, Robertson and Smith 2010). For the species to survive within areas exposed to frequent disturbance events, the availability of refuge such as rocks and soil cracks is pivotal (Smith and Robertson 1999). Despite the species ability to inhabit areas previously exposed to disturbance events, it is unlikely the species will recolonise an isolated patch of habitat given the limited dispersal ability. The species demonstrates is deterred by barriers such as rivers, areas of bare grounds or roads as vagility is limited to <12 m/year (Robertson and Smith 2010). The subject land experiences periodic slashing, ongoing grazing and compaction of soil, compromising the integrity of topsoil and removing structural components of exotic grass tussocks. Additionally, the site is bordered by roads, limiting connectivity. Therefore, the species is unlikely to be present within the subject land and no further assessment is required for the species.	Unlikely	No

Scientific Name	Common Name	Habitat requirement	Habitat present on develop-ment site	Species requires further assess-ment
Hoplocephalus bitorquatus	Pale-headed Snake	A patchy distribution from north-east Queensland to the north-eastern quarter of NSW. The Pale-headed Snake is a highly cryptic species that can spend weeks at a time hidden in tree hollows. Found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest. In drier environments, it appears to favour habitats close to riparian areas. Shelter during the day between loose bark and tree-trunks, or in hollow trunks and limbs of dead trees. No NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of this species from the subject land.	Likely	No
Litoria aurea	Green and Golden Bell Frog	The Green and Golden Bell Frog main populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast (one an island population). There is only one known population on the NSW Southern Tablelands. Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available. Some sites, particularly in the Greater Sydney region occur in highly disturbed areas. No NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of this species from the subject land.	Likely	No
Litoria brevipalmata	Green-thighed Frog	Isolated localities along the coast and ranges from just north of Wollongong to south-east Queensland. Green-thighed Frogs occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain. It prefers wetter forests in the south of its range, but extends into drier forests in northern NSW and southern Queensland. No NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of this species from the subject land.	Likely	No

Scientific Name	Common Name	Habitat requirement	Habitat present on develop-ment site	Species requires further assess-ment
Marsupials				
Cercartetus nanus	Eastern Pygmy-possum	The Eastern Pygmy-possum is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extents from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes. Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (*Pseudocheirus peregrinus*) dreys or thickets of vegetation, (e.g. grass-tree skirts). No NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of this species from the subject land.	Likely	No
Petaurus norfolcensis	Squirrel Glider	Inhabits mature or old growth Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey. Require abundant tree hollows for refuge and nest sites. Species was not associated with the PCTs present however was detected during targeted survey efforts for other arboreal species (eg. Brush-tailed Phascogale) and therefore has been determined present in VZs detected (VZ1).	Likely	Yes
Petrogale penicillata	Brush-tailed Rock-wallaby	The range of the Brush-tailed Rock-wallaby extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. However the distribution of the species across its original range has declined significantly in the west and south and has become more fragmented. In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. No habitat suitable for this species exists on the subject lands. There are no rocky outcroppings or escarpments or cliffs, or any steep rocky lands. No further assessment required.	Unlikely	No

Scientific Name	Common Name	Habitat requirement	Habitat present on develop-ment site	Species requires further assess-ment
Phascogale tapoatafa	Brush-tailed Phascogale	The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is mainly found east of the Great Dividing Range although there are occasional records west ot the divide. Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest. This species was detected during remote camera deployments, and therefore has been determined present in VZs detected (VZ1). The Brush-tailed Phascogale (BTP) was recorded on one night on a single baited camera (total effort of 960 camera nights with 32 cameras) in a tree with no hollows, nests, dreys or other potential refuge. Following the detection, the specific record tree and surrounding trees were dusk-watched into darkness to detect any emergence activity associated with cryptic nests or hollows not visible from ground level. The surrounding area including habitat trees were then spotlighted on foot. No further signs of BTP were detected. The camera record occurred on 5th May 2022, during the peak mating season when males are most likely to be detected. It is likely that the individual BTP detected is a roving male exploring marginal habitat for breeding opportunity.	Likely	Yes
Phascolarctos cinereus	Koala	The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. Inhabit eucalypt woodlands and forests. 5 NSW OEH Bionet records exist within a 10 km search area. Targeted surveys confirmed the absence of the species from the subject land.	Likely	No
Planigale maculata	Common Planigale	Coastal north-eastern NSW, coastal east Queensland and Arnhem Land. The species reaches its confirmed southern distribution limit on the NSW lower north coast however there are reports of its occurrence as far south as the central NSW coast west of Sydney. Common Planigales inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water. No records exist in a 10 km Bionet search. The species was not recorded during targeted surveys.	Likely	No

5.2 Threatened Flora Results

In accordance with methods outlined in **Section 3.3** no threatened flora species were recorded during field surveys.

The following table outline the species that could not be discounted due to habitat constraints from occurring within the Study Area, and dates that surveys were undertaken.

Table 7 Threatened Flora Survey Schedule

Species	Survey Period	Survey Carried out	Presence/ Absence	Comment
Acacia bynoeana	All year	10-13th May 2022	Not recorded	
Callistemon linearifolius	Oct-Jan	12-13th Oct 2021	Not recorded	Large-Area Survey Method (OEH 2016)
Cryptostylis hunteriana	Nov-Jan	6th Dec 2022	Not recorded	Large-Area Survey Method (OEH 2016)
Cynanchum elegans	All year	12-13th Oct 2021	Not recorded	
Diuris tricolor	Sep-Oct	12-13th Oct 2021	Not recorded	Large-Area Survey Method (OEH 2016)
Eucalyptus castrensis	All year	10-13th May 2022	Not recorded	
Eucalyptus glaucina	All year	10-13th May 2022	Not recorded	
Eucalyptus parramattensis subsp. Decadens	All year	10-13th May 2022	Not recorded	
Eucalyptus pumila	All year	10-13th May 2022	Not recorded	
Grevillea parviflora subsp. parviflora	Aug-Oct	12-13th Oct 2021	Not recorded	Large-Area Survey Method (OEH 2016)
Monotaxis macrophylla	Aug-Feb	6th Dec 2022	Not recorded	Large-Area Survey Method (OEH 2016)
Ozothamnus tesselatus	Sep-Oct	12-13th Oct 2021	Not recorded	Large-Area Survey Method (OEH 2016)
Persicaria elatior	Dec-May	6th Dec 2022	Not recorded	Large-Area Survey Method (OEH 2016)
Persoonia pauciflora	All year	10-13th May 2022	Not recorded	Large-Area Survey Method (OEH 2016)
Pomaderris queenslandica	All year	10-13th May 2022	Not recorded	
Prostanthera cineolifera	Sep-Oct	12-13th Oct 2021	Not recorded	Large-Area Survey Method (OEH 2016)
Pterostylis chaetophora	Sep-Nov	12-13th Oct 2021	Not recorded	Large-Area Survey Method (OEH 2016). At time of survey, reference population was in flower.
Rutidosis heterogama	All year	10-13th May 2022	Not recorded	
Thesium australe	Nov-Feb	6th Dec 2022	Not recorded	Large-Area Survey Method (OEH 2016)

5.3 Fauna Survey Results

A total of 81 fauna species were recorded during the survey period. A full list of the fauna species recorded within the site is provided as **Appendix C**. Locations of threatened fauna caught on cameras, detected via ultrasonic call analysis or observed during nocturnal events have been presented as **Figure 11.**

Table 5 outline the species (Species Credit Species as determined by the BAM-C) that could not be discounted from occurring within the Study Area and **Table 8** outlines the survey requirements and dates surveys were undertaken.

5.3.1 Mammals

Two threatened mammal species were observed – the BC Act listed Vulnerable species *Petaurus norfolcensis* (Squirrel Glider) and *Phascogale tapoatafa* (Brush-tailed Phascogale). Other Native species recorded included *Bos taurus* (European Cattle), *Macropus giganteus* (Eastern Grey Kangaroo), *Petaurus breviceps* (Sugar Glider), *Petaurus norfolcensis* (Squirrel Glider), *Phascogale tapoatafa* (Brush-tailed Phascogale), *Rattus norvegicus* (Brown Rat), *Rattus rattus* (Black rat), *Trichosurus vulpecula* (Brushtail Possum), *Vulpes vulpes* (European Red Fox).

The Brush-tailed Phascogale (BTP) was recorded on one night on a single baited camera (total effort of 960 camera nights with 32 cameras) in a tree with no hollows, nests, dreys or other potential refuge. Following the detection, the specific record tree and surrounding trees were dusk-watched into darkness to detect any emergence activity associated with cryptic nests or hollows not visible from ground level. The surrounding area including habitat trees were then spotlighted on foot. No further signs of BTP were detected. The camera record occurred on 5th May 2022, during the peak mating season when males are most likely to be detected. It is likely that the individual BTP detected is a roving male exploring marginal habitat for breeding opportunity.

5.3.2 Avifauna

No threatened bird species were recorded. Numerous native bird species were recorded during the early morning and dusk survey efforts. A total of 39 native and 2 exotic bird species were identified visually or by vocalisation during the surveys. A full list of species recorded is found in **Appendix C**.

5.3.3 Herpetofauna

No threatened herpetofauna were recorded. Three reptile species and twelve amphibian species were recorded during surveys. A full list of species recorded is found in **Appendix C**.

5.3.4 Microbats

A total of sixteen microbat species, including six threatened species, were identified as definite or probable using Anabat express ultrasonic echo-location call recorder. Definite threatened species include the BC Act Vulnerable species *Micronomus norfolkensis* (Eastern Coastal Free-tailed Bat), *Miniopterus australis* (Little Bent-winged Bat), *Miniopterus orianae oceanensis* (Large Bent-winged Bat) and *Myotis macropus* (Southern Myotis). Threatened species identified as probable included the BC Act Vulnerable species *Scoteanax rueppellii* (Greater Broad-nosed Bat) and *Vespadelus troughtoni* (Eastern Cave Bat).

Refer to **Appendix C** for a detailed list of recorded species and **Appendix D** for the Anabat Call Recording reports.

5.3.5 Nocturnal Call Playback

Two Owl species were seen or heard calling during surveys; neither species is threatened. The species recorded were *Ninox boobook* (Boobook) and *Tyto alba* (Barn Owl).

5.4 Habitat Survey

The study area contains scattered native canopy vegetation comprising 21 hollow-bearing trees.

The current condition of the study area is predominantly cleared agricultural paddocks with no structures with the exception of fences. There is a wooded waterline in the north that collects overland flow through mostly cleared paddocks. There is a series of paddocks in the north-east that retains scattered canopy trees but no other substantial woody vegetation. In the west, there is a sparse patch of regenerating woodland on steeper ground that includes canopy and shrubs. The subject lots total approximately 81.97in size of which 42ha has been identified as low to moderate quality native vegetation. The remainder of the study area is grazed native and exotic pasture, agricultural dams, and cleared areas including tracks.

Several species of exotic flora are present on the site including Hight Threat Exotic shrub, grass and forb species. HTE grasses are especially prevalent and are dominant in the lower condition grasslands.

The remnant native vegetation within the study area provides good habitat for mobile fauna species within the canopy, and to a lesser extent the groundcover however this is limited to the wooded waterline. A large number of mature trees with hollows occur primarily within the north-eastern portion of the study area. The *Myrtaceae* species observed within the study area have at least three age cohorts. Such species provide good foraging opportunities for species that rely on nectar, seed, sap and other vegetative food sources within the community.

The groundcover varies throughout the study area from low grazed pasture to native tussock grassland, providing marginal shelter and foraging habitat for small terrestrial fauna and macropods.

An abandoned caravan and lean-to adjacent to the riparian area were assessed as potential roost habitat for microbats. No signs of microbat habitation including guano were detected in the structures, and evidence of frequent black rat use of the structure makes it unlikely the structure is regularly utilised by microbat species.

The waterline is a second order unnamed creek within the northern portion of the study area. This area was observed to be eroded with limited permanent water, dominated by *Casuarina* glauca (Swamp oak). Marginal habitat suitable for amphibians and other water-associated species exists, although aquatic vegetation is limited. This area is likely to hold water after a rainfall event.

Table 8 Species Credit Fauna Survey Effort

Active Time	Fauna Group	Target species	Survey Period (TBDC)	Survey Conducted	Survey method	Survey effort	Comment	TBDC Requirements Compliance and Guidelines
Nocturnal	Amphibians	*Litoria aurea* (Green and Golden Bell Frog)	Nov-Mar	24th Mar 2022 4th Oct 2022 6th Oct 2022 15th Nov 2022	Spotlight; Call Playback; Active habitat searches	• 2000m spotlight transect carried out over site following riparian habitat, repeated on 4 occasions in ideal weather conditions (during or following rain). A total of 9 person hours of survey undertaken. • Call playback carried out every 50m, consisting of at least 2 min of call playback of each species, followed by 5 min listening • Raking leaf litter and turning logs, rocks and other debris in areas of potential habitat		**Compliant**: NSW DPIE (2020d) NSW Survey Guide for threatened Frogs
		Litoria brevipalmata (Green-thighed Frog)	Sep-Apr					**Compliant**: NSW DPIE (2020d) NSW Survey Guide for threatened Frogs
	Bats	*Chalinolobus dwyeri* (Large-eared Pied Bat) (breeding)	Nov-Jan	4-13th Dec 2022 (Anabat 1) 7-13th Dec 2022 (Anabat 2)	Ultrasonic recorder; Harp Traps	• Surveys undertaken by recording echolocation calls using two Anabat Express Detector units set to remotely record for 4 nights (civilian sunset to sunrise). A total of 8 survey nights were carried out. • Harp traps placed at likely flyways for a total of 16 trap nights. Checked daily prior to dawn, with catch bags removed during daylight hours.		**Compliant**: NSW OEH (2018) 'Species credit' threatened bats and their habitats
		Miniopterus australis (Little Bent-winged Bat) (breeding)	Dec-Feb				Recorded using site (definite);	**Compliant**: NSW OEH (2018) 'Species credit' threatened bats and their habitats
		Miniopterus orianae oceanensis (Large Bent-winged Bat) (breeding)	Dec-Feb				Recorded using site (definite)	**Compliant**: NSW OEH (2018) 'Species credit' threatened bats and their habitats
		Myotis macropus (Southern Myotis)	Oct-Mar				Recorded using site (probable)	**Compliant**: NSW OEH (2018) 'Species credit' threatened bats and their habitats
		Vespadelus troughtoni (Eastern Cave Bat)	Nov-Jan				Recorded using site (probable)	**Compliant**: NSW OEH (2018) 'Species credit' threatened bats and their habitats
		Pteropus poliocephalus (Grey-headed Flying-fox) (Breeding)	Oct-Dec	Oct 2021-Mar 2023	Diurnal Survey	• Opportunistic surveys over the entire site extent concurrent with habitat, vegetation and other diurnal fauna surveys.		**Compliant**: NSW OEH (2018) 'Species credit' threatened bats and their habitats
	Birds	*Burhinus grallarius* (Bush Stone-curlew)	All year	23-24th May 2022 23rd Jun 2022	Spotlight	• A total of 13.5 person spotlighting hours were undertaken over 5 separate nights in wooded areas, using headtorches and 6W LED reflector lens handheld searchlights (1 LUX @ 334m) • 54 x 200m transects were undertaken at a distance of at least 10.8km in total (spotlighting was additionally carried out between transects and traversing the site) covering over a large portion of the study area.		n/a
		Ninox connivens (Barking Owl)	May-Dec	22, 23, 23rd Jun 2022	Spotlight; Call Playback	• A total of 13.5 person spotlighting hours were undertaken over 5 separate nights in wooded areas, using headtorches and 6W LED reflector lens handheld searchlights (1 LUX @ 334m) • 54 x 200m transects were undertaken at a distance of at least 10.8km in total (spotlighting was additionally carried out between transects and traversing the site) covering over a large portion of the study area. • Call playback was undertaken every 50m. The call of each species was broadcast for at least two minutes, followed by five minutes of listening. • Calls were broadcast through an amplification system (loud hailer) designed to project the sound for at least 1 km under still night conditions.		**Compliant**: TBDC
		Ninox strenua (Powerful Owl)	May-Aug	22, 23, 23rd Jun 2022				**Compliant**: TBDC
		Tyto novaehollandiae (Masked Owl)	May-Aug	22, 23, 23rd Jun 2022				**Compliant**: TBDC
	Marsupials	*Cercartetus nanus* (Eastern Pygmy-possum)	Oct-Mar	6th Apr - 5th May 2022	Spotlight; Baited Remote Camera	• A total of 13.5 person spotlighting hours were undertaken over 5 separate nights in wooded areas, using headtorches and 6W LED reflector lens handheld searchlights (1 LUX @ 334m)		n/a

Active Time	Fauna Group	Target species	Survey Period (TBDC)	Survey Conducted	Survey method	Survey effort	Comment	TBDC Requirements Compliance and Guidelines
		Petaurus norfolcensis (Squirrel Glider)	All year	6th Apr - 5th May 2022		• 54 x 200m transects were undertaken at a distance of at least 10.8km in total (spotlighting was additionally carried out between transects and traversing the site) covering over a large portion of the study area. • Baited remote motion-activated cameras were mounted in appropriate habitat within study area, designed to take photographs when triggered by motion. Cameras were used to detect both diurnal and nocturnal faunal movement • 32 Scoutguard infrared motion cameras mounted 2.5m above ground (facing bait pods on tree trunks) were utilised during field surveys, for a total of 960 camera nights.	Captured opportunistically by Camera surveys – not nominated in BAM-C	n/a
		Phascogale tapoatafa (Brush-tailed Phascogale)	Dec-Jun	6th Apr - 5th May 2022			Captured by Camera surveys	**Compliant**: TBDC
		Phascolarctos cinereus (Koala)	All year	5-6th Sep 2022	Spotlight	• A total of 13.5 person spotlighting hours were undertaken over 5 separate nights in wooded areas, using headtorches and 6W LED reflector lens handheld searchlights (1 LUX @ 334m) • 54 x 200m transects were undertaken at a distance of at least 10.8km in total (spotlighting was additionally carried out between transects and traversing the site) covering over a large portion of the study area.		**Compliant**: NSW DPE (2022a) Koala (*Phascolarctos cinereus*) Biodiversity Assessment Method Survey Guide
		Planigale maculata (Common Planigale)	All year	22nd Aug – 2nd Sep 2022	Pitfall Trap	• 26 pitfall arrays (2x pitfall traps along a minimum 10m drift fence) were deployed for 4 nights across suitable habitat. Traps were checked each morning before dawn, and traps closed during daylight hours. • Total effort of 208 trap-nights or 104 array-nights		**Compliant**: TBDC
	Reptiles	*Hoplocephalus bitorquatus* (Pale-headed Snake)	Nov-Mar	17-19th Jan 2022	Spotlight; Active habitat searches	• A total of 13.5 person spotlighting hours were undertaken over 5 separate nights in wooded areas, using headtorches and 6W LED reflector lens handheld searchlights (1 LUX @ 334m) • 54 x 200m transects were undertaken at a distance of at least 10.8km in total (spotlighting was additionally carried out between transects and traversing the site) covering over a large portion of the study area. • Specific searches for this species were conducted in favourable weather conditions (humid >80% or on warm nights following rain) • Raking leaf litter and turning logs, rocks and other debris in areas of potential habitat		**Compliant:** NSW DPE (2022b) Threatened reptiles Biodiversity Assessment Method survey guide
Diurnal	Birds	*Callocephalon fimbriatum* (Gang-gang Cockatoo)	Oct-Jan	31st Aug 2022 5th Sep 2022 4th Oct 2022	Diurnal Survey	• Binoculars were used to examine living and dead trees for stick nests or hollows of a size appropriate for different species breeding requirements. • Opportunistic bird surveys undertaken at dawn and dusk using visual or auditory cues for identification.		**Compliant**: TBDC
		Calyptorhynchus lathami (Glossy Black-Cockatoo)	Jan-Sep	31st Aug 2022 5th Sep 2022 4th Oct 2022				**Compliant**: TBDC
		Hieraaetus morphnoides (Little Eagle)	Aug-Oct	31st Aug 2022 5th Sep 2022 4th Oct 2022				**Compliant**: TBDC
		Lophoictinia isura (Square-tailed Kite)	Sep-Jan	31st Aug 2022 5th Sep 2022 4th Oct 2022				**Compliant**: TBDC

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FIGURE 11: THREATENED FAUNA RESULTS

0 100 200 300 400

Metres

1:5500

Legend

- Study Area
- Cadastral Boundary
- **Batcam 1**
  Definite: *Miniopterus orianae oceanensis, Miniopterus australis*
  Probable: *Micronomus norfolkensis, Myotis macropus, Scoteanax rueppellii, Vespadelus troughtoni*
- **Batcam 4**
  Definite: *Micronomus norfolkensis, Miniopterus australis*
  Probable: *Miniopterus orianae oceanensis, Myotis macropus, Scoteanax rueppellii, Vespadelus troughtoni*
- **Camera ID: CN**
  Phascogale tapoatafa

MJD Environmental

Aerial: Nearmap (2022) | Data: MJD Environmental (2023), NSW Spatial Services, ADW Johnson (2022) | Datum/Projection: GDA2020 / MGA zone 56 | Date: 05/04/2023 | Version: 2 | Z:\21020 - Radford Park Sewer | This plan should not be relied upon for critical design dimension.

RADFORD PARK

FIGURE 12: SPECIES POLYGON – MYOTIS MACROPUS

Legend

- Study Area
- Cadastral Boundary
- Species Polygon – *Myotis macropus*

0 100 200 300 400

Metres

1:5500

N E S W

MJD Environmental

Aerial: Nearmap (2022) | Data: MJD Environmental (2023), NSW Spatial Services, ADW Johnson (2022) | Datum/Projection: GDA2020 / MGA zone 56 | Date: 05/04/2023 | Version: 2 | Z:\21020 - Radford Park Sewer | This plan should not be relied upon for critical design dimension.

RADFORD PARK

FIGURE 13: SPECIES POLYGON – PHASCOGALE TAPOATAFA

Legend

- Study Area
- Cadastral Boundary
- Species Polygon – *Phascogale tapoatafa*

0 100 200 300 400

Metres

1:5500

N E S W

MJD Environmental

Aerial: Nearmap (2022) | Data: MJD Environmental (2023), NSW Spatial Services, ADW Johnson (2022) | Datum/Projection: GDA2020 / MGA zone 56 | Date: 05/04/2023 | Version: 1 | Z:\21020 - Radford Park Sewer | This plan should not be relied upon for critical design dimension.

6 Identify Prescribed Additional Biodiversity Impacts

6.1 Habitat for threatened entities

Karst, caves, crevices, cliffs, rocks, and other geological features of significance

There are no occurrences of karst, caves, crevices, rock outcrops or cliffs within the subject land.

Human made structures

Several occupied residential dwellings and agricultural outbuildings are present within the subject land, all of which are in regular use and good repair. A dilapidated caravan exists adjacent to the second order watercourse in VZ5. This structure was examined closely for signs of habitation by native fauna and no indications were recorded.

Non-native vegetation

The subject land contains non-native vegetation in the form of exotic shrub and groundcover species including grasses and herbaceous species. A description of exotic vegetation within the site is contained within **Section 4**. Exotic vegetation within species polygons is deemed unsuitable; habitat features are lacking in cleared areas, and exotic wooded vegetation does not contain foraging or breeding resources required by the threatened species.

6.2 Habitat Connectivity

The Study Area lies in the primarily cleared western extent of a highly fragmented patch of remnant native vegetation over an area of approximately 2000 ha. The patch is bounded by large buffers of heavily cultivated land adjoining the Hunter River in the north and east. In the south it is bounded by the developed areas of Branxton and Greta, and the Hunter Expressway. Highly marginal connectivity exists southward to the larger remnant vegetation patch associated with North Rothbury. To the west, it is bounded by heavily cultivated land adjoining Black Creek, and the nearest connectivity to a larger regional patch of remnant native vegetation is approximately 2 km. This larger patch is contiguous with the North Rothbury vegetation, notwithstanding the hostile connections of the Main Northern Railway, New England Highway and Hunter Expressway, and includes Belford National Park.

Within the sector of this 2000 ha patch in the north of Branxton occupied by the Study Area, the vast majority of native vegetation exists east of Elderslie Road, with the exception of an area of primarily riparian land north-west of the intersection of Elderslie Road and Rusty Lane. Approximately 22 ha of this approximately 150 ha area occurs on the study area lands, in the form of the vegetated riparian zone of a 2nd order stream and an area of scattered canopy on grazing land in the north-east of the study area.

The study area contains other small areas of retained or regenerated native vegetation, however no intact or contiguous patches that expand the habitat provided by those areas described. To the south of the study area is ongoing development, which itself has been carried out on predominantly cleared land. To the west the land is completely cleared, improved or cropped until the banks of Black Creek approximately 1 - 1.5 km away. The study area therefore provides no local or regional connectivity between patches of native vegetation as habitat for native flora and fauna, and the study area itself contains very limited areas of marginal habitat, being situated as described on the extreme western extent of a 2000 ha area of fragmented remnant native vegetation in an otherwise very heavily cleared and cultivated landscape.

6.3 Water bodies, water quality and hydrological processes that sustain threatened entities

The Study Area is located within the Hunter River catchment in the Hunter region. The Study Area is located approximately 3km south of the Hunter River at Elderslie.

The hydrology of the study area is typified by a series of mapped ephemeral 1st order streams draining farm dams, ultimately tributary to Black Creek. A 2nd order stream runs from the Radford Park Estate through the northern lots of the study area, incorporating the catchment of most 1st order streams in the study area. The 2nd order stream runs in a coarsely south-north direction, connecting with Black Creek approximately 1km from its junction with the Hunter River. The remaining 1st order streams are mapped within the south western corner of the study area, directly tributary to Black Creek.

No estuaries or wetlands are present within the subject land or Study Area.

6.4 Wind turbine strikes

Not applicable to this proposal.

6.5 Vehicle strikes

There is limited current vehicle thoroughfare except for unsealed driveways leading to the occupied dwellings. Vehicle movement will increase within the development area as a consequence of the construction of sealed roads and significant increase in occupancy.

7 Matters of National Environmental Significance

An EPBC Act Protected Matters Search (accessed 07-02-2023) was undertaken to generate a list of those Matters of National Environmental Significance (MNES) from within 10 km of the Study Area. An assessment of those MNES relevant to biodiversity has been undertaken in accordance within EPBC Act Policy Statement 1.1 Significant Impact Guidelines Matters of National Environmental Significance (DoE, 2013). The Matters of National Environmental Significance protected under national environment law include:

- Listed threatened species and communities;
- Listed migratory species;
- Ramsar wetlands of international importance;
- Commonwealth marine environment;
- World heritage properties;
- National heritage places;
- The Great Barrier Reef Marine Park;
- Nuclear actions; and
- A water resource, in relation to coal seam gas development and large coal mining development.

Listed Threatened Species and Communities:

A total of 47 threatened species and 8 threatened ecological communities listed under the EPBC Act have been recorded on the protected matters search.

No threatened entities protected by the EPBC Act were detected during surveys over the study area. As such Commonwealth Referral of any future proposal is unlikely to be required.

Listed Migratory Species:

The protected matters search nominated sixteen migratory species or species habitat that may occur with the 10km subject site buffer search area. No listed migratory species were observed within the subject site. A preliminary appraisal of nominated species suggests that no habitat within the Study Area is critical to their survival. Therefore, it is unlikely that any proposal over the subject site will impact migratory species.

Wetlands of International Significance (declared Ramsar wetlands):

The subject site is not a wetland of international significance or declared Ramsar wetland.

One wetland of international importance was nominated within a 10 km radius of the Study Area. The subject site is located 20-30 km upstream (north-west) of:

Hunter estuary wetlands

- The Hunter Estuary Wetlands Ramsar site supports species that are nationally and internationally listed. Importantly the green and golden bell frog (*Litoria aurea*) listed as vulnerable under the EPBC Act 1999 have been found within the Kooragang component of the Ramsar site. The Australasian bittern (*Botaurus poiciloptilus*) listed as endangered on both the EPBC Act and the IUCN Red List (Version 2009.1) has been found at both components of the Ramsar site.

  The Hunter Estuary Wetland Ramsar site supports 112 species of waterbirds and 45 species of migratory birds listed under international agreements, including the great egret (*Ardea alba*), cattle egret (*Ardea ibis*), terns (*Sterna* spp.), glossy ibis (*Plegadis falcinellus*) and white-breasted sea-eagle (*Haliaeetus leucogaster*).

These wetlands also provide refuge for waterbirds such as ducks and herons during periods of inland drought.

The Hunter Estuary Wetland Ramsar site regularly supports 1% of the population of the eastern curlew (*Numenius madagascariensis*) and the red-necked avocet (*Recurvirostra novaehollandiae*),

Commonwealth Marine Areas:

The subject site is not part of a Commonwealth Marine Area and is not in close proximity to any such area.

World Heritage Properties:

The subject site is not a World Heritage area and is not in close proximity to any such area.

National Heritage Places:

The subject site is not a National Heritage area and is not in close proximity to any such area.

Great Barrier Reef Marine Parks:

The subject site is not part of or within close proximity to any Great Barrier Reef Marine Park.

Nuclear Actions:

The proposal over the subject site is not and does not form part of a Nuclear action.

Water Resources in relation to Coal Mining and CSG:

The proposal over the subject site is related to residential development and as such is not or does not form part of a coal mining and/or CSG proposal.

In summary, any future proposal subject to rezoning approval over the land will need to assess potential for impact to MNES based on the preliminary assessment undertaken in accordance with criteria set out in relevant Commonwealth policies and advices as at the time of that assessment.

8 Conclusion

MJD Environmental has been engaged by Belford Land to prepare Stage 1 BAM - Biodiversity Inventory Report (BIR) to be submitted with the Planning Proposal application for the rezoning of an 81.97 hectare parcel of land at Lot 1 in D 1124566 (94 Alma Rd), Lot 111 in DP850244 (285 Elderslie Rd), Lot 122 in DP1165184 (225 Elderslie Rd) & Part Lot 300 in DP1248134, Branxton NSW.

The Planning Proposal aims to rezone the 81.97 hectares of RU1 Primary production zoned land located at the above lots to R5 Large Lot Residential.

The proposed rezoning will occur over land containing a mosaic of cleared land and remnant native vegetation in various condition, including 24.25 ha of native vegetation comprising of grassland, forest and woodland.

This Stage 1 BAM - Biodiversity Inventory Report (BIR) has been prepared for submission with the aforementioned Planning Proposal for gateway determination. As such this BIR has been produced in a manner which is consistent with the Biodiversity Assessment Methodology (BAM) in order to satisfy later stages of the biodiversity planning process, post gateway.

The BAM was used as the assessment method, to establish impacts on threatened species and threatened ecological communities in the locality under the *Biodiversity Conservation Act* 2016.

In addition, preliminary assessment was also undertaken having regard to those threatened entities listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The proposed study area is zoned as RU1 Primary Production and is currently a series of grazing paddocks containing unsealed roads, fences, a creek and native vegetation. The land has undergone historic clearing and ongoing grazing, evident by the large areas without tree cover, pasture condition and weed invasion, and disturbed nature of native vegetation. The overall native woody vegetation is in poor to moderate condition comprising low species diversity and simple structure.

Field surveys carried out as part of the biodiversity assessment identified two Plant Community Types (PCT).

- 1600 – Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter (in several forms, including association with BC Act listed Endangered *Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions*; and association with BC Act listed Endangered *Central Hunter Ironbark—Spotted Gum—Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions*
- 1731 – Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley (not commensurate with the BC Act listed Endangered Ecological Community (EEC) *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*

A preliminary assessment under the EPBC Act indicated that no threatened species or communities listed as MNES occur on the site or are likely to be impacted by any future development at the time of assessment.

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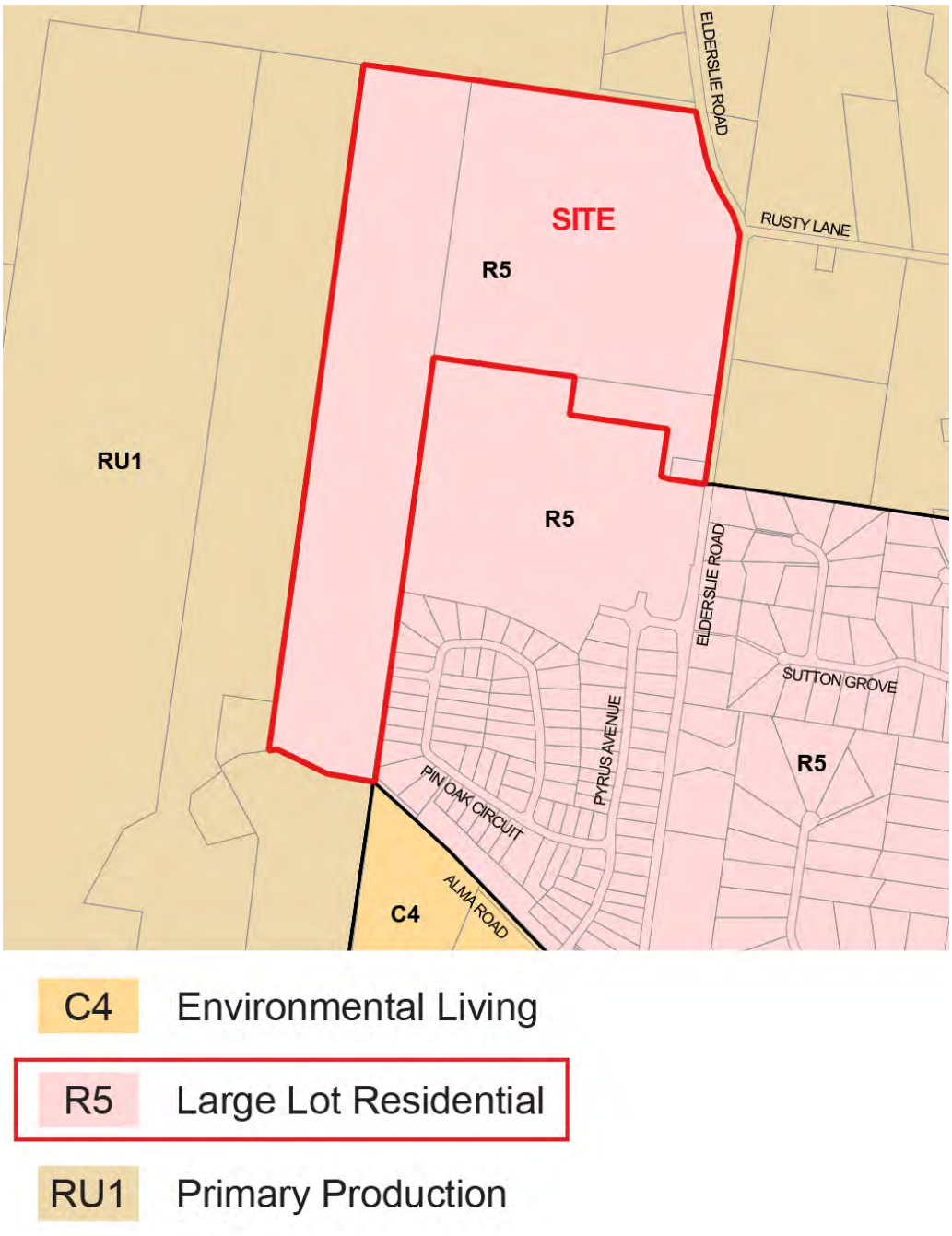
Appendix A Plan of Proposal

3 Proposed Zoning



Appendix B BAM Plot Data

Plot Info							Composition						Structure (%)						Function										
Plot	PCT	Condition Class	Zone	Easting	Northing	Bearing	Tree	Shrub	Grass	Forbs	Ferns	Other	Tree	Shrub	Grass	Forbs	Ferns	Other	Lge Tree	Hollows	Litter Cover (%)	Logs	Tree Stem 5-10	Tree Stem 10-20	Tree Stem 20-30	Tree Stem 30-50	Tree Stem 50-80	Tree Regen	HTE (%)
B01	1600	101	Exotic	56	345268.1	6387252	10	0	0	3	0	0	0	0	0	5.2	0	0	0	0	0	0.1	0	0	0	0	0	0	0
B02	1600	101	LowerHunterEEC	56	346200.4	6388309.3	198	2	2	10	7	1	1	25	0.6	14.1	1.6	0.1	0.1	0	0	18.8	0	0	0	0	1	1	1
B03	1600	101	LowerHunterEEC	56	346107.8	6388502.9	2	1	1	5	2	0	1	35	0.2	10.8	0.4	0	0.1	0	1	4.8	0	0	0	1	1	1	1
B04	1600	101	LowerHunterEEC	56	345962.9	6388666.7	169	2	2	5	6	1	1	27	0.3	12.5	0.7	0.1	0.1	1	2	11.0	0	0	1	1	1	1	1
B05	1600	101	Exotic	56	346116.6	6388096.6	267	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13.0	0	0	0	0	0	0	0
B06	1600	101	Exotic	56	345731.3	6388695.5	285	0	0	1	1	0	0	0	0	0.1	0.2	0	0	0	0	15.0	0	0	0	0	0	0	0
B07	1600	101	Exotic	56	345780.9	6388187.6	97	0	0	1	0	0	0	0	0	1	0	0	0	0	0	14.0	0	0	0	0	0	0	0
B08	1600	101	GrasslandLow	56	345358.3	6387552.8	124	0	0	10	1	1	0	0	0	72.3	0.1	0.1	0	0	0	14.0	0	0	0	0	0	0	0
B09	1600	101	GrasslandLow	56	345356.6	6387773.9	165	0	2	11	5	1	1	0	5.3	95.3	0.5	0.1	0.1	0	0	17.0	0	0	0	0	0	0	0
B10	1600	101	CentralHunterEEC	56	345383.8	6387975.1	347	2	5	16	10	1	2	36	3.9	70.5	2.5	0.1	0.2	1	0	43.0	0	1	1	0	1	1	1
B11	1600	101	GrasslandLow	56	345395	6388132.1	66	0	2	10	6	1	1	0	2.5	68.6	1.6	0.1	0.1	0	0	22.0	0	0	0	0	0	0	0
B12	1600	101	CentralHunterEEC	56	345345.7	6388231.7	3	3	4	13	11	1	1	21	0.8	31.6	1.5	0.1	0.1	0	7	64.0	3	1	1	1	1	1	1
B13	1600	101	GrasslandLow	56	345525.5	6388310.2	210	0	2	10	7	0	0	0	2.2	48.4	0.8	0	0	0	0	20.0	0	0	0	0	0	0	0
B14	1731	101	Moderate	56	345738.8	6388338.2	306	1	1	6	4	0	1	10	0.2	75.5	1.3	0	0.1	0	0	6.0	18	1	1	1	1	0	1
B15	1731	101	Moderate	56	345598.8	6388732.8	321	1	1	9	5	0	1	10	1	87.3	1.1	0	0.1	0	2	17.0	45	1	1	1	1	0	1
B16	1731	101	Exotic	56	345346	6387453.0	230	1	0	4	0	0	0	0.1	0	36.2	0	0	0	0	0	64.0	0	0	0	0	0	0	1

Flora Species by BAM Plot

Family	Species Name	Common Name	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	B13	B14	B15	B16
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower		X		X						X		X				
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed														X		
Anthericaceae	*Arthropodium milleflorum*	Pale Vanilla-Lily		X		X								X			X	
	Laxmannia gracilis	Slender Wire Lily									X	X						
	Tricoryne elatior	Yellow Autumn-Lily									X	X						
Apiaceae	*Centella asiatica*	Indian Pennywort												X	X			
	Cyclospermum leptophyllum	Slender Celery	X		X	X												
Apocynaceae	*Gomphocarpus fruticosus*	Narrow-Leaved Cotton Bush											X			X		
Asteraceae	*Bidens spp.*			X	X	X										X	X	
	Calotis cuneata	Mountain Burr-Daisy												X				
	Chrysocephalum apiculatum	Common Everlasting									X		X	X				
	Chrysocephalum semipapposum	Clustered Everlasting						X										
	Chrysocephalum spp.														X			
	Cirsium vulgare	Spear Thistle	X	X		X		X				X		X			X	
	Conyza canadensis		X	X	X													
	Conyza spp.	A Fleabane				X	X		X	X	X	X	X	X	X	X	X	
	Cyanthillium cinereum	Little Ironweed		X		X								X				
	Euchiton sphaericus	Star Cudweed								X			X					
	Gamochaeta coarctata		X	X		X												
	Gamochaeta spp.				X													
	Glossocardia bidens	Cobbler's Tack												X				
	Hypochaeris radicata	Catsear	X	X		X	X	X	X	X	X	X	X	X	X			X
	Senecio madagascariensis	Fireweed	X	X	X	X		X	X	X			X	X		X	X	
	Sonchus oleraceus	Common Sowthistle			X	X	X					X				X		
	Taraxacum officinale	Dandelion				X						X						
Bignoniaceae	*Tecoma stans*	Yellow Bignonia				X												
Brassicaceae	*Lepidium africanum*	Common Peppercress		X	X	X						X		X				
Cactaceae	*Opuntia spp.*											X						

Family	Species Name	Common Name	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	B13	B14	B15	B16
Campanulaceae	*Lobelia purpurascens*	Whiteroot		X								X		X		X	X	
	Wahlenbergia gracilis	Sprawling Bluebell									X		X		X			
Caryophyllaceae	*Petrorhagia dubia*					X												
	Stellaria media	Common Chickweed								X			X					
Casuarinaceae	*Casuarina glauca*	Swamp Oak														X	X	X
Chenopodiaceae	*Einadia hastata*	Berry Saltbush		X								X						
	Einadia nutans	Climbing Saltbush				X												
	Enchylaena tomentosa	Ruby Saltbush										X						
Commelinaceae	*Commelina cyanea*	Native Wandering Jew		X		X					X					X	X	
	Murdannia graminea				X													
Convolvulaceae	*Dichondra repens*	Kidney Weed										X	X			X	X	
Cyperaceae	*Cyperus aggregatus*		X	X	X	X	X		X	X	X	X	X		X			
	Cyperus brevifolius		X				X				X							
	Cyperus gracilis	Slender Flat-Sedge		X		X						X		X	X			
	Fimbristylis dichotoma	Common Fringe-Sedge		X	X	X				X	X		X		X			
Dilleniaceae	*Hibbertia obtusifolia*	Hoary Guinea Flower				X												
Ericaceae - Epacridoideae	*Leucopogon juniperinus*	Prickly Beard-Heath									X	X	X		X			
Fabaceae - Faboideae	*Daviesia ulicifolia*	Gorse Bitter Pea											X	X	X			
	Glycine tabacina	Variable Glycine		X	X	X					X	X	X	X		X	X	
	Trifolium arvense	Haresfoot Clover				X												
	Trifolium campestre	Hop Clover		X	X				X									
	Trifolium fragiferum	Strawberry Clover	X															
	Trifolium repens	White Clover	X	X	X	X												
	Vicia sativa	Common Vetch	X															
Fabaceae - Mimosoideae	*Acacia parvipinnula*	Silver-Stemmed Wattle									X	X		X				
Gentianaceae	*Centaurium erythraea*	Common Centaury			X					X	X							
Geraniaceae	*Geranium homeanum*												X		X			
Goodeniaceae	*Brunonia australis*	Blue Pincushion												X				
	Goodenia rotundifolia					X								X				
Haloragaceae	*Haloragis heterophylla*	Variable Raspwort										X			X			
Hypericaceae	*Hypericum gramineum*	Small St John's Wort											X		X			
Juncaceae	*Juncus usitatus*		X															X
Lomandraceae	*Lomandra confertifolia*	Matrush										X						
	Lomandra longifolia	Spiny-Headed Mat-Rush															X	

Family	Species Name	Common Name	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	B13	B14	B15	B16
	Lomandra multiflora subsp. multiflora	Many-Flowered Mat-Rush										X		X				
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry										X						
Malvaceae	*Modiola caroliniana*	Red-Flowered Mallow	X	X													X	
	Sida rhombifolia	Paddy's Lucerne		X	X	X	X	X				X		X		X	X	
Myrtaceae	*Corymbia maculata*	Spotted Gum		X		X						X		X				
	Eucalyptus crebra	Narrow-Leaved Ironbark												X				
	Eucalyptus fibrosa	Red Ironbark		X	X	X												
	Eucalyptus moluccana	Grey Box										X		X				
Oleaceae	*Olea europaea*	Common Olive			X	X						X		X			X	
Oxalidaceae	*Oxalis perennans*		X												X			
Phormiaceae	*Dianella caerulea*	Blue Flax-Lily		X										X				
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush		X														
	Phyllanthus gunnii													X				
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn		X	X	X						X						
Plantaginaceae	*Plantago debilis*	Shade Plantain										X						
	Plantago lanceolata	Lamb's Tongues	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
	Veronica plebeia	Trailing Speedwell		X								X					X	
Poaceae	*Aristida vagans*	Threeawn Speargrass		X								X		X	X	X		
	Axonopus compressus	Broad-Leaved Carpet Grass			X													
	Axonopus fissifolius	Narrow-Leafed Carpet Grass	X								X				X			
	Bothriochloa macra	Red Grass				X				X				X		X		
	Briza subaristata								X		X		X		X			
	Bromus catharticus	Praire Grass	X	X			X	X							X			
	Capillipedium spicigerum	Scented-Top Grass								X	X							
	Cenchrus clandestinus	Kikuyu Grass	X	X	X	X			X			X						
	Chloris gayana	Rhodes Grass			X	X		X	X							X		
	Chloris ventricosa	Tall Chloris								X		X		X			X	
	Cymbopogon refractus	Barbed Wire Grass		X	X	X				X	X	X	X	X	X			
	Cynodon dactylon	Common Couch			X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Cynodon spp.		X	X														
	Dichanthium sericeum	Queensland Bluegrass										X	X				X	
	Dichelachne micrantha	Shorthair Plumegrass									X	X	X		X			

Family	Species Name	Common Name	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	B13	B14	B15	B16
	Digitaria ciliaris	Summer Grass		X														
	Digitaria didactyla	Queensland Blue Couch		X							X	X						
	Echinochloa crusgalli	Barnyard Grass	X															
	Echinopogon caespitosus	Bushy Hedgehog-Grass				X									X		X	
	Entolasia stricta	Wiry Panic		X													X	
	Eragrostis brownii	Brown's Lovegrass			X			X			X	X	X		X		X	
	Eragrostis curvula	African Lovegrass			X	X												
	Eragrostis elongata	Clustered Lovegrass														X		
	Eriochloa pseudoacrotricha	Early Spring Grass																X
	Lachnagrostis filiformis		X										X					
	Lolium perenne	Perennial Ryegrass		X	X	X										X		
	Melinis repens	Red Natal Grass			X						X							
	Microlaena stipoides	Weeping Grass								X	X	X		X		X	X	
	Oplismenus aemulus	Basket Grass															X	
	Panicum effusum	Hairy Panic			X													
	Panicum simile	Two-Colour Panic		X						X	X	X	X	X	X	X		
	Paspalidium distans									X		X		X				
	Paspalum dilatatum	Paspalum	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
	Paspalum notatum	Bahia Grass					X	X										
	Rytidosperma pumilum	Feldmark Grass										X		X				
	Setaria parviflora			X	X	X	X	X	X	X	X	X	X		X	X	X	
	Setaria pumila	Pale Pigeon Grass	X															
	Setaria sphacelata	South African Pigeon Grass						X	X									
	Sporobolus creber	Slender Rat's Tail Grass		X	X						X	X	X	X				X
	Sporobolus fertilis	Giant Parramatta Grass						X	X								X	
	Themeda triandra			X					X	X	X	X	X	X	X			
	Urochloa panicoides	Urochloa Grass								X								
Polygonaceae	*Rumex brownii*	Swamp Dock														X		
	Rumex sagittatus	Turkey Rhubarb	X															
Portulacaceae	*Portulaca oleracea*	Pigweed										X						
Primulaceae	*Lysimachia arvensis*	Scarlet Pimpernel			X													
Pteridaceae	*Cheilanthes sieberi*	Rock Fern		X		X				X	X	X	X	X				
Rubiaceae	*Galium leptogonium*												X					

Family	Species Name	Common Name	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	B13	B14	B15	B16
	Pomax umbellata	Pomax			X	X								X				
	Richardia humistrata										X							
	Richardia stellaris			X										X				
Scrophulariaceae	*Eremophila debilis*	Amulla										X		X		X	X	
Solanaceae	*Solanum nigrum*	Black-Berry Nightshade										X				X	X	
	Solanum prinophyllum	Forest Nightshade		X								X		X				
	Solanum pseudocapsicum	Madeira Winter Cherry														X		
	Solanum seaforthianum	Climbing Nightshade	X															
Verbenaceae	*Lantana camara*	Lantana		X								X				X	X	
	Verbena bonariensis	Purpletop	X					X	X	X			X	X	X	X	X	X

Appendix C Fauna Results

Species Name	Common Name
Mammals	
Macropus giganteus	Eastern Grey Kangaroo
Petaurus breviceps	Sugar Glider
Petaurus norfolcensis ^	Squirrel Glider
Phascogale tapoatafa ^	Brush-tailed Phascogale
Rattus norvegicus	Brown Rat
Rattus rattus *	Black rat
Trichosurus vulpecula	Brushtail Possum
Vulpes vulpes *	Fox
Amphibians	
Crinia parinsignifera	Eastern Sign-bearing Froglet
Crinia signifera	Common Eastern Froglet
Limnodynastes peronii	Brown-striped Frog
Limnodynastes tasmaniensis	Spotted Grass Frog
Litoria caerulea	Green Tree Frog
Litoria fallax	Eastern Dwarf tree frog
Litoria latopalmata	Broad-palmed Frog
Litoria peronii	Peron's Tree Frog
Litoria verreauxii	Verreaux's Frog
Uperoleia fusca	Dusky toadlet
Uperoleia laevigata	Smooth toadlet
Uperoleia rugosa	Wrinkled Toadlet
Birds	
Acanthiza nana	Yellow Thornbill
Acridotheres tristis *	Common myna
Alisterus scapularis	Australian King-Parrot
Anas superciliosa	Pacific Black Duck
Aquila audax	Wedge-tailed Eagle
Bubulcus ibis	Cattle Egret
Cacatua galerita	Sulphur-crested cockatoo
Cacatua tenuirostris	Long-billed corella
Centropus phasianinus	Pheasant Coucal
Chenonetta jubata	Australian Wood Duck
Coracina novaehollandiae	Black-faced Cuckoo-shrike
Corvus coronoides	Australian Raven
Cracticus nigrogularis	Pied Butcherbird
Cracticus torquatus	Grey Butcherbird
Egretta novaehollandiae	White-faced Heron
Elanus axillaris	Black-Shouldered Kite
Entomyzon cyanotis	Blue-faced Honeyeater
Eolophus roseicapilla	Galah
Falco cenchroides cenchroides	Nankeen Kestrel
Grallina cyanoleuca	Magpie-Lark
Gymnorhina tibicen	Australian Magpie

Species Name	Common Name
Hirundo neoxena	Welcome Swallow
Malurus cyaneus	Galah
Malurus cyaneus	Superb Fairy-Wren
Malurus lamberti	Variegated Fairy-wren
Manorina melanocephala	Noisy miner
Ninox boobook	Boobook
Ocyphaps lophotes	Crested Pigeon
Pardalotus punctatus	Spotted Pardalote
Phalacrocorax sulcirostris	Little Black Cormorant
Philemon corniculatus	Noisy Friarbird
Platycercus eximius	Eastern Rosella
Podargus strigoides	Tawny Frogmouth
Porphyrio porphyrio	Purple Swamphen
Rhipidura albiscapa	Grey Fantail
Rhipidura leucophrys	Willie Wagtail
Spilopelia chinensis *	Spotted Turtle-Dove
Strepera graculina	Pied Currawong
Trichoglossus haematodus	Rainbow Lorikeet
Tyto alba	Barn Owl
Vanellus miles	Masked Lapwing
Bats	
Austronomus australis	White-striped Freetail-bat
Chalinolobus gouldii	Gould's Wattled Bat
Chalinolobus morio	Chocolate Wattled Bat
Micronomus norfolkensis ^	Eastern Coastal Free-tailed Bat
Miniopterus australis ^	Little Bent-winged Bat
Miniopterus orianae oceanensis ^	Large Bent-winged Bat
Myotis macropus ^	Southern Myotis
Nyctophilus spp.	A long-eared bat #
Ozimops planiceps	South-eastern Free-tailed Bat
Ozimops ridei	Eastern Free-tailed Bat
Rhinolophus megaphyllus	Eastern Horseshoe-bat
Scoteanax rueppellii ^	Greater Broad-nosed Bat #
Vespadelus pumilus	Eastern Forest Bat #
Vespadelus regulus	Southern Forest Bat #
Vespadelus troughtoni ^	Eastern Cave Bat #
Vespadelus vulturnus	Little Forest Bat #
Reptiles	
Intellagama lesueurii	Eastern Water Dragon
Pogona barbata	Bearded Dragon
Pseudechis porphyriacus	Red-bellied Black Snake

^ vulnerable BC act #probable ID * exotic

Appendix D Anabat Report

Identification of echolocation call sequences recorded at Branxton, New South Wales.

Data

Data was received by email on the 2212/2022 and was analysed using Anabat Insight v2.0.6. In total 3,754 recording were received 3,017 of which were, marked as containing recognisable microbat calls, by the use of a filter (please see below).

The data was recorded over from the 4th of December to the 13th of December 2022, identifications per site are presented in Table 1. Calls were recorded with a division ratio of 8. The original call files display Australian Eastern Standard Time.

Reference Library

Call identification for this data set was based on call keys and descriptions for New South Wales (Pennay et al 2004) with reference to descriptions published for southern Queensland (Reinhold et al 2001), and the authors own library.

Analysis

The reliability of identification is as follows:

Definite; one or more calls were there is no doubt about the identification of the species

Probable; most likely to be the species named, low probability of confusion with species that use similar calls

Possible; call is comparable with the named species, with a moderate to high probability of confusion with species of similar calls.

The filter (All Bats) used in this analysis screens call by applying criteria based on smoothness, duration and characteristic frequency. The filter is a generalised filter that includes parameters suitable for the microbat species of Australia (Titley, 2009). Subsequent to identifying species that passed the All Bats filter, all files were manually scanned to identify calls from species who are more likely produce weaker or fragmented calls.

Table 1. Species identification per detector location	Batcam 1	Batcam 4
Dates	4th - 13th December 2022	7th - 13th December 2022
Total Files	1,100	2,654
Marked files (passed filter)	861	2,156
Species		
Austronomus australis	X	X
Ozimops planiceps	#	X
Ozimops ridei	X	X
Chalinolobus gouldii	X	X
Micronomus norfolkensis	#	X
Ozimops spp./*C. gouldii*	#	#
Ozimops ridei/Micronomus norfolkensis	#	
Scoteanax rueppellii	#	#
Miniopterus orianae oceanensis	X	
Miniopterus orianae oceanensis/Vespadelus regulus	#	#
Myotis macropus		#
Myotis macropus/Nyctophilus spp.	#	
Vespadelus troughtoni /V. vulturnus	#	#
Chalinolobus morio	X	X
Chalinolobus morio/Vespadelus pumilus	#	#
Miniopterus australis/Vespadelus pumilus	#	#
Miniopterus australis	X	X
Rhinolophus megaphyllus	X	X

X - Definite

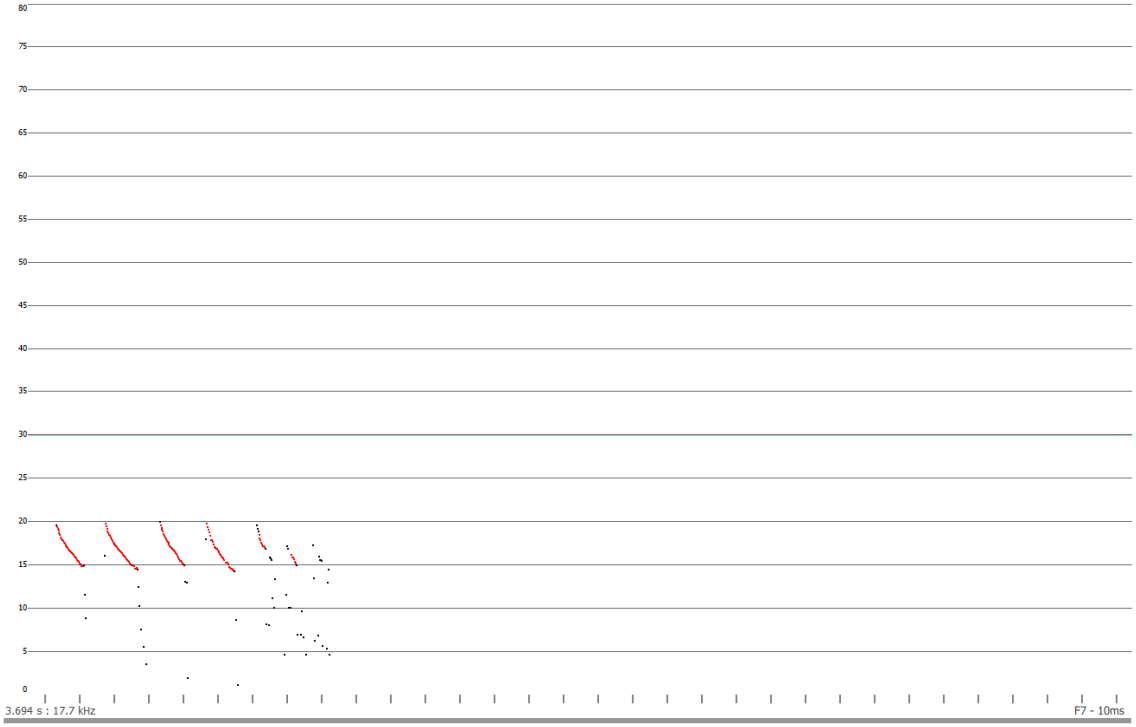
- Probable

* - Possible

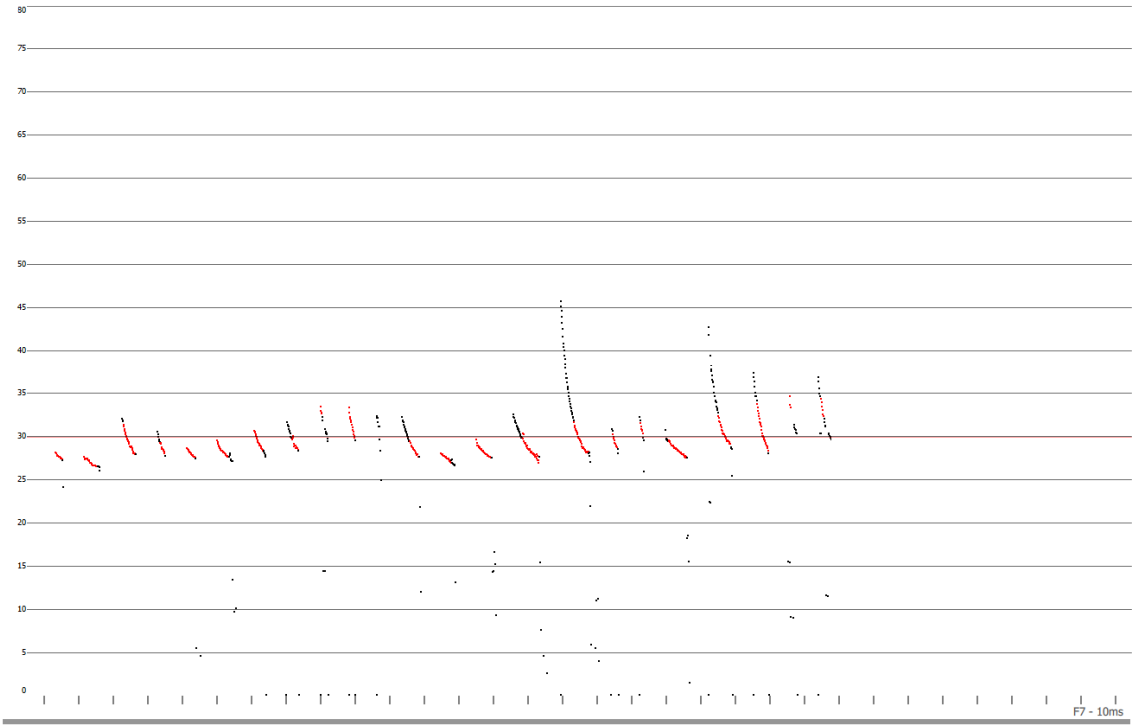
Call Examples (calls have been edited and filtered for reporting purposes)

Section 1.

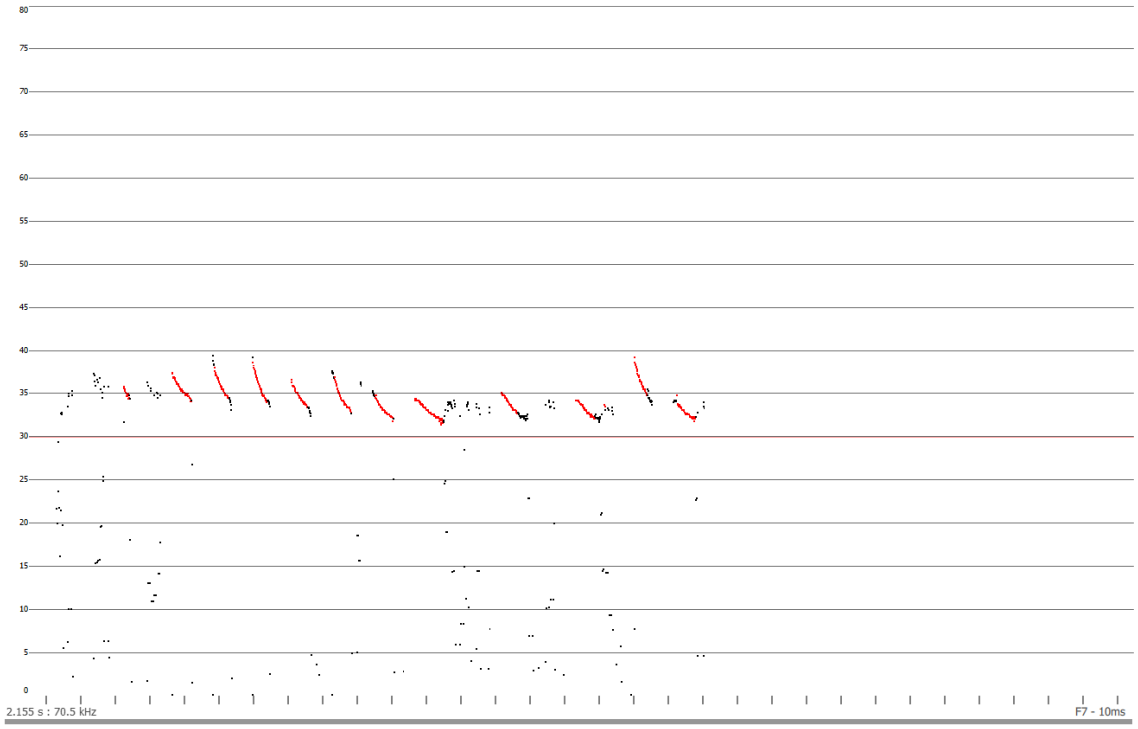
Species positively identified



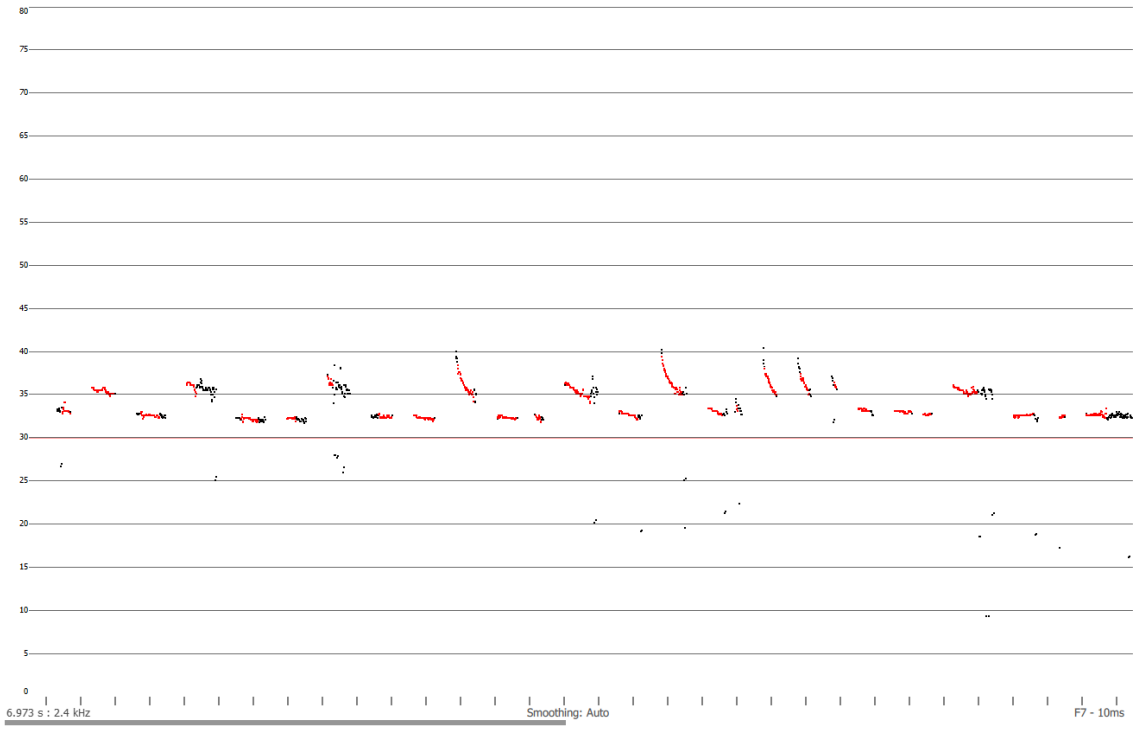
Definitely *Austronomus australis*. The characteristic frequency if this species is between 10 – 15 kHz. This species may be confused with *Saccolaimus flaviventris* at its lower harmonics.



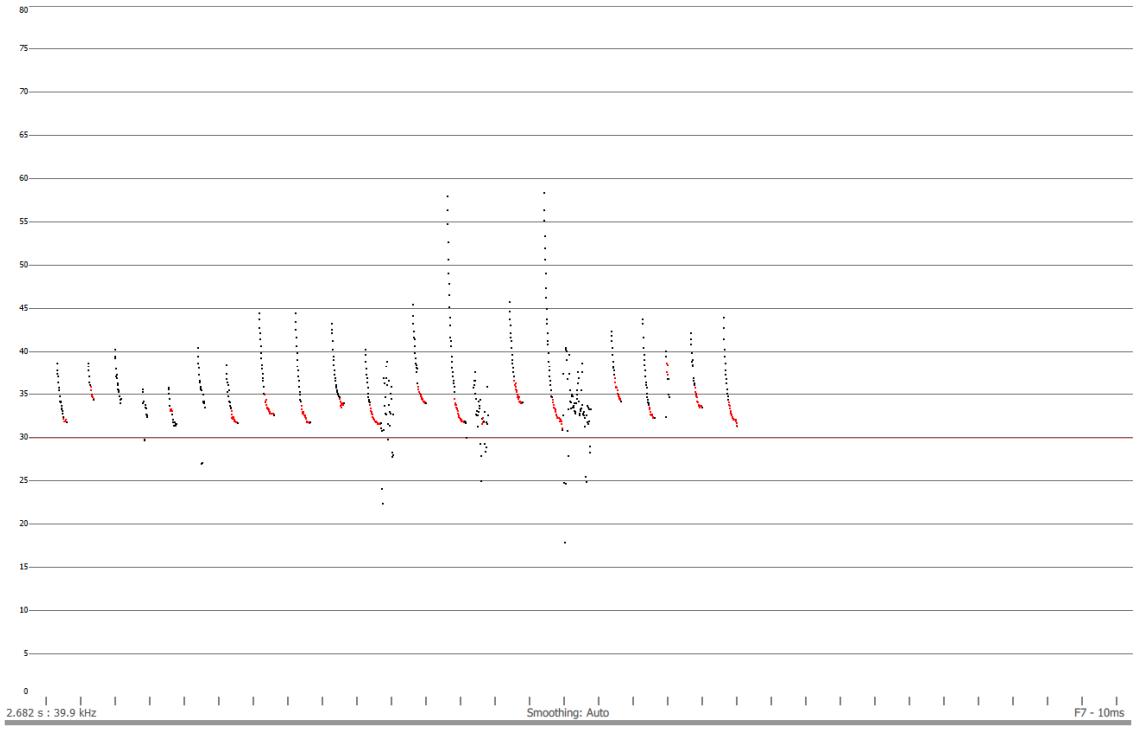
Definitely Ozimops planiceps. Published descriptions of calls for this species report that it calls between 26 – 30.5 kHz, although it has been recorded lower at around 24 kHz (pers. com. Greg Ford November 2015). The calls will be flat in the lower ranges and curved at the higher limits, and dependant on activity and environment.



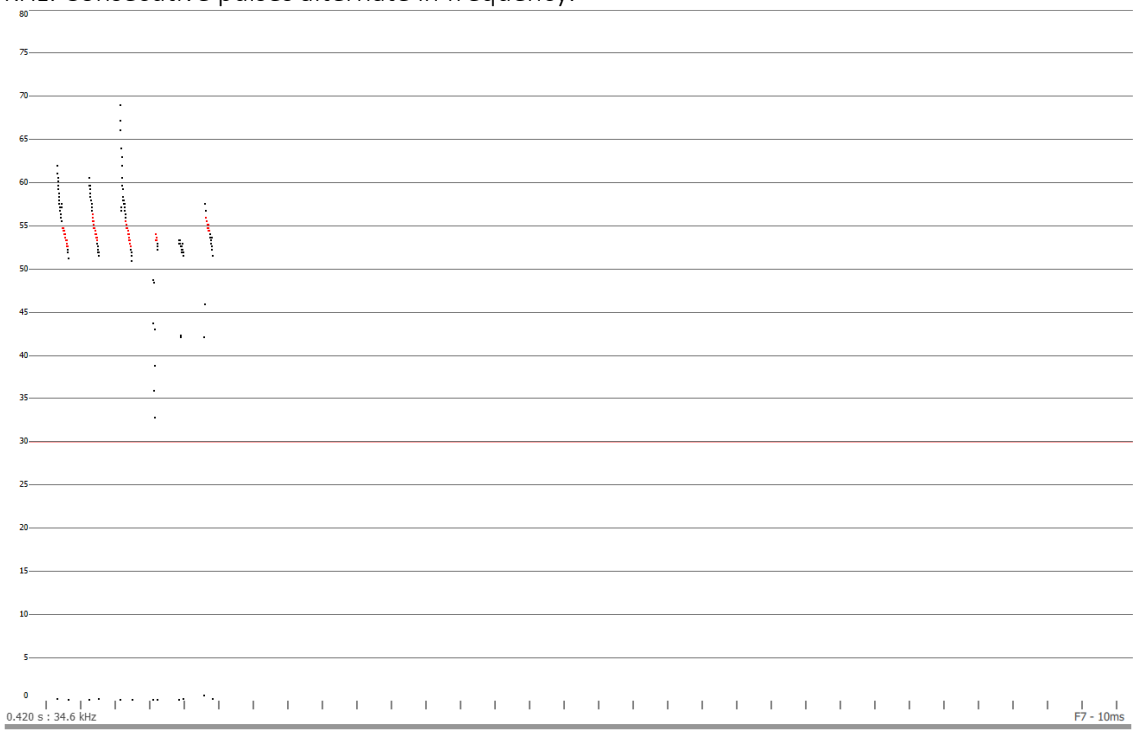
Definitely *Ozimops ridei.* The characteristic frequency of this call is greater than 31 kHz.



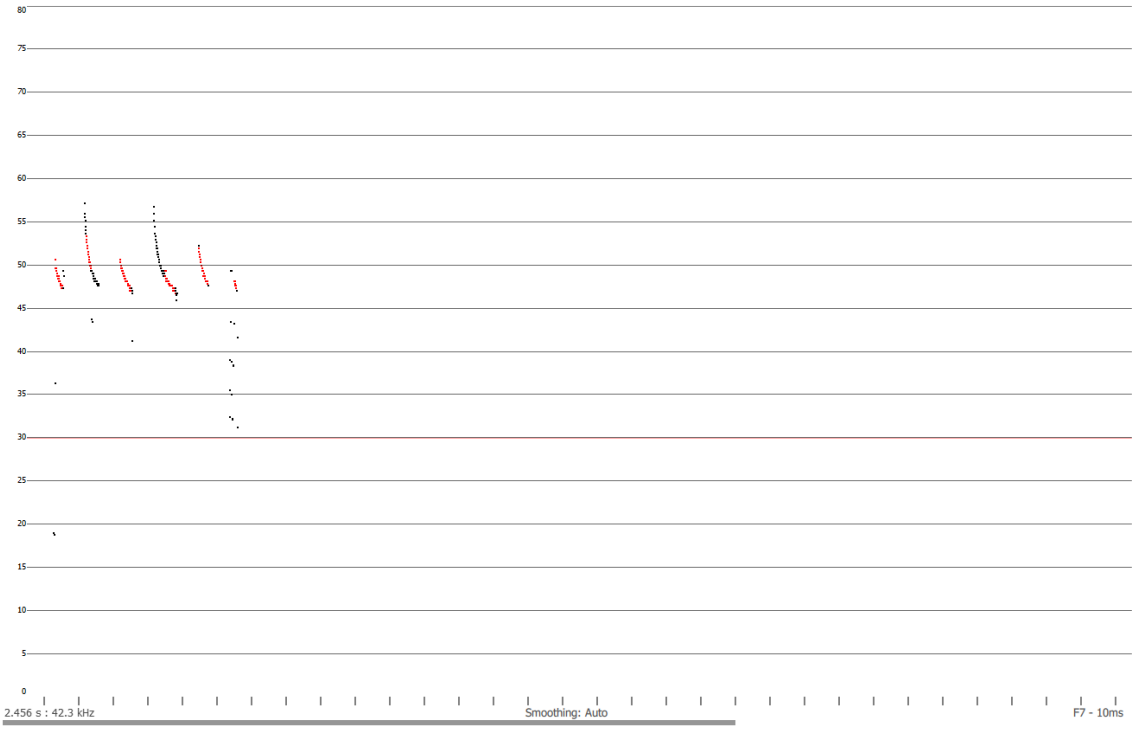
Definitely *Micronomus norfolkensis*. Calls of this species alternate and the general shape of the calls indicate the species.



Definitely *Chalinolobus gouldii*. The average characteristic frequency is between 25 and 34 KHz. Consecutive pulses alternate in frequency.

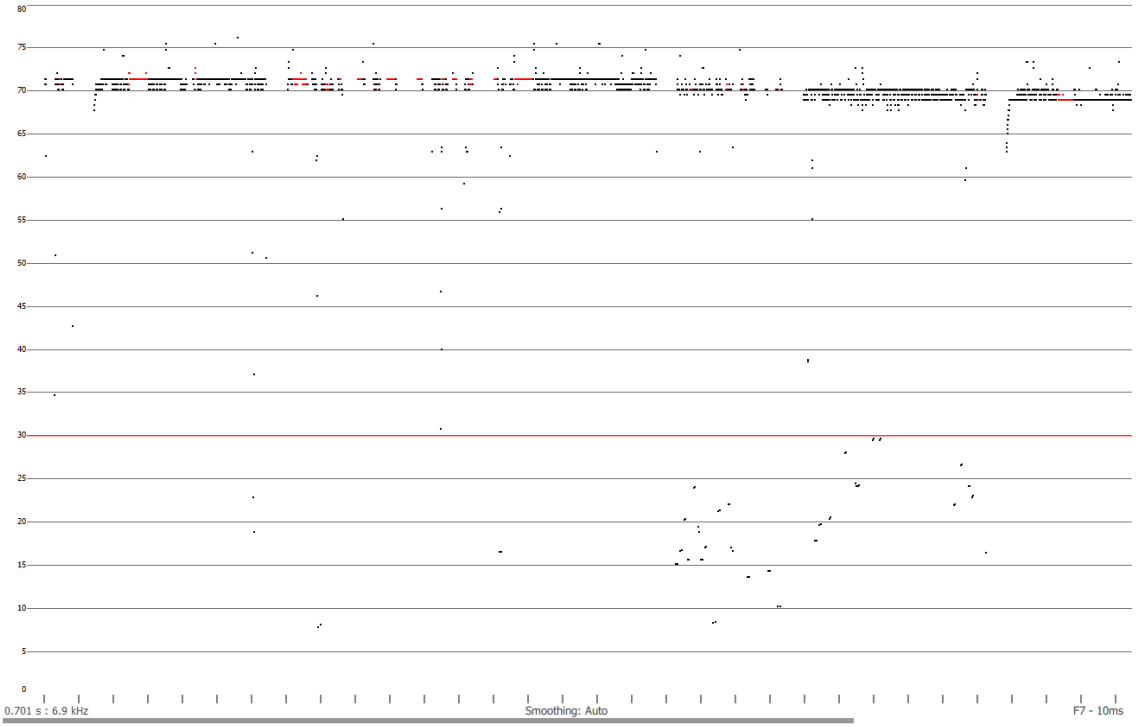


Definitely *Chalinolobus morio*. The species can be distinguished by a down sweeping tail, at this frequency.



Definitely *Miniopterus orianae oceanensis.* The species can be distinguished from *V. regulus* by having a longer pre-characteristic section, and by uneven consecutive pulses often with a down - sweeping tail.

Definitely *Miniopterus australis.* The characteristic frequency and the down sweeping tail are indicative of this species.

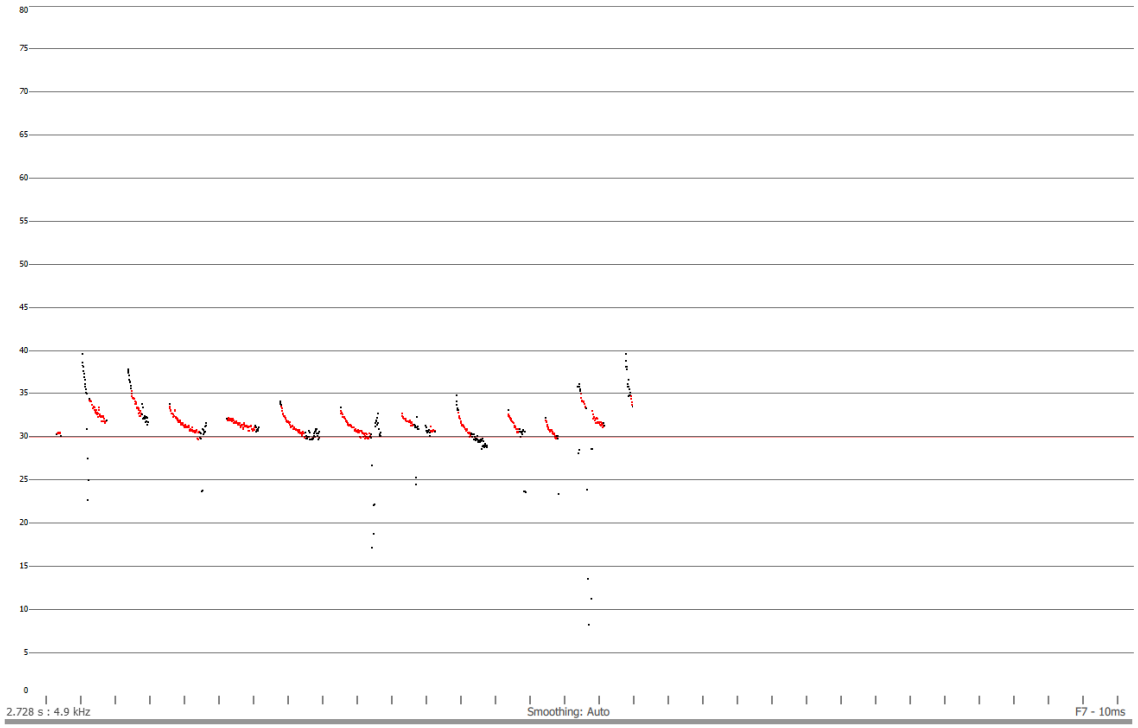


Definitely *Rhinolophus megaphyllus*. The constant frequency call between 66-70 kHz with upsweeping initial, and down sweeping tail are distinctive.

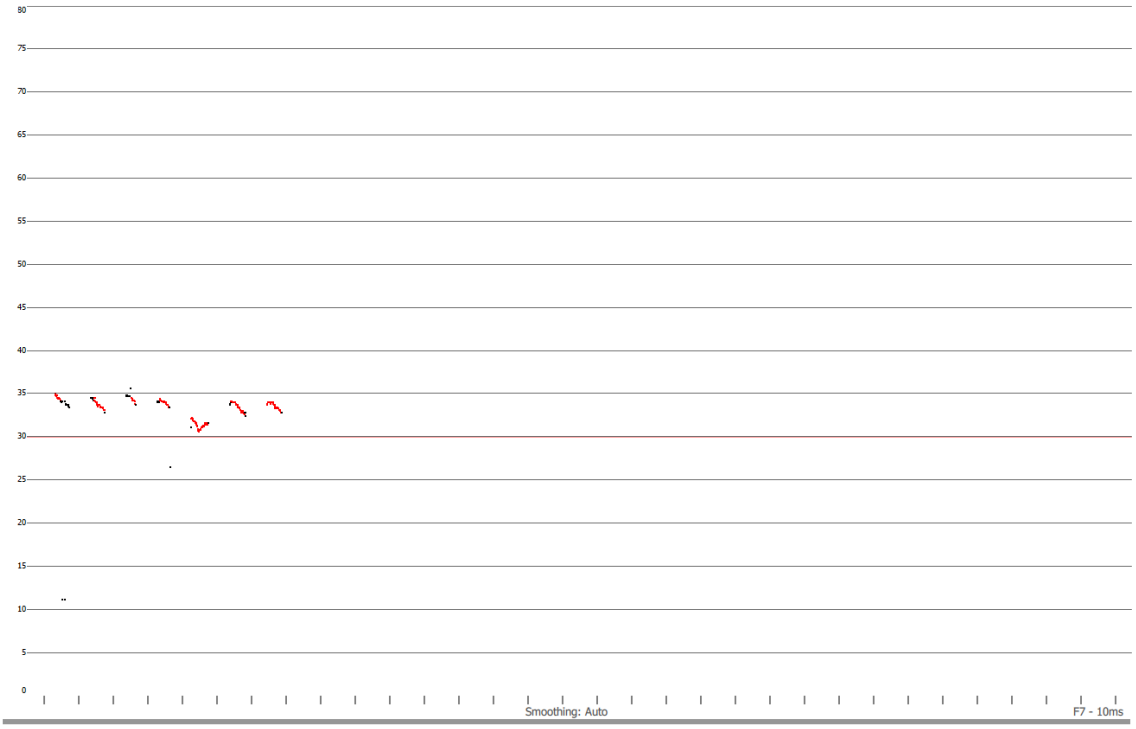
Section 2.

Species composites/groups identified.

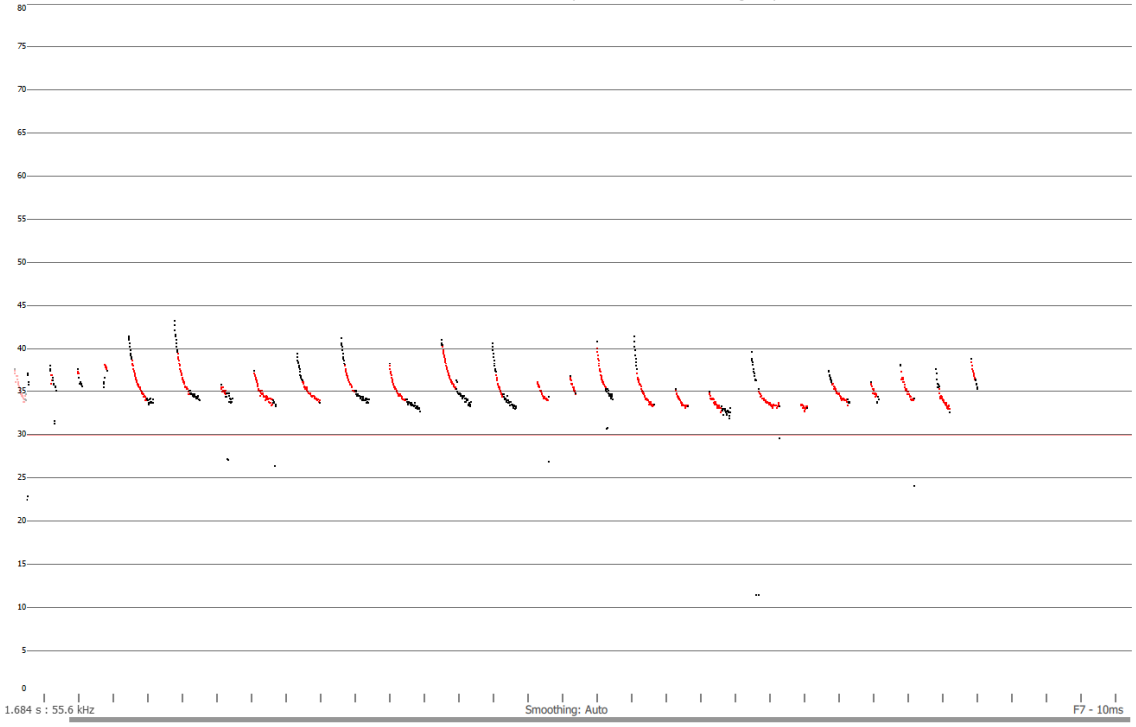
A species listed here that is not listed in the species positively identified should be considered. Likelihood of occurrence and call identification issues for these species are discussed below each call example.



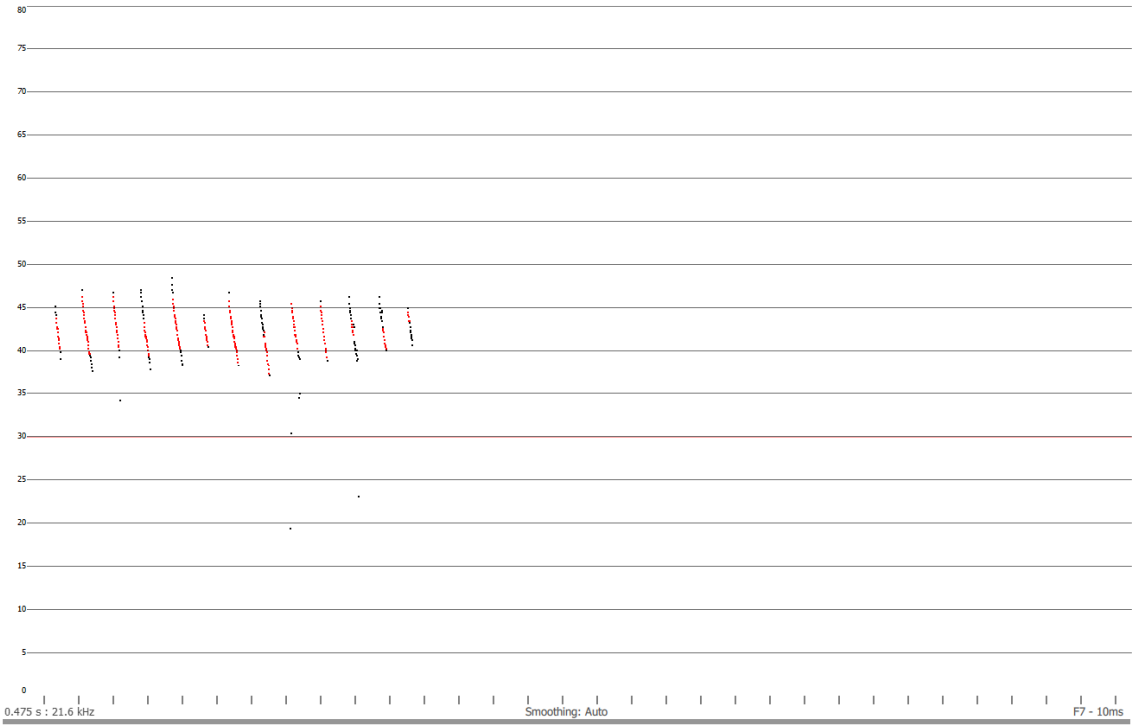
Probably *Chalinolobus gouldii/Ozimops* species. Frequency ranges overlap in the species, *C. gouldii* usually has steep, curved pulses that alternate in frequency compared to flat or shallow-curved pulses of Ozimops. *O. planiceps* (see Reardon et al. 2014 for a discussion of *O. planiceps*) and *O. ridei* have been recorded in the area (NPWS Atlas and Atlas of Living Australia Data January 2023).



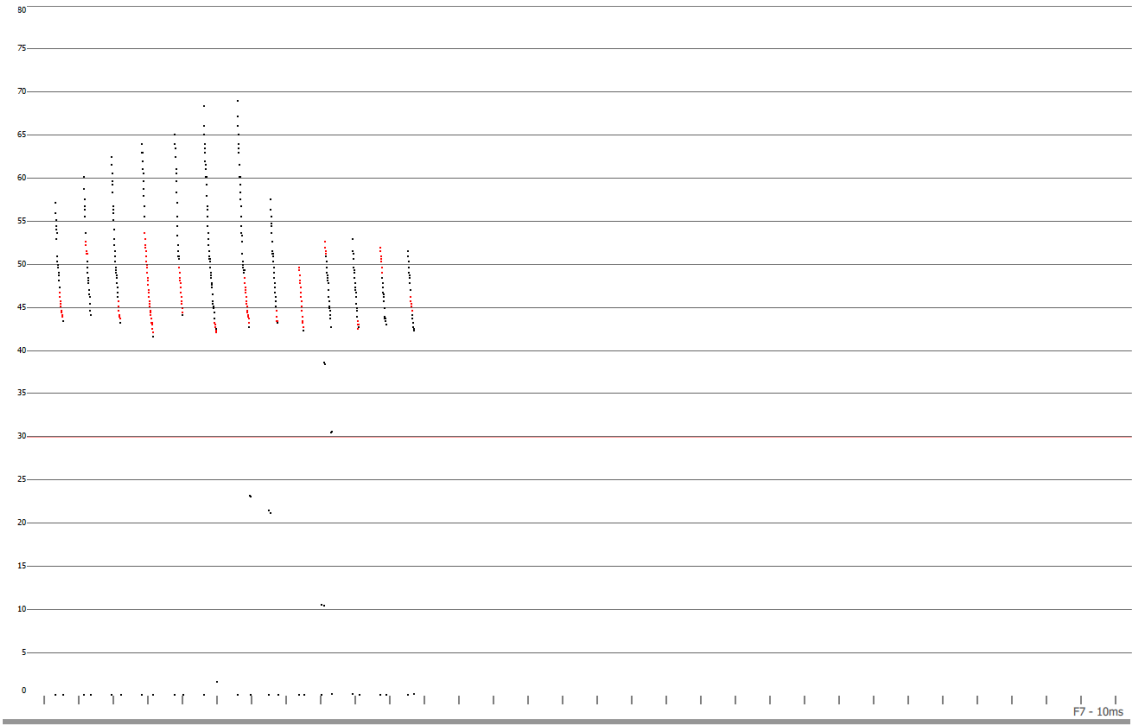
Probably *Ozimops ridei/Micronomus norfolkensis*. Both species have been recorded in this dataset. There is insufficient detail I this call sequence to assign positive identification.



Probably *Scoteanax rueppellii.* The call sequence is suggestive of this species, particularly the frequency of the knee, being consistently greater than 37kHz. However, the pre characteristic drop on good quality calls (with sufficient structure), range from ~ 2.8 – 3.6 kHz. This species cam be difficult to separate from *Scotorepens orion* and steeper calls of *Ozimops ridei*.

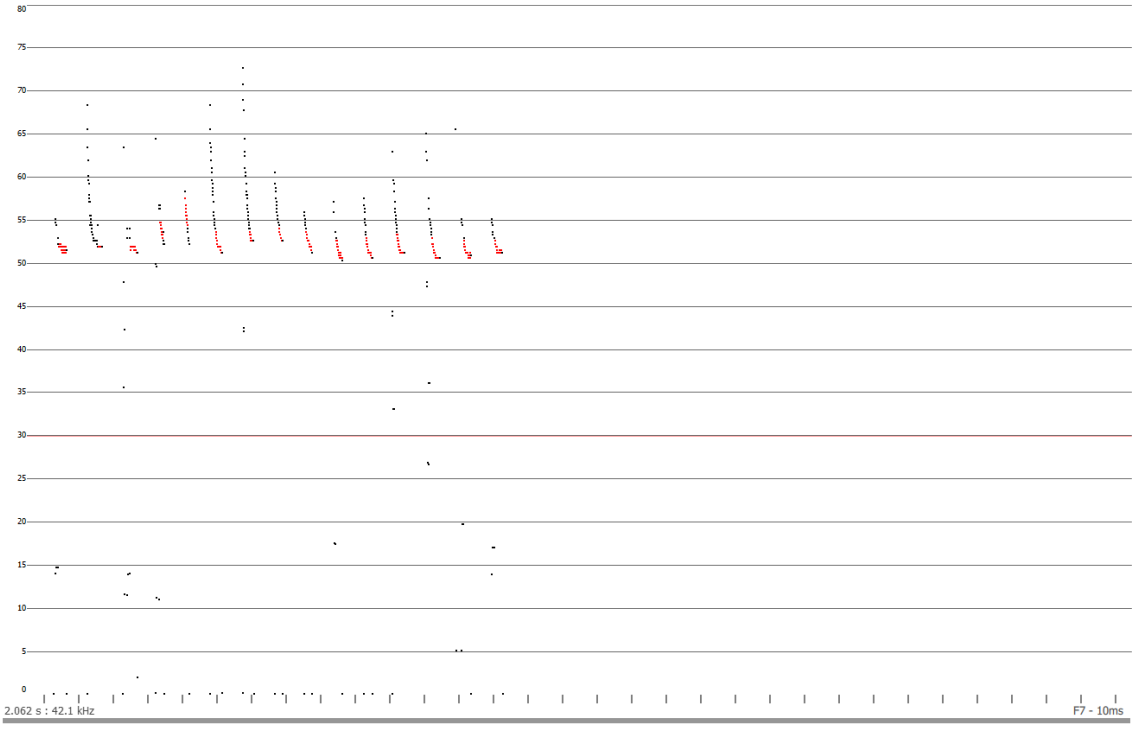


Probably *Myotis macropus*. Calls in this sequence are suggestive of the species. Habitat and location information provided with the data set indicate appropriate habitat in the area.

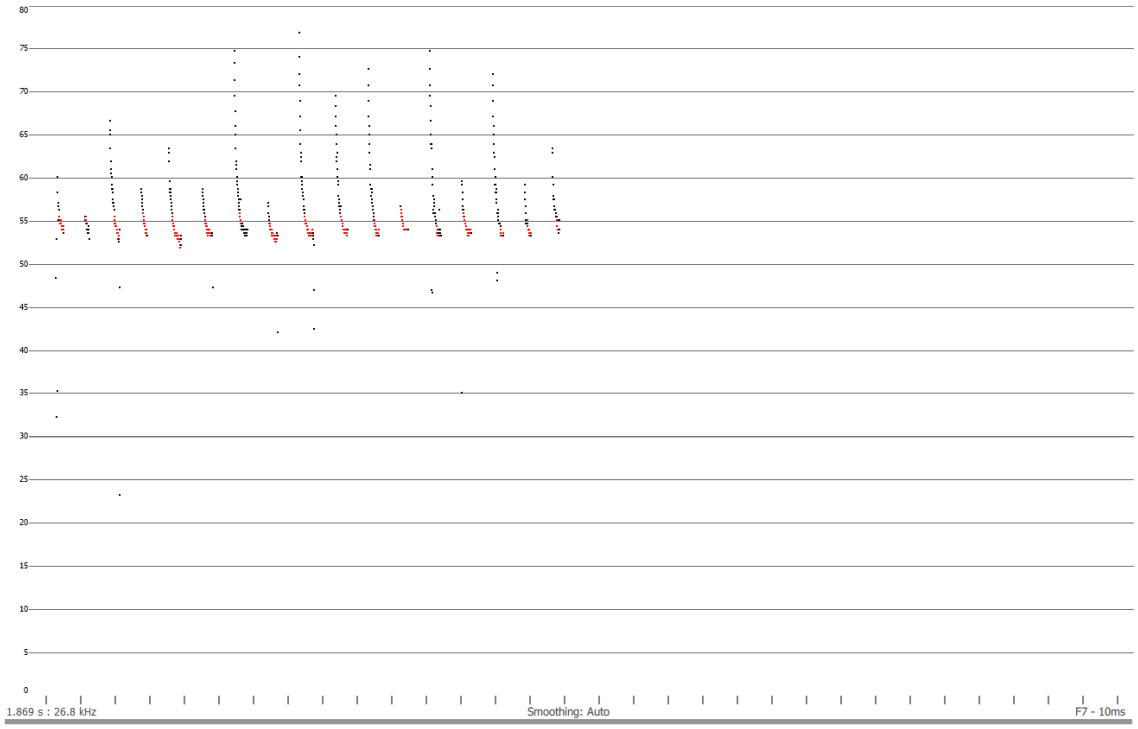


Probably *Myotis macropus/Nyctophilus* species. *M. macropus* calls can be differentiated from Nyctophilus species by having a pulse interval less than 75ms, an initial slope of greater than 400 OPS and often displaying a single change in slope (kink) in the central part of the pulse. There is insufficient detail in the call sequence to separate the species. *Nyctophilus* bats generally produce distinctive calls, however the species within the genus cannot be reliably differentiated from call data. *N. geoffroyi* and *N. gouldi* occur in the area.

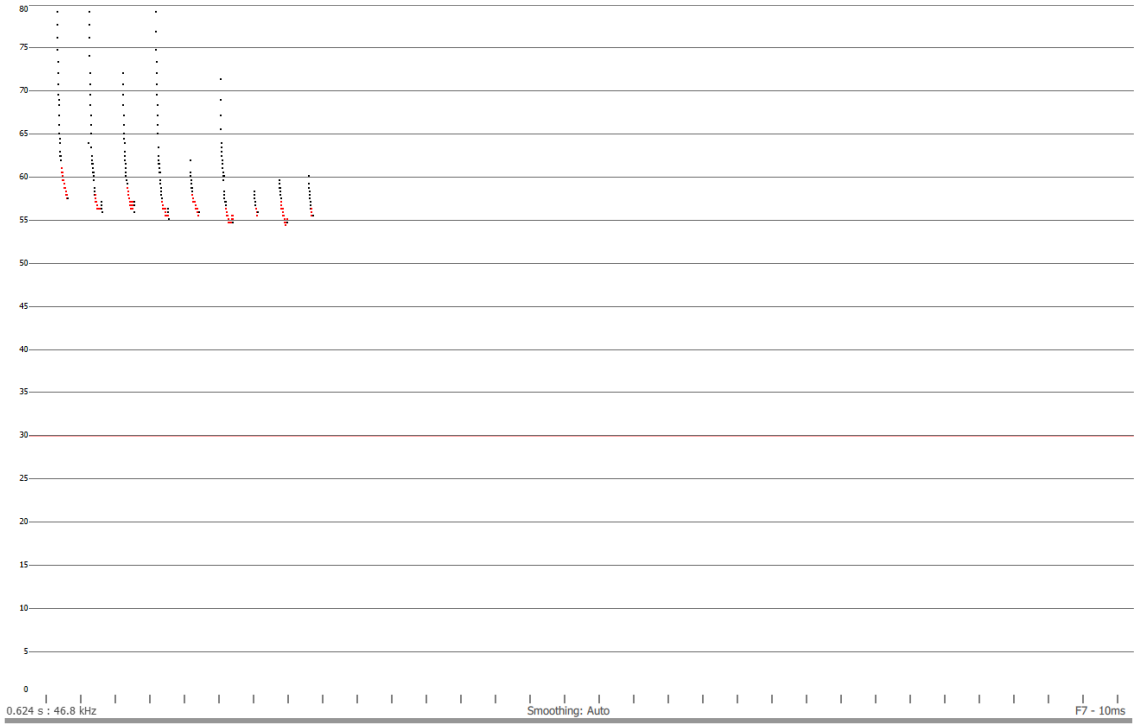
Probably *Vespadelus regulus/ Miniopterus orianae oceanensis*. Call characteristics sufficient to separate the species are not evident in some of the call sequences recorded in this dataset.



Probably *Vespadelus vulturnus/Vespadelus troughtoni*. The calls of these species overlap between 50.5 – 53 KHz. Published calls descriptions indicate that *Vespadelus pumilus* can also call at this frequency.



Probably *Vespadelus pumilus*/*Chalinolobus morio*. There is insufficient detail to assign positive identification.



Probably *Vespadelus pumilus/Miniopterus australis*. The species overlap above 55 kHz.

References

Churchill, S. (2008) Australian Bats, Allen and Unwin, Sydney.

Pennay, M., B. Law & L. Reinhold (2004). Bat calls of New South Wales: Region based guide to the echolocation calls of Microchiropteran bats. Hurstville: NSW Department of Environment and Conservation.

Reardon T. B., McKenzie N. L., Cooper S. J. B., Appleton B., Carthew S. & Adams M. (2014) A molecular and morphological investigation of species boundaries and phylogenetic relationships in Australian free-tailed bats Mormopterus (Chiroptera : Molossidae). Australian Journal of Zoology 62, 109-36.

Reinhold, L., Law, B., Ford, G. and Pennay, M. 2001, Key to the bat calls of southeast Queensland and north-east New South Wales. Forest Ecosystem Research and Assessment Technical paper 2001-07, Department of Natural Resources and Mines, Queensland.

Disclaimer

Appendix E Personnel Qualifications

Name	Title	Qualifications	Roles
Matt Doherty	Director	▪ BAM Assessor (#BAAS17044) ▪ B. Landscape Management and Conservation (Soil and Water Management) ▪ Bush Regeneration Cert IV	Review and Approval of Biodiversity Inventory Report. BAM-C
Chris Spraggon	Senior Ecologist	▪ B. Science (Hons.I) ▪ Cert 3 Conservation Land Management	Production of Biodiversity Inventory Report BAM-C Field work
Laidlaw Puha	GIS Analyst	▪ B. Science (Earth Sciences)	Produce figures for BIR and Spatial Data Management for Project
Ellen Saxon	GIS Coordinator	▪ B. Environmental Science and Management ▪ Diploma Conservation & Land Management	Produce figures for BIR and Spatial Data Management for Project
Coral Pearce	Senior Ecologist	▪ BAM Assessor (#BAAS21024) ▪ M. Sc – Mammal Ecology ▪ B. App. Science (Ecology)	Review and input of Biodiversity Inventory Report Field work
Maddy Walsh	Senior Ecologist	▪ B. Environmental Biology (Hons) ▪ BAM Assessor (#BAAS21010)	Field work
Simone-Louise Yasui	Ecologist	▪ B: Biological Sciences (Hons) ▪ Msc: Ecology and Evolutionary Biology ▪ PhD: Biological and Environmental Sciences	Field work
Ali Bragg	Field Ecologist	▪ B. Animal Science (Hons)	Field work
Robert Fay	Field Ecologist	▪ B. Environmental Science and Management	Field work
Max Manion-Sharrock	Field Ecologist	▪ B. Environmental Science and Management	Field work
Mathew Grassi	Field Ecologist	▪ B. Environmental Science and Management (Ecosystems and Biodiversity)	Field work
Nixon Jowett	Field Ecologist	▪ B. Environmental Science and Management ▪ Graduate Certificate Geospatial Intelligence	Field work
Laura Smith	Field Ecologist	▪ B. Environmental Science and Management (Marine)	Field work
Tom Fletcher	Field Ecologist	▪ B. Environmental Science and Management	Field work
Josh Smart	Ecologist	▪ B. Environmental Science and Management (Honours)	Field work
David Russel	Ecologist	▪ BAM accreditation (#BAAS-18084) ▪ Bachelor of Science	Field Work