

A stylized topographic map with green contour lines is positioned on the left side of the page, extending from the top left towards the bottom left.

Aspect Industrial Estate - Biodiversity Development Assessment Report

Prepared for Mirvac Projects Pty Ltd

DOCUMENT TRACKING

Project Name	Aspect Industrial Estate - Biodiversity Development Assessment Report
Project Number	18SYD - 11929
Project Manager	Rebecca Ben-Haim
Prepared by	Alex Gorey
Reviewed by	Nicole McVicar
Approved by	David Bonjer
Status	Final
Version Number	4
Last saved on	30 September 2020

This report should be cited as 'Eco Logical Australia. 2019 Aspect Industrial Estate - Biodiversity Development Assessment Report. Prepared for Mirvac Projects Pty Ltd.'

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd. Mirvac Projects Pty Ltd

Disclaimer

This document may only be used for the purpose for which it was commissioned and in accordance with the contract between Eco Logical Australia Pty Ltd and Mirvac Projects Pty Ltd. The scope of services was defined in consultation with Mirvac Projects Pty Ltd, by time and budgetary constraints imposed by the client, and the availability of reports and other data on the subject area. Changes to available information, legislation and schedules are made on an ongoing basis and readers should obtain up to date information. Eco Logical Australia Pty Ltd accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report and its supporting material by any third party. Information provided is not intended to be a substitute for site specific assessment or legal advice in relation to any matter. Unauthorised use of this report in any form is prohibited.

Template 2.8.1

Executive Summary

Eco Logical Australia Pty Ltd (ELA) was engaged by Mirvac Projects Pty Ltd (Mircvac) to prepare a Biodiversity Development Assessment Report (BDAR) in accordance with the NSW *Biodiversity Conservation Act 2016* (BC Act) at Lots 54 – 58 DP 259135 Mamre Road, Kemps Creek. The proposed development includes an 11-lot of industrial subdivision, internal road network, car parking and landscaping. The development will also include an amenity lot along Mamre Road and the realignment of a second order stream along the western boundary of the development site.

This BDAR is required as the development will impact on vegetation mapped on the Biodiversity Values Map (Accessed 17/12/2018). This report has been prepared to meet the requirements of the Biodiversity Assessment Method (BAM) established under Section 6.7 of the NSW BC Act. The following Plant Community Types (PCTs) were identified in the development site and are in poor condition:

- *PCT 835 - Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion*
- *PCT 849 – Grey Box – Forest Red Gum grassy open woodland on flats of the Cumberland Plain, Sydney Basin Bioregion.*

PCT 835 is consistent with *River-flat Eucalypt Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*, an endangered ecological community under the BC Act. PCT 835 was present in poor condition. This community is proposed for listing under the commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

PCT 849 is consistent with *Cumberland Plain Woodland in the Sydney Basin Bioregion* (CPW), listed as critically endangered under both the BC Act and EPBC Act. PCT 849 was in poor condition, and present as poor condition remnants, scattered paddock trees and plantings. The planted zones do not comprise the threatened ecological community listing under both state and Commonwealth legislation. PCT 849 identified as poor condition and scattered paddock trees does not meet the EPBC Act definition of the vegetation community. Areas mapped as paddock trees were consistent the definition of paddock trees in the BAM.

Myotis macropus (Southern Myotis), listed as vulnerable under the BC Act was identified as utilising the development site through echolocation surveys. Southern Myotis is a species credit species under the BAM. The investigations did not confirm whether the site is being used for breeding, so the assessment has assumed this is the case and calculated the credits accordingly.

This BDAR also outlines the measures taken to avoid, minimise and mitigate impacts on the vegetation and species habitat present within the development site and measures to minimise impacts during construction and operation of the development. Following consideration of the above aspects, the residual unavoidable impacts of the project were calculated in accordance with BAM by utilising the Biodiversity Assessment Method Credit Calculator.

A total of three species credits are required for Southern Myotis. One credit is required to offset the impact to PCT 849 Scattered Paddock Tree. No ecosystem credits are required for PCT 849 or PCT 835

in poor condition as they received a vegetation integrity score of < 17. These PCTs achieved scores of 7.2 and 9.5 respectively.

Serious and Irreversible Impacts (SII) values have been considered as part of this assessment. Cumberland Plain Woodland is a listed candidate entity. Approximately 0.61 ha of Cumberland Plain Woodland will be removed as a result of the development. However, due to the condition of this community within the development site, no offsets consistent with the Biodiversity Offsets Scheme (BOS) are required. It is noted that the threshold for what is considered a SII is yet to be published by the Department of Industry, Planning and Environment (DPIE). A SII assessment has been undertaken consistent with the BAM. The determination of SII on biodiversity values is to be made by the approval authority.

Contents

1. Stage 1: Biodiversity assessment	1
1.1 Introduction	1
1.1.1 General Description of the Development Site	1
1.1.2 Development Site Footprint	2
1.1.3 Sources of information used	2
1.2 Legislative Context	6
1.3 Landscape Features	7
1.3.1 IBRA regions and Subregions	7
1.3.2 Native Vegetation Extent	7
1.3.3 Rivers and Streams	7
1.3.4 Wetlands	7
1.3.5 Connectivity Features	7
1.3.6 Areas of Geological Significance and Soil Hazard Features	8
1.3.7 Site Context	8
1.4 Native Vegetation	8
1.4.1 Survey Effort	8
1.4.2 Plant Community Types Present	11
1.4.3 TEC Selection Justification	14
1.4.4 Vegetation Integrity Assessment	14
1.4.5 Use of local data	15
1.5 Threatened Species	19
1.5.1 Ecosystem Credit Species	19
1.6 Species Credit Species	19
1.6.1 Targeted Surveys	19
2. Stage 2: Impact Assessment (Biodiversity Values)	39
2.1 Avoiding Impacts	39
2.1.1 Locating a Project to Avoid and Minimise Impacts on Vegetation and Habitat	39
2.1.2 Designing a Project to Avoid and Minimise Impacts on Vegetation and Habitat	39
2.1.3 Prescribed Biodiversity Impacts	40
2.2 Assessment of Impacts	41
2.2.1 Direct Impacts	41
2.2.2 Change in Vegetation Integrity	41
2.2.3 Indirect Impacts	41
2.2.4 Prescribed Biodiversity Impacts	42
2.2.5 Mitigating and Managing Impacts	42
2.2.6 Serious and Irreversible Impacts (SAII)	47
2.3 Risk assessment	48

2.4 Impact Summary.....	52
2.4.1 Serious and Irreversible Impacts (SAII)	52
2.4.2 Impacts Requiring Offsets.....	52
2.4.3 Impacts Not Requiring Offsets.....	52
2.4.4 Areas not Requiring Assessment	53
2.4.5 Credit Summary	53
2.5 Consistency with Legislation and Policy.....	58
2.5.1 Draft Cumberland Plain Conservation Plan	58
2.5.2 Western Sydney Employment Area SEPP Clause 33K.....	58
2.5.3 Environment Protection and Biodiversity Conservation Act 1999	58
3. References	62
Appendix A Definitions.....	64
Appendix B Credit Report Summary.....	67
Appendix C Vegetation plot data	69
Appendix D Ultrasonic analysis report	76
Appendix E Plot photos	93

List of Figures

Figure 1: Site Map	4
Figure 2: Location Map.....	5
Figure 3: Plant Community Types and native vegetation extent.....	16
Figure 4: Plot locations.....	17
Figure 5: Threatened Ecological Communities.....	18
Figure 6: Targeted surveys	37
Figure 7: Species polygons	38
Figure 8: Final project footprint including construction and operation	51
Figure 9: Serious and Irreversible Impacts.....	54
Figure 10: Impacts requiring offset.....	55
Figure 11: Impacts not requiring offset.....	56
Figure 12: Areas not requiring assessment.....	57
Figure 13. Call profile for <i>Austronomus australis</i> (White-striped Free-tailed Bat) recorded on SUT02 at 2001 (8:01 pm) on 1 October 2019.....	86
Figure 14. Call profile for <i>Chalinolobus gouldii</i> (Gould's Wattled Bat) recorded on SUT02 at 2246 (10.46 pm) 3 October 2019.	86
Figure 15. Call profile for <i>Chalinolobus morio</i> (Chocolate Wattled Bat) recorded on SUT02 at 2020 (8:20 pm) on 30 September 2019.	87
Figure 16. Call profile for <i>Falsistrellus tasmaniensis</i> (Eastern False Pipistrelle) recorded at on COF02 at 1821 (6:21 pm) on 3 October 2019.....	87

Figure 17: Potential call profile for either <i>Falsistrellus tasmaniensis</i> (Eastern False Pipistrelle), <i>Scoteanax rueppellii</i> (Greater Broad Nosed Bat) or <i>Scotorepens orion</i> (Eastern Broad-nosed Bat) recorded on COF02 at 18:30 (6:30 pm) on 1 October 2019.	88
Figure 18. Call profile for <i>Micronomus norfolkensis</i> (Eastern Coastal Free-tailed Bat) recorded on SUT02 at 1936 (7:36 pm) on 30 September 2019.	89
Figure 19. Call profile for <i>Miniopterus orianae oceanensis</i> (Eastern Bentwing Bat) recorded on SUT02 at 2059 (8:59 pm) on 1 October 2019.	89
Figure 20. Call profile for <i>Myotis macropus</i> (Southern Myotis) recorded on COF02 at 2326 (11:26 pm) on 2 October 2019.	90
Figure 21. Potential call profile for <i>Myotis macropus</i> (Southern Myotis) recorded on SUT02 at 0105 (1:05 am) on 2 October 2019. Please note that it appears that two bats are calling in this recording.	90
Figure 22. Call profile for either <i>Nyctophilus gouldii</i> (Gould's Long-eared Bat) / <i>Nyctophilus geoffroyi</i> (Lesser Long-eared Bat) recorded on COF02 at 1855 (6:55 pm) on 30 September 2019.	91
Figure 23. Call profile for <i>Ozimops ridei</i> (Ride's Free-tailed Bat) recorded on COF01 at 1823 (6:23 pm) on 30 September 2019.	91
Figure 24. Potential Call profile for <i>Scoteanax rueppellii</i> (Greater Broad Nosed Bat) / <i>Scotorepens orion</i> (Eastern Broad-nosed Bat) / recorded on COF02 at 2055 (8:55 pm) on 1 October 2019.	92
Figure 25. Call profile for <i>Vespadelus vulturnus</i> (Little Forest Bat) recorded on COF02 at 2055 (8:55 pm) on 1 October 2019.	92

List of Tables

Table 1: Legislative context	6
Table 2: Native vegetation extent	7
Table 3: Rivers and streams	7
Table 4: Percent native vegetation cover in the landscape	8
Table 5: Patch size	8
Table 6: Full-floristic PCT identification plots	9
Table 7: Vegetation integrity plots	10
Table 8: Plant Community Types	11
Table 9: Threatened Ecological Communities	11
Table 10: PCT selection justification	11
Table 11: Vegetation integrity	14
Table 12: Predicted ecosystem credit species	20
Table 13: Justification for exclusion of predicted ecosystem credit species	22
Table 14: Candidate species credit species	25
Table 15: Targeted surveys	35
Table 16: Weather conditions	35
Table 17: Survey effort	35
Table 18: Species credit species included in the assessment	36
Table 19: Locating a project to avoid and minimise impacts on vegetation and habitat	39
Table 20: Designing a project to avoid and minimise impacts on vegetation and habitat	39
Table 21: Direct impacts to native vegetation and threatened ecological communities	41

Table 22: Direct impacts on threatened species and threatened species habitat	41
Table 23: Change in vegetation integrity	41
Table 24: Indirect impacts	42
Table 25: Measures proposed to mitigate and manage impacts.....	43
Table 26: Candidate Serious and Irreversible Impacts.....	47
Table 27: Evaluation of an impact on a TEC.....	47
Table 28: Likelihood criteria	48
Table 29: Consequence criteria.....	48
Table 30: Risk matrix	49
Table 31: Risk assessment	49
Table 32: Impacts to native vegetation that require offsets	52
Table 33: Impacts on threatened species and threatened species habitat that require offsets.....	52
Table 34: Impacts to native vegetation that do not require offsets.....	52
Table 35: Ecosystem credits required	53
Table 36: Species credit summary.....	53
Table 37: Significant impact assessment for Latham's Snipe.....	59
Table 38: Significant Impact Assessment on Grey-headed Flying-fox	59
Table 39: Composition, structure and function exported from plot data	75
Table 40: Correlations between current and previous nomenclature for the Free-tailed bats of NSW .	77
Table 41. Microbat species diversity and number of calls recorded ultrasonically at Lots 54 – 58 Mamre Rd, Kemps Creek between the 30 September and 3 October 2019.	78
Table 42: Microbat species diversity and number of calls recorded ultrasonically on COF01 at Lots 54 – 58 Mamre Rd, Kemps Creek between 30 September and 3 October 2019.....	82
Table 43: Microbat species diversity and number of calls recorded ultrasonically on COF01 at Lots 54 – 58 Mamre Rd, Kemps Creek between 30 September and 3 October 2019.....	83
Table 44: Microbat species diversity and number of calls recorded ultrasonically on SUT01 at Lots 54 – 58 Mamre Rd, Kemps Creek between 30 September and 3 October 2019.....	84
Table 45: Microbat species diversity and number of calls recorded ultrasonically on SUT020 at Lots 54 – 58 Mamre Rd, Kemps Creek between 30 September and 3 October 2019.	85

Abbreviations

Abbreviation	Description
BAM	Biodiversity Assessment Method
BAMC	Biodiversity Assessment Method Credit Calculator
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
BDAR	Biodiversity Development Assessment Report
BSSAR	Biodiversity Stewardship Site Assessment Report
CEEC	Critically Endangered Ecological Community
DPIE	Department of Planning Industry and Environment
DNG	Derived Native Grassland
DoEE	Commonwealth Department of Environment and Energy
DPE	NSW Department of Planning and Environment (now Department of Planning Industry and Environment)
EEC	Endangered Ecological Community
ELA	Eco Logical Australia Pty Ltd.
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
FM Act	NSW <i>Fisheries Management Act 1994</i>
GFA	Gross Floor Area
GIS	Geographic Information System
GPS	Global Positioning System
IBRA	Interim Biogeographic Regionalisation for Australia
LGA	Local Government Area
LLS	Local Land Service
NSW	New South Wales
NOW	NSW Office of Water
OEH	NSW Office of Environment and Heritage (now Department of Planning Industry and Environment)
PCT	Plant Community Type
SEPP	State Environmental Planning Policy
SSD	State Significant Development
SSI	State Significant Infrastructure
TEC	Threatened Ecological Community
VIS	Vegetation Information System
WM Act	NSW <i>Water Management Act 2000</i>

1. Stage 1: Biodiversity assessment

Eco Logical Australia Pty Ltd (ELA) was engaged by Mirvac Projects Pty Ltd (Mircvac) to prepare this Biodiversity Development Assessment Report (BDAR) for the proposed industrial subdivision across Lots 54 – 58 DP 259135 Mamre Road, Kemps Creek. This report complies with the NSW *Biodiversity Conservation Act 2016* (BC Act) and the Biodiversity Assessment Methodology (BAM). The proposed development includes a concept Masterplan for 11 industrial buildings, internal road network layout, building locations, gross floor area (GFA), car parking, concept landscaping, building heights, setbacks and built form parameters. The development will also include an amenity lot along Mamre Road and the realignment of a second order stream along the western boundary of the development site.

1.1 Introduction

This BDAR has been prepared by Alex Gorey and Mike Lawrie who is an accredited person (BAAS18162) under the BC Act.

1.1.1 General Description of the Development Site

Aspect Industrial Estate (the development site) is legally described as Lots 54 – 58 in DP 259135, with an area of approximately 56.3 ha. The site is located east of Mamre Road, Kemps Creek within the Penrith Local Government Area (LGA).

The site has approximately 950 m of direct frontage to Mamre Road with a proposed intersection providing vehicular access via Mamre Road to the M4 Motorway and Great Western Highway to the north and Elizabeth Drive to the south.

The site is located approximately 4 km north-west of the future Western Sydney Nancy-Bird Walton Airport, 13 km south-east of the Penrith CBD and 40km west of the Sydney CBD.

The development site predominantly consists of exotic pasture, market gardens and farm dams. The development site contains one second order stream and several small, isolated patches of remnant native vegetation. There are a number of residential properties with managed gardens and one poultry shed on Lot 54 DP 259135.

The Department of Planning, Industry and Environment (DPIE) rezoned Mamre Road Precinct, including the site, in June 2020 under the *State Environmental Planning Policy (Western Sydney Employment Area) 2009* (WSEA SEPP).

Consistent with the above, this report has been prepared to support a Development Application under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the purpose of:

- A Concept Masterplan for the site comprising 11 industrial buildings, internal road network layout, building locations, GFA, car parking, concept landscaping, building heights, setbacks and built form parameters.
- Stage 1 development of the site including:
 - The demolition, removal of existing rural structures and remediation works;
 - Heritage salvage works (if applicable);

- Clearing of existing vegetation on the subject site and associated dam dewatering and decommissioning;
- Realignment of existing creek and E2 Environmental Conservation zone;
- Onsite bulk earthworks including any required ground dewatering;
- The importation, placement and compaction of spoil material, consisting of:
 - Virgin Excavated Natural material (VENM) within the meaning of the POEO Act; and/or
 - Excavated Natural material (ENM) within the meaning of the NSW Environmental Protection Authority's (EPA) Resource Recovery Exemption under Part 9, Clauses 91 and 92 of the POEO (Waste) Regulation 2014 – The Excavated Natural Material Order 2014; and/or
 - Materials covered by a specific NSW EPA Resource Recovery Order and Exemption which are suitable for their proposed use.
- Boundary retaining walls;
- Catchment level stormwater infrastructure, trunk services connections, utility infrastructure, roads and access infrastructure (signalised intersection with Mamre Road) associated with Stage 1;
- Construction, fit out and 24 hours a day/ 7 days per week use of warehouse and distribution centre within Stage 1;
- Detailed on lot earthworks, stormwater, services and utility infrastructure associated with the construction of warehouse and distribution centre within Stage 1;
- Boundary stormwater management, fencing and landscaping; and
- Staged subdivision of Stage 1.

The Secretary's Environmental Assessment Requirements (SEARs) have been issued in respect of the proposal. This report addresses the relevant SEARs considerations.

This report includes two base maps, the Site Map (Figure 1) and the Location Map (Figure 2).

1.1.2 Development Site Footprint

The development footprint encompasses the entirety of Lots 54 – 58 DP259135. All works associated with the proposed subdivision and the operational footprint will be contained within the development site. The proposed development involves the construction of the following:

- industrial warehouses and office buildings
- carparks
- roads
- a realigned creek
- hardstand surfaces.

1.1.3 Sources of information used

The following data sources were reviewed as part of this report:

- Biodiversity Assessment Methodology Calculator
- BioNet Vegetation Classification
- BioNet / Atlas of NSW Wildlife 5 km database search (OEH 2019a)

- EPBC Act Protected Matters Search Tool 5 km database search (DotEE 2019)
- NSS Government Biodiversity Values Map (accessed on 21 October 2019)
- The Native Vegetation of the Sydney Metropolitan Area v.3 (OEH 2016)
- aerial mapping (SIXMaps)
- additional GIS datasets including soil, topography, geology and drainage
- Penrith Local Environmental Plan 2010
- Penrith Development Control Plan 2014.

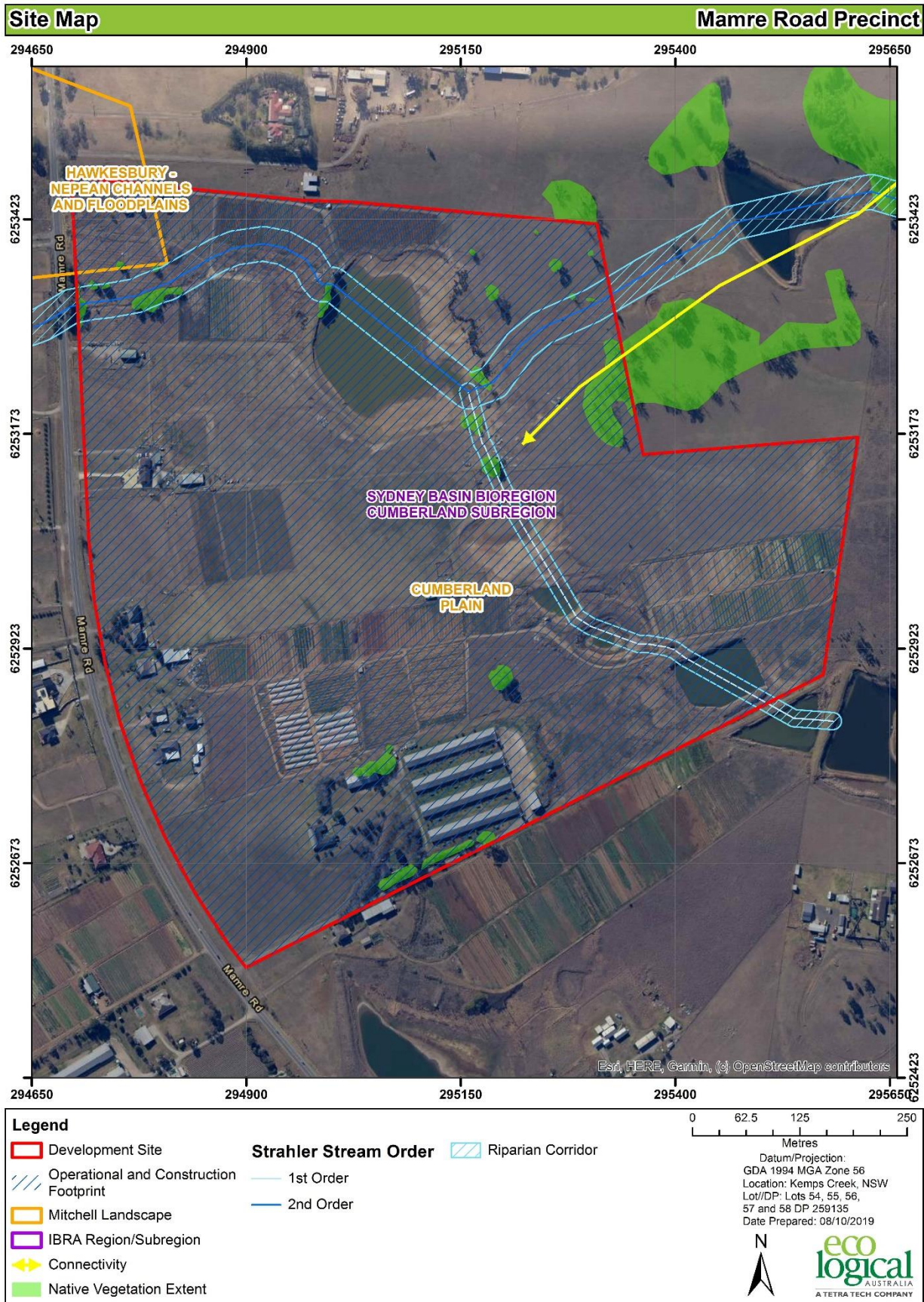


Figure 1: Site Map

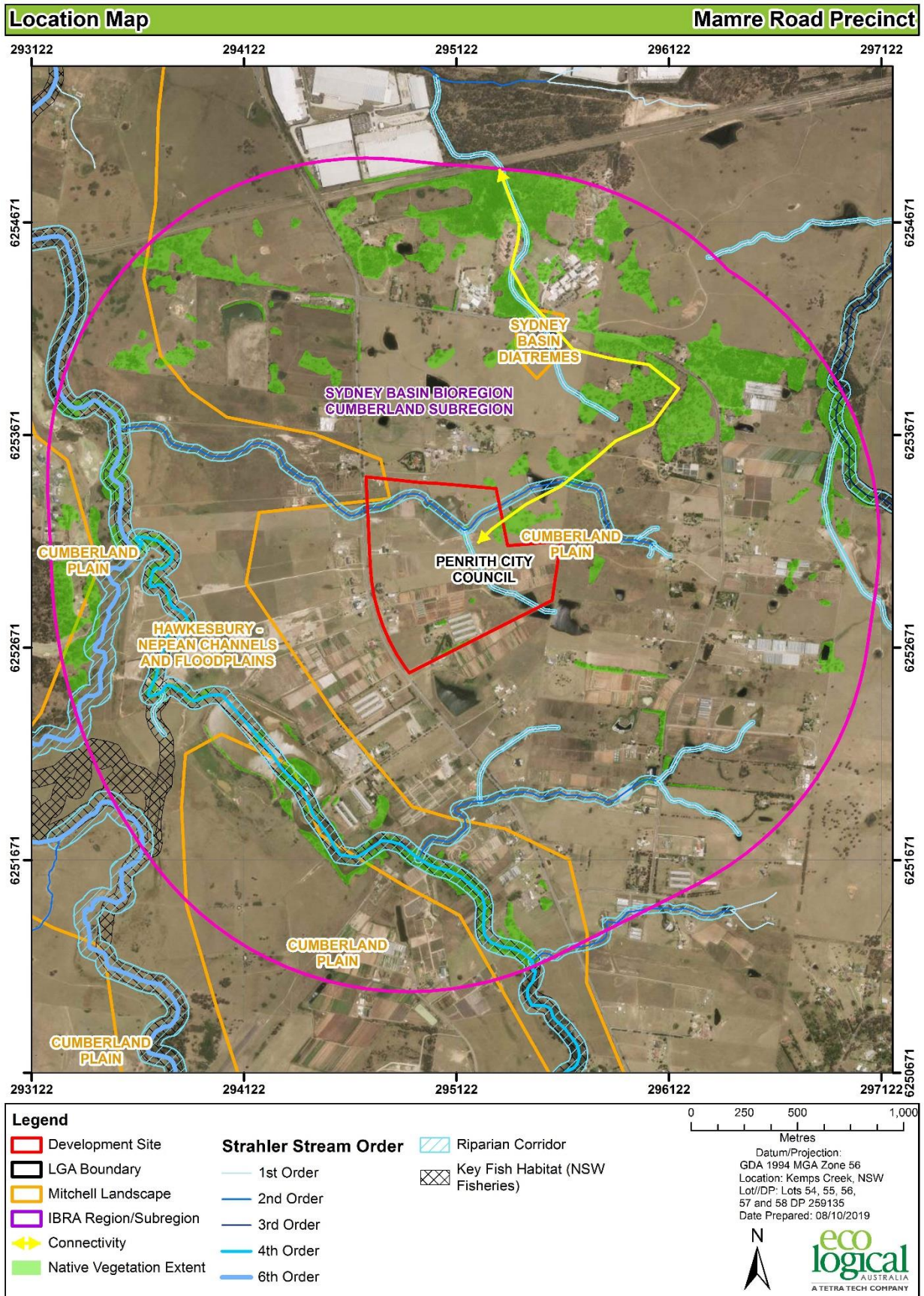


Figure 2: Location Map

1.2 Legislative Context

Table 1: Legislative context

Name	Relevance to the project	Report Section
Commonwealth		
<i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act)	<p>The EPBC Act aims to protect Matters of National Environmental Significance (MNES), including vegetation communities and species listed under the EPBC Act. If a development is likely to have a significant impact on MNES, it is likely to be considered a 'Controlled Action' by the Commonwealth and requires assessment and approval by the Commonwealth to proceed.</p> <p>No MNES have been previously identified in the study area. Two MNES are likely to occur in the development site: <i>Gallinago hardwickii</i> (Latham's Snipe) and <i>Pteropus poliocephalus</i> (Grey-headed Flying-fox). The EPBC Act significant impact criteria was applied and concluded that the proposed action is unlikely to constitute a significant impact.</p>	Section 2.5
State		
<i>Environmental Planning and Assessment Act 1979</i> (EP&A Act)	The proposed development is State Significant Development and is to be assessed under Part 4.1 of the EP&A Act. Secretary's Environmental Assessment Requirements have not been issued.	Section 2.5
<i>Biodiversity Conservation Act 2016</i> (BC Act)	In accordance with Section 7.9 of the BC Act, any SSD application 'is to be accompanied by a biodiversity development assessment report unless the Planning Agency Head and the Environment Agency Head determine that the proposed development is not likely to have any significant impact on biodiversity values'.	Throughout document
<i>Fisheries Management Act 1994</i> (FM Act)	The development does not involve impacts to Key Fish Habitat, does not involve harm to marine vegetation, dredging, reclamation or obstruction of fish passage. A permit or consultation under the FM Act is not required.	N/A
<i>Water Management Act 2000</i> (WM Act)	In accordance with Part 4, Division 1.7, Section 4.41 (g) of the EP&A Act, a water use approval under Section 89, a water management work approval under Section 90 or an activity approval (other than an aquifer interference approval) under Section 91 of the WM Act is not required for SSD.	N/A
Planning Instruments		
State Environmental Planning Policy (Vegetation in Non-rural Areas) 2017	The Vegetation SEPP applies to development that does not require consent. As this seeks consent as State Significant Development, the Vegetation SEPP is not relevant.	N/A
State Environmental Planning Policy (Coastal Management) 2018	The proposed development is not located on land subject to the Coastal Management SEPP.	N/A
SEPP Koala Habitat Protection 2019	The SEPP does not apply to the Penrith LGA	N/A
Western Sydney Employment Area (SEPP)	The site primarily zoned IN1 General Industrial with a small sliver of land zoned E2 Environmental Conservation. The development site is subject to clause 33K of the SEPP. Under clause 33K clearing of native vegetation in lands zoned E2 or RE1 are not permissible without development consent.	Section 2.5

1.3 Landscape Features

1.3.1 IBRA regions and Subregions

The development site falls within the Sydney Basin and the Cumberland IBRA Subregion.

1.3.2 Native Vegetation Extent

The extent of native vegetation within the development site and buffer is outlined in Table 2.

Table 2: Native vegetation extent

Area within the development site (ha)	Area within the 1,500 m buffer area (ha)
0.35	139.50

There are no differences between the mapped vegetation extent and the aerial imagery.

1.3.3 Rivers and Streams

The development site contains rivers and streams as outlined in Table 3. Figure 1 shows the previously mapped watercourses (Strahler 1:25,000 hydroline mapping) in the study area. An assessment of these watercourses was completed by ELA to determine whether the previously mapped watercourses met the definition of a 'river' consistent with the *Water Management Act 2000* (WM Act). Although the second order stream had some sections where there was no defined bed or bank, the watercourse would be considered a second order watercourse due to the existence of defined channels upstream and downstream. Further assessment and details are contained in a separate report (ELA 2020).

Table 3: Rivers and streams

River/stream	Order	Riparian buffer
1	Second	20 m either side

1.3.4 Wetlands

The study area does not contain any wetlands. There are several artificial dams in the development site.

1.3.5 Connectivity Features

The development site contains a riparian corridor that connects the site to the broader landscape to the east and west. The riparian corridor is in poor condition and has been dammed which prevents large amounts of flow along the corridor. Further to this, the fringing vegetation that would have once lined the corridor has been removed. The corridor has limited capacity to facilitate movement of fauna species throughout the development site.

The vegetation along the eastern boundary of the development site forms part of a larger patch that extends beyond the development site to the east. This vegetation has marginal connectivity. Although it forms part of a larger patch, the larger patch is also isolated within the broader landscape. Highly mobile species such as birds and microchiropteran bats (microbats) may utilise this connectivity and allow the movement of genetic material. Less mobile species such as mammals, frogs, reptiles and invertebrates would be unable to utilise the vegetation to move across the landscape.

1.3.6 Areas of Geological Significance and Soil Hazard Features

The development site does not contain any areas of geological significance or soil hazard features.

1.3.7 Site Context

1.3.7.1 Method Applied

The site-based method has been applied to this development.

1.3.7.2 Percent Native Vegetation Cover in the Landscape

The current percent native vegetation cover in the landscape was assessed in a Geographic Information System (GIS) using aerial imagery sourced from NearMaps using increments of 5%. The results of this analysis are shown in Table 4.

Table 4: Percent native vegetation cover in the landscape

Area within the development site (ha)	Cover within the 1,500 m buffer area (%)
1.13	11

1.3.7.3 Patch Size

Patch size was calculated using available vegetation mapping for all patches of intact native vegetation on and adjoining the development site (Table 5; Figure 3).

Table 5: Patch size

Patch	Patch size area (ha)
Zone 1	< 5
Zone 2	<5 and 5 – 24 ha
Zone 3	< 5
Zone 4	< 5

1.4 Native Vegetation

1.4.1 Survey Effort

An initial rapid appraisal of the development site was conducted by ELA ecologists Alex Gorey and Claire Wheeler on 10 December 2018 for a total of eight 8 person hours to validate the vegetation communities present and map potential threatened species habitat. This included an assessment of all water bodies and previously mapped riparian corridors in the development site. Where water bodies were assessed, notes were taken on the following features:

- type of waterbody (i.e. human made dam, natural depression, riparian corridor)
- size
- depth
- fringing habitat present, and if so, what species were present including density
- basking habitat present (rocks, woody debris or rubbish)
- presence of *Gambusia holbrooki* (Plague minnow)
- hydrological connections within or outside of the development site
- disturbance history including cattle grazing, water extraction, removal of native vegetation, introduction of exotic flora and ongoing management for agricultural purposes.

All hollow bearing trees identified in the development site were marked spatially using a handheld GPS unit. Hollow bearing trees included trees with hollows or fissures.

A second vegetation survey was undertaken within the development site by Alex Gorey and Carolina Mora on 30 September and 1 October 2019 for a total of 24 person hours (Figure 4).

A total of seven full-floristic plots were undertaken to identify Plant Community Types (PCTs) and threatened ecological communities (TECs) within the development site (Table 6). Two plots were utilised to determine that no native species were present in areas of the site occupied by pasture grasses. A total of five vegetation integrity plots were undertaken on the development site in areas that were consistent with a PCT. All field data collected at full-floristic and vegetation integrity plots is included in Appendix C. In some areas, the zones were smaller than the required size to accommodate a full floristic plot. This resulted in encroachment into another PCT or zone. Where this occurred, the plot was orientated to capture the largest area of the zone in the 20 x 20 m area.

Table 6: Full-floristic PCT identification plots

PCT ID	PCT Name	Number of plots surveyed
PCT 835	Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	2
PCT 849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	3
no PCT	exotic pasture and market gardens	2

Table 7: Vegetation integrity plots

Veg Zone	PCT ID	PCT Name	Condition	Area (ha)	Plots required	Plots surveyed
1	835	Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Poor	0.28	1	2
2	849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Poor	0.55	1	2
3	849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	paddock tree	0.06	N/A	N/A
4	849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	planted	0.23	1	1
5	-	Not a PCT	Pasture	54.03	0	2

1.4.2 Plant Community Types Present

Two PCTs were identified as occurring within the development site:

- PCT 835 - Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats (Plate 1)
- PCT 849 - Grey Box – Forest Red Gum grassy woodland on flats (Plate 2, Plate 3, Plate 4).

Both are listed TECs under the BC Act and one is listed under the EPBC Act (Table 9, Figure 5). Justification for the selection of PCTs occurring on the development site is based on a quantitative analysis of full-floristic plot data and is provided in Table 10 (Appendix E).

Table 8: Plant Community Types

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Area	Percent cleared
835	Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats	Coastal Floodplain Wetland	Forested Wetland	0.29	93%
849	Grey Box – Forest Red Gum grassy woodland on flats	Coastal Valley Grassy Woodlands	Grassy Woodlands	0.84	93%

Table 9: Threatened Ecological Communities

PCT ID	BC Act			EPBC Act		
	Listing status	Name	Area (ha)	Listing status	Name	Area (ha)
835	E	River-flat Eucalypt Forest	0.29	-	-	-
849	CE	Cumberland Plain Woodland	0.61	-	-	-

Table 10: PCT selection justification

PCT ID	PCT Name	Selection criteria	Species relied upon for identification of vegetation type and relative abundance
835	Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats	IBRA region and sub-region, location, vegetation formation, region, soil type, flora species	<i>Casuarina glauca</i> . Located along previously mapped waterways, low lying areas with pooled water or close to dams, mapped in the Sydney IBRA region in the Cumberland sub-region
849	Grey Box – Forest Red Gum grassy woodland on flats	IBRA region and sub-region, location, vegetation formation, region, soil type, flora species	<i>Eucalyptus moluccana</i> , <i>Eucalyptus tereticornis</i> . Mapped along flats in the Sydney IBRA region in the Cumberland sub-region on shale soils



Plate 1: PCT 835 in poor condition



Plate 2: PCT 849 in poor condition



Plate 3: PCT 849 scattered paddock trees



Plate 4: PCT 849 planted

1.4.3 TEC Selection Justification

1.4.3.1 Cumberland Plain Woodland

Cumberland Plain Woodland in the Sydney Basin Bioregion is listed as a critically endangered ecological community (CEEC) under the BC Act. It is also listed as the CEEC *Cumberland Plain Shale Woodland and Shale-Gravel Transition Forest* under the EPBC Act, however, the vegetation must meet more stringent condition thresholds to be consistent with the EPBC listed community.

PCT 849 is listed as 'wholly a subset of' the BC Act listed Cumberland Plain Woodland in the BioNet Vegetation Classification. Zone 2 and Zone 3 (PCT 849) within the development site is consistent with the BC Act definition based on the BioNet classification in addition to dominant flora species which fits the description of the TEC. These characteristic species include a canopy dominated *Eucalyptus moluccana* (Grey Box) and *Eucalyptus tereticornis* (Forest Red Gum). The mid-storey had been cleared and the groundcover was generally dominated by exotic species, however, several characteristic groundcover species were present including *Microlaena stipoides* var. *stipoides* (Weeping Meadow Grass), *Einadia hastata* (Berry Saltbush), *Einadia nutans* and *Dichondra repens*.

Zone 4 of this community did not meet the BC Act or EPBC Act definition of the community as the species present were planted and consisted of *Eucalyptus microcorys* (Tallowwood) and *Eucalyptus saligna* (Blue Gum). These species are plantings and do not occur naturally in Cumberland Plain Woodland.

1.4.3.2 River-flat Eucalypt Forest

River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is listed as an endangered ecological community under the BC Act. This community is not listed under the EPBC Act.

PCT 835 is listed as 'wholly a subset of' the BC Act listed River-flat Eucalypt Forest in the BioNet Vegetation Classification. Zone 1 (PCT 835) within the development site is consistent with the BC Act definition based on the BioNet classification in addition to dominant flora species which fits the description of the TEC. These characteristics include a canopy dominated by *Casuarina glauca*. The community was highly disturbed and did not contain a midstorey or groundcover species. This community was generally located within the proximity of the previously mapped waterways or in areas that displayed waterlogging.

1.4.4 Vegetation Integrity Assessment

A vegetation integrity assessment using the Credit Calculator (BAMC) was undertaken and the results are outlined in Table 11.

Table 11: Vegetation integrity

Veg Zone	PCT ID	Condition	Area (ha)	Composition Condition Score	Structure Condition Score	Function Condition Score	Current vegetation integrity score
1	835	Poor	0.29	6.3	2.4	23.9	7.2
2	849	Poor	0.55	24	1.7	21.1	9.5
3	849	Paddock tree	0.06	N/A	N/A	N/A	N/A
4	849	Planted	0.06	14.5	4.3	58.3	15.4

1.4.5 Use of local data

Use of local data is not proposed.



Figure 3: Plant Community Types and native vegetation extent

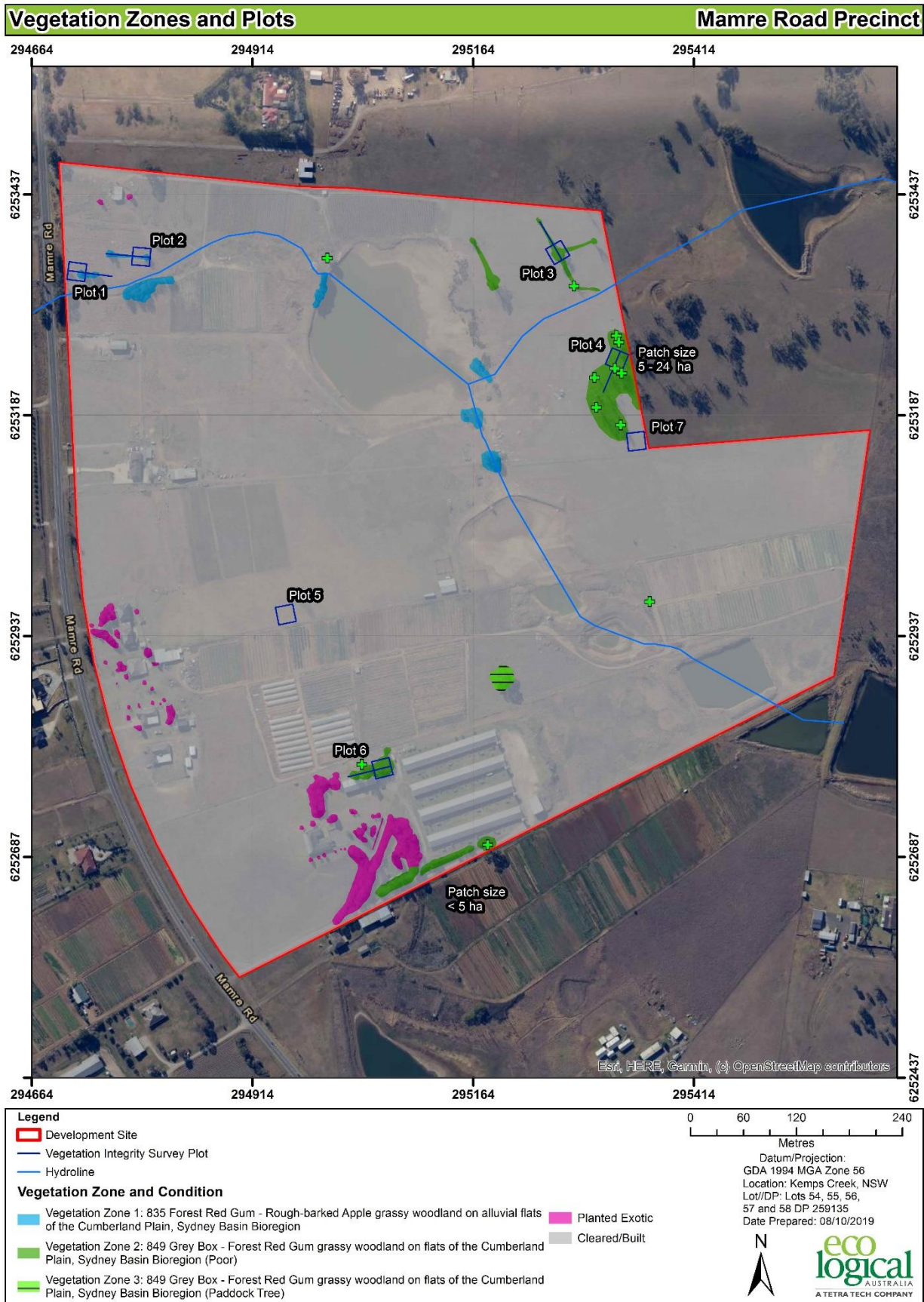


Figure 4: Plot locations

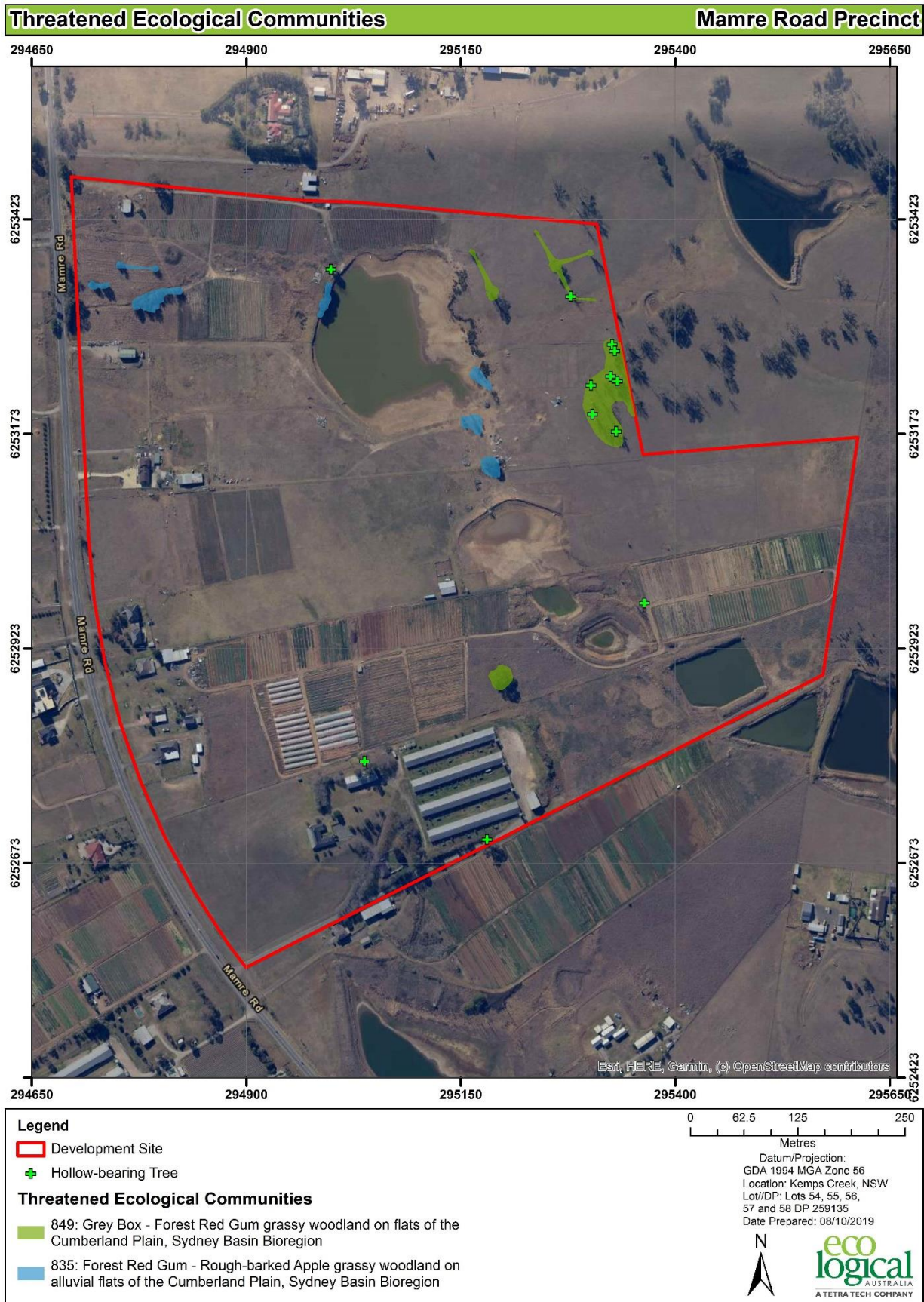


Figure 5: Threatened Ecological Communities

1.5 Threatened Species

1.5.1 Ecosystem Credit Species

Ecosystem credit species predicted to occur at the development site, their associated habitat constraints, geographic limitations and sensitivity to gain class is included in Table 12.

Ecosystem credit species which have been excluded from the assessment and relevant justification is included in Table 13.

1.6 Species Credit Species

Species credit species predicted to occur at the development site (i.e. candidate species), their associated habitat constraints, geographic limitations and sensitivity to gain class is included in Table 14.

1.6.1 Targeted Surveys

Targeted surveys for species credit species were undertaken at the development site on the dates outlined in Table 15. The location of targeted surveys are shown on Figure 6, with the results of the surveys shown as individual species polygons on Figure 7.

Table 12: Predicted ecosystem credit species

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC listing	EPBC Listing
<i>Anthochaera phrygia</i>	Regent Honeyeater	-	-	High	V	-
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	-	-	Moderate	E	E
<i>Botaurus poiciloptilus</i>	Australasian Bittern	Waterbodies, Brackish or freshwater wetlands	-	Moderate	V	-
<i>Callocephalon fimbriatum</i>	Gang Gang Cockatoo (Foraging)	-	-	Moderate	V	-
<i>Chthonicola sagittata</i>	Speckled Warbler	-	-	High	V	-
<i>Circus assimilis</i>	Spotted Harrier	-	-	Moderate	V	-
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	-	-	High	V	-
<i>Daphoenositta chrysoptera</i>	Varied Sittella	-	-	Moderate	V	E
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	-	-	High	V	-
<i>Glossopsitta pusilla</i>	Little Lorikeet	-	-	High	V	V
<i>Grantiella picta</i>	Painted Honeyeater	Other, Mistletoes present at a density of greater than five mistletoes per hectare	-	Moderate	V	-
<i>Haliaeetus leucogaster</i>	White-bellied Sea Eagle (Foraging)	Waterbodies, Within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines	-	High	V	-
<i>Hieraetus morphnoides</i>	Little Eagle (Foraging)	-	-	Moderate	V	-
<i>Ixobrychus flavicollis</i>	Black Bittern	Waterbodies, Land within 40 m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation	-	Moderate	E	CE
<i>Lathamus discolor</i>	Swift Parrot (Foraging)	-	-	Moderate	V	-

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC listing	EPBC Listing
<i>Lophoictinia isura</i>	Square-tailed Kite (Foraging)	-	-	Moderate	V	-
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	-	-	Moderate	V	-
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	--	-	Moderate	V	-
<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat	-	-	High	V	-
<i>Miniopterus australis</i>	Little Bent-winged Bat (Foraging)	-	-	High	V	-
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat (Foraging)	-	-	High	V	-
<i>Neophema pulchella</i>	Turquoise Parrot	-	-	High	V	-
<i>Ninox strenua</i>	Powerful Owl (Foraging)	-	-	High	V	-
<i>Pandion cristatus</i>	Eastern Osprey (Foraging)	-	-	Moderate	V	-
<i>Petroica boodang</i>	Scarlet Robin	-	-	Moderate	V	-
<i>Petroica phoenicea</i>	Flame Robin	-	-	Moderate	V	-
<i>Phascolarctos cinereus</i>	Koala (Foraging)	-	-	High	V	V
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox (Foraging)	-	-	High	V	V
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	-	-	High	V	-
<i>Stagonopleura guttata</i>	Diamond Firetail	-	-	Moderate	V	-
<i>Tyto novaehollandiae</i>	Masked Owl (Foraging)	-	-	High	V	-

Table 13: Justification for exclusion of predicted ecosystem credit species

Species	Common Name	BC listing	EPBC Listing	Justification for exclusion of species
<i>Anthochaera phrygia</i>	Regent Honeyeater	V	-	<u>Excluded</u> No feed trees present in the development site
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	E	E	<u>Included</u> Marginal foraging habitat present in PCT 849 (poor)
<i>Botaurus poiciloptilus</i>	Australasian Bittern	V	-	<u>Excluded</u> Dams present, however no fringing vegetation is present, with high levels of disturbance from cattle.
<i>Callocephalon fimbriatum</i>	Gang Gang Cockatoo (Foraging)	V	-	<u>Excluded</u> One extant population within Sydney restricted to Hornsby and Ku-ring-gai area, significantly further north-east of the development site. No records within 5km of the development site.
<i>Chthonicola sagittata</i>	Speckled Warbler	V	-	<u>Excluded</u> Species requires large undisturbed remnants to persist. Vegetation in site is highly fragmented and small in extent, with no clear connections large remnant patches of vegetation
<i>Circus assimilis</i>	Spotted Harrier	V	-	<u>Included</u> Marginal foraging habitat present in the development site
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	V	-	<u>Excluded</u> No habitat present, no records within a 5 km radius of the development site
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	E	<u>Included</u> Marginal foraging habitat present in the form of PCT 849
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	-	<u>Excluded</u> No habitat connectivity between the development site and surrounding landscape
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	V	<u>Included</u> Marginal foraging habitat present in the form of PCT 849
<i>Grantiella picta</i>	Painted Honeyeater	V	-	<u>Excluded</u> No foraging habitat present in the form of mistletoes
<i>Haliaeetus leucogaster</i>	White-bellied Sea Eagle (Foraging)	V	-	<u>Included</u> Development site contains dams which may present foraging habitat

Species	Common Name	BC listing	EPBC Listing	Justification for exclusion of species
<i>Hieraaetus morphnoides</i>	Little Eagle (Foraging)	V	-	<u>Included</u> Marginal foraging habitat present
<i>Ixobrychus flavicollis</i>	Black Bittern	E	CE	<u>Included</u> One record within a 5 km radius of the site, and dams present which represent marginal foraging habitat
<i>Lathamus discolor</i>	Swift Parrot (Foraging)	V	-	<u>Included</u> Marginal foraging habitat present
<i>Lophoictinia isura</i>	Square-tailed Kite (Foraging)	V	-	<u>Included</u> Marginal foraging habitat present
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	V	-	<u>Excluded</u> Development sit does not include any structurally diverse habitat or stumps, fallen timber or low hanging branches that could be used for hunting
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	V	-	<u>Included</u> Marginal foraging habitat present
<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat (foraging)	V	-	<u>Included</u> Marginal foraging habitat present
<i>Miniopterus australis</i>	Little Bent-winged Bat (Foraging)	V	-	<u>Included</u> Marginal foraging habitat present
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat (Foraging)	V	-	<u>Included</u> Marginal foraging habitat present
<i>Neophema pulchella</i>	Turquoise Parrot	V	-	<u>Included</u> Marginal foraging habitat present
<i>Ninox strenua</i>	Powerful Owl (Foraging)	V	-	<u>Included</u> Marginal foraging habitat present
<i>Pandion cristatus</i>	Eastern Osprey (Foraging)	V	-	<u>Excluded</u> This species is a coastal species, preferring large rivers, lagoons and lakes none of which are in the development site. there are no records within a 5 km radius of the development site
<i>Petroica boodang</i>	Scarlet Robin	V	-	<u>Included</u> Marginal foraging habitat present
<i>Petroica phoenicea</i>	Flame Robin	V	-	<u>Included</u> Marginal foraging habitat present

Species	Common Name	BC listing	EPBC Listing	Justification for exclusion of species
<i>Phascolarctos cinereus</i>	Koala (Foraging)	V	V	<u>Excluded</u> Habitat is highly fragmented. No connectivity with surrounding landscape or areas known to contain this species. No records within a 5 km radius of the development site
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox (Foraging)	V	V	<u>Included</u> Marginal foraging habitat present
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V	-	<u>Included</u> Marginal foraging habitat present
<i>Stagonopleura guttata</i>	Diamond Firetail	V	-	<u>Included</u> Marginal foraging habitat present
<i>Tyto novaehollandiae</i>	Masked Owl (Foraging)	V	-	<u>Included</u> Marginal foraging habitat present

Table 14: Candidate species credit species

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC listing	EPBC Listing	Justification for inclusion / exclusion of species
<i>Acacia bynoeana</i>	Bynoe's Wattle	-	-	High	E	E	<u>Excluded</u> Unsuitable soil profile. Occurs on sandy soils, development site contains shale. Development site has a long history of disturbance and is severely degraded. Was not detected during surveys
<i>Acacia pubescens</i>	Downy Wattle	-	-	High	E	E	<u>Excluded</u> Development site has a long history of disturbance and is severely degraded. Was not detected during survey
<i>Anthochaera phrygia</i>	Regent Honeyeater (Breeding)	As per mapped areas	-	High	CE	CE	<u>Excluded</u> Development site is not on mapped area
<i>Burhinus grallarius</i>	Bush Stone-curlew (Breeding)	Fallen/standing dead timber including logs	-	High	E	-	<u>Excluded</u> Site does not contain any breeding habitat in the form of standing dead timber, logs or woody debris
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	-	-	Moderate	E	V	<u>Excluded</u> Species not recorded within 5km of the development site. Habitat modified/degraded such that species is unlikely to be present.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC listing	EPBC Listing	Justification for inclusion / exclusion of species
<i>Callistemon linearifolius</i>	Netted Bottle Brush	-	-	Moderate	V	-	<u>Excluded</u> Unsuitable soil profile. Occurs on sandy soils, development site contains shale. Development site has a long history of disturbance and is severely degraded. Was not detected during survey
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	Hollow bearing trees Eucalypt tree species with hollows greater than 9 cm diameter	-	High	V	-	<u>Excluded</u> No trees with suitably sized hollows plus the site is substantially degraded such that the species is unlikely to be present.
<i>Cercartetus nanus</i>	Eastern Pygmy-possum (Breeding)	-	-	High	V	-	<u>Excluded</u> Habitat within the development site is substantially degraded such that the species is unlikely to utilise the subject land in accordance with Section 6.4.1.17 of the BAM. Suitable habitat (well-developed mid-storeys containing nectar-producing shrubs such as Banksia spp.) is not present.
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	Cliffs, Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or	-	Very High	V	V	<u>Excluded</u> No cliffs, rocky caves, escarpments, crevices within 2 km of the development site

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC listing	EPBC Listing	Justification for inclusion / exclusion of species
		within two kilometres of old mines or tunnels					
<i>Cynanchum elegans</i>	White-flowered Wax Plant	-	-	High	E	E	<u>Excluded</u> Associated habitat in the region (Dry Rainforest) not present within or adjacent to the development site. No records within 5km of the development site.
<i>Dillwynia tenuifolia</i>	Dillwynia tenuifolia	-	-	Moderate	V	-	<u>Excluded</u> Habitat highly disturbed, species generally associated with Shale Sandstone Transition Forest and Castlereagh Ironbark Forest which are not present in the development site
<i>Dillwynia tenuifolia</i> - endangered population	Dillwynia tenuifolia, Kemps Creek	-	the area bounded by western Road, Elizabeth Drive, Devonshire Road and Cross Street, Kemps Creek in the Liverpool LGAs	High	E2	-	<u>Excluded</u> As above
<i>Eucalyptus benthamii</i>	Camden White Gum	-	-	High	V	V	<u>Excluded</u> No records within 5km of the development site. Known only from two populations on the Nepean River and its tributaries.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC listing	EPBC Listing	Justification for inclusion / exclusion of species
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Juniper-leaved Grevillea	-	-	Moderate	V	-	<u>Included</u> Marginal habitat present
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	Other, Living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines	-	High	V	-	<u>Excluded</u> Vagrant species.
<i>Hibbertia sp. Bankstown</i>	Hibbertia sp. Bankstown	-	-	High	CE	CE	<u>Excluded.</u> Does not occur in correct LGA, no habitat present due to extensive history of disturbance
<i>Hieraetus morphnoides</i>	Little Eagle (Breeding)	Other, Nest trees - live (occasionally dead) large old trees within vegetation)	-	Moderate	V	-	<u>Excluded</u> No suitable breeding habitat present in the form or large old trees in vegetation
<i>Lathamus discolor</i>	Swift Parrot (Breeding)	As per mapped area	-	Moderate	E	CE	<u>Excluded</u> Not on mapped area.
<i>Litoria aurea</i>	Green and Golden Bell Frog (Breeding)	Semi-permanent/ephemeral wet areas, Within 1km of wet area, Swamps within 1km of swamp Waterbodies Within 1km of waterbody	-	High	E	V	<u>Excluded</u> Large farm dams present with no fringing vegetation sheltering habitat or basking habitat. Highly degraded from cattle grazing and <i>Gambusia holbrooki</i> present.
<i>Lophoictinia isura</i>	Square-tailed Kite (Breeding)	nest trees	-	Moderate	V	-	<u>Excluded</u> No nest trees present.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC listing	EPBC Listing	Justification for inclusion / exclusion of species
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> - endangered population	-	--		Moderate	E2	-	<u>Included</u> Marginal habitat present
<i>Marsdenia viridiflora</i> R. Br. subsp. <i>viridiflora</i> population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	-		those LGAs named in the population's	High	E	-	<u>Included</u> Marginal habitat present
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	-	-	Very High	V	-	<u>Excluded</u> Highly degraded habitat. No previous records within 5 km radius of the development site.
<i>Miniopterus australis</i>	Little Bent-winged Bat (breeding)	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave' observation type code 'E nest-roost' with numbers of individuals >500 or from the scientific literature	-	Very High	V	-	<u>Excluded</u> No caves, tunnels mines or known roosting / breeding habitat in the development site.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC listing	EPBC Listing	Justification for inclusion / exclusion of species
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat (breeding)	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave, " observation type code "E nest-roost, " with numbers of individuals >500	-	High	V	-	<u>Excluded</u> No caves, tunnels mines or known roosting / breeding habitat in the development site.
<i>Myotis macropus</i>	Southern Myotis (breeding)	Hollow bearing trees, Within 200 m of riparian zone, Bridges, caves or artificial structures within 200 m of riparian zone, Waterbodies, include rivers, creeks, billabongs, lagoons, dams and other waterbodies on or within 200m of the site	-	High	V	-	<u>Included</u> Potential roosting habitat present.
<i>Ninox strenua</i>	Powerful Owl (breeding)	Hollow bearing trees Living or dead trees with hollow greater than 20cm diameter	-	Moderate	V	-	<u>Excluded</u> No suitable hollow bearing trees present.
<i>Pandion cristatus</i>	Eastern Osprey (breeding)	Presence of stick-nests in living and dead trees (>15m) or artificial structures within 100m of a floodplain for nesting)	-	High	V	V	<u>Excluded</u> No stick nests or artificial structures present.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC listing	EPBC Listing	Justification for inclusion / exclusion of species
<i>Persicaria elatior</i>	Tall Knotweed	Semi-permanent/ephemeral wet areas, or within 50 , Swamps or within 50 , Waterbodies including Wetlands, or within 50 m	-	High	E	V	<u>Included</u> Marginal habitat present.
<i>Persoonia bargoensis</i>	Bargo Geebung	-	-	High	E	E	<u>Excluded</u> Development site has a long history of disturbance and is severely degraded. Was not detected during survey
<i>Persoonia hirsuta</i>	Hairy Geebung	-	-	High	V	-	<u>Excluded</u> Development site has a long history of disturbance and is severely degraded. Was not detected during survey
<i>Petaurus norfolcensis</i>	Squirrel Glider	-	-	High	V	V	<u>Excluded</u> No suitable habitat present, highly fragmented patches of vegetation, no suitably sized hollows and no records within a 5 km radius.
<i>Phascolarctos cinereus</i>	Koala	Areas identified via survey as important habitat	-	High	E	-	<u>Excluded</u> No records within a 5 km radius, highly fragmented habitat, high levels of historical disturbance.
<i>Pilularia novae-hollandiae</i>	Austral Pillwort	-	-	High	V	V	<u>Excluded</u> Preferred habitat not present, only recorded in drying mud.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC listing	EPBC Listing	Justification for inclusion / exclusion of species
							Species has not been recorded within 5km of the development site. No known extant populations in the Sydney region.
<i>Pimelea curviflora</i> <i>var. curviflora</i>		-	-	High	E	E	<u>Excluded</u> Suitable habitat was not present for this species which is associated shale-sandstone transitional soils. No records within 5km of the development site.
<i>Pimelea spicata</i>	Spiked Rice-flower	-	-	High	E	V	<u>Included</u> Suitable habitat not present due to the highly degraded nature and maintained understorey of the development site. However, a conservative approach was taken and this species was included in the targeted survey. No individuals were recorded.
<i>Pomaderris brunnea</i>	Brown Pomaderris	-	-	High	E	E	<u>Excluded</u> Unsuitable soil profile. Occurs on sandy soils or transitional soils, development site contains shale.
<i>Pommerhelix duralensis</i>	Dural Land Snail	Leaf litter and shed bark or within 50m of litter or bark, rocky areas, Rocks	-	High	V	V	<u>Excluded</u> Suitable habitat not present for this species which is

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC listing	EPBC Listing	Justification for inclusion / exclusion of species
		or within 50m of rock, Fallen/standing dead timber including logs, Including logs and bark or within 50m of logs or bark					associated with shale-sandstone transitional soils. No records within 5km of the development site.
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	Breeding camps	-	Moderate	E	E	<u>Excluded</u> No camps located within the development site
<i>Pterostylis saxicola</i>	Sydney Plains Greenhood	-	-	High	E	-	<u>Excluded</u> Suitable habitat not present, typically occurs on sandstone rock shelves above cliff lines. No records within 5km of development site.
<i>Pultenaea pedunculata</i>	Matted Bush-pea	-	-	Moderate	V	V	<u>Included</u> Suitable habitat not present due to the highly degraded nature and maintained understorey of the development site. However, a conservative approach was taken and this species was included in the targeted survey. No individuals were recorded.
<i>Thesium australe</i>	Austral Toadflax	-	-	High	V	-	<u>Excluded</u> Suitable habitat not present in the development site due to lack of associated species. No

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	BC listing	EPBC Listing	Justification for inclusion / exclusion of species
							records within 5km of the development site.
<i>Tyto novaehollandiae</i>	Masked Owl (Breeding)	Hollow bearing trees, Living or dead trees with hollows greater than 20cm diameter	-	High	E2	-	<u>Excluded</u> No breeding habitat (living or dead trees with hollows >20cm diameter) present in development site.
<i>Wahlenbergia multicaulis</i> - endangered population in the Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield LGAs	-	-	-	High	E	V	<u>Excluded</u> Does not occur in correct LGA. Development site has a long history of disturbance and is severely degraded. Was not detected during survey

Table 15: Targeted surveys

Date	Surveyors	Target species
10 December 2018, 30 September 2019, 1 October 2019	Alex Gorey and Carolina Mora	<i>Grevillea juniperina</i> subsp. <i>juniperina</i> (Juniper-leaved Grevillea) <i>Pimelea spicata</i> (Spiked Rice Flower) <i>Persicaria elatior</i> (Knot weed) <i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> <i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> – endangered population <i>Pultenaea pedunculata</i> (Matted Bush-pea)
30 September 2019 1 October 2019 2 October 2019 3 October 2019	Echolocation surveys	<i>Myotis macropus</i>

Weather conditions during the targeted surveys are outlined in Table 16.

Table 16: Weather conditions

Date	Rainfall (mm)	Minimum temperature °C	Maximum temperature °C
10 December 2018	0	18.5	27.6
30 September 2019	0	11.4	20.1
1 October 2019	0	9.9	21.9
2 October 2019	0	6.8	27.9
3 October 2019	0	7.9	30.9

Survey effort undertaken at the development is outlined in Table 17.

Table 17: Survey effort

Method	Habitat (ha)	Total effort (hours)	Target species
Area search	PCT 849	16	<i>Grevillea juniperina</i> subsp. <i>juniperina</i> (Juniper-leaved Grevillea) <i>Pimelea spicata</i> (Spiked Rice Flower) <i>Persicaria elatior</i> (Knotweed) <i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> <i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> – endangered population <i>Pultenaea pedunculata</i> (Matted Bush-pea)
Call recording (Anabat)	PCT 849 and dams	4 echolocation recording devices over 4 nights. Recording started one hour before dusk and ceased one hour after dawn	<i>Myotis macropus</i>

Method	Habitat (ha)	Total effort (hours)	Target species
Parallel transects	PCT 849 and 835	10	<i>Grevillea juniperina</i> subsp. <i>juniperina</i> (Juniper-leaved Grevillea) <i>Pimelea spicata</i> (Spiked Rice Flower) <i>Persicaria elatior</i> (Knotweed) <i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> <i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> – endangered population <i>Pultenaea pedunculata</i> (Matted Bush-pea)
Random meander	PCT 849, 835 and 16 exotic pasture	16	<i>Grevillea juniperina</i> subsp. <i>juniperina</i> (Juniper-leaved Grevillea) <i>Pimelea spicata</i> (Spiked Rice Flower) <i>Persicaria elatior</i> (Knotweed) <i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> <i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> – endangered population <i>Pultenaea pedunculata</i> (Matted Bush-pea)

Following completion of targeted surveys, the species credit species included in the assessment are outlined in Table 18.

Table 18: Species credit species included in the assessment

Species	Common Name	Species presence	Geographic limitations	Number of individuals / Habitat (ha)	Biodiversity Risk Weighting
<i>Myotis macropus</i>	Southern Myotis	Yes (surveyed)	Nil	0.84	2

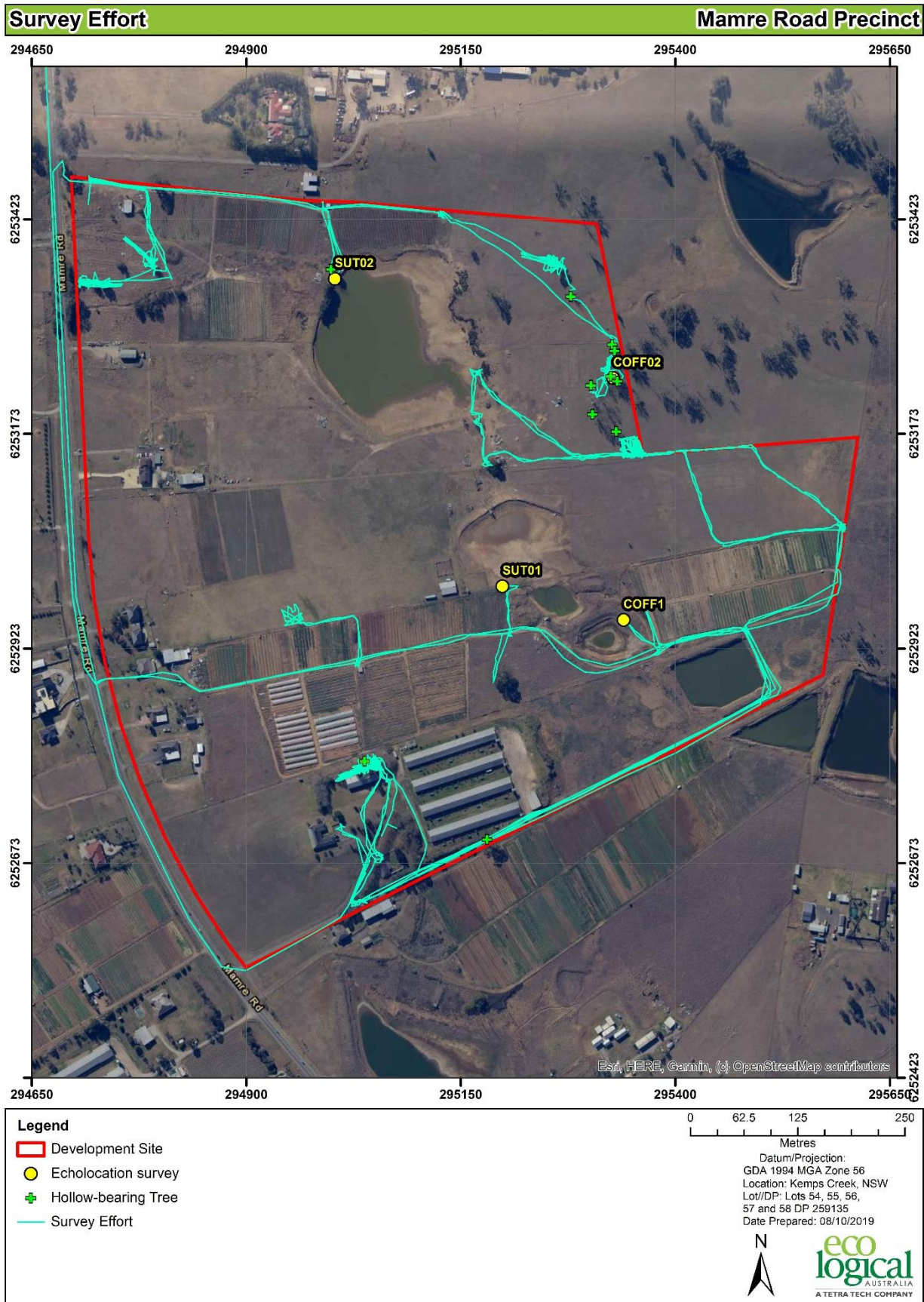


Figure 6: Targeted surveys

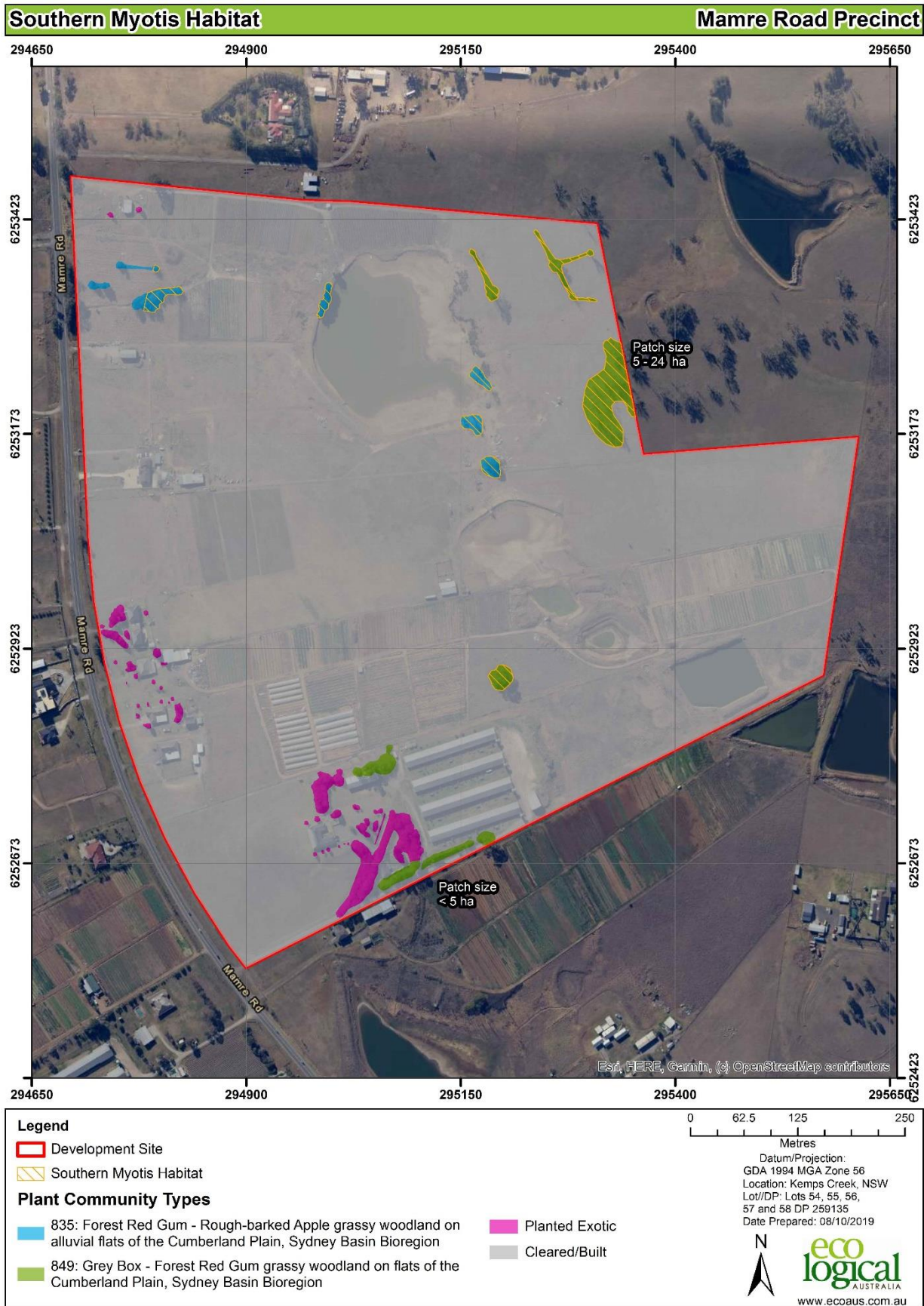


Figure 7: Species polygons

2. Stage 2: Impact Assessment (Biodiversity Values)

2.1 Avoiding Impacts

2.1.1 Locating a Project to Avoid and Minimise Impacts on Vegetation and Habitat

The proposed development will utilise the entire lot and therefore has not avoided or minimised impacts to biodiversity. It is noted that the development site is located within predominantly cleared areas and native vegetation present is in poor condition. BAM requirements to avoid and minimise impacts have been addressed in Table 19.

Table 19: Locating a project to avoid and minimise impacts on vegetation and habitat

Approach	How addressed	Justification
Locating the project in areas where there are no biodiversity values	All areas containing hard stand surfaces, exotic vegetation or cleared land have been utilised. 0.29 ha of PCT 849 (CPW – CEEC) and 0.61 ha of PCT 835 will be affected.	Impacts to CPW are unavoidable within the scope of the project. The project will impact 0.61 ha of PCT 849 (CPW – CEEC) and 0.29 ha of PCT 835
Locating the project in areas where the native vegetation or threatened species habitat is in the poorest condition	The native vegetation in the development site is in poor condition. Although a portion of PCT 849 forms part of a larger patch, this patch does not meet the EPBC Act definition of the community	The areas to be affected are poor condition zones and are dominated by exotic species in the groundcover and which extensive disturbance from cattle in some areas. Integrity scores of X and Y demonstrate the poor condition.
Locating the project in areas that avoid habitat for species and vegetation in high threat categories (e.g. an EEC or CEEC), indicated by the biodiversity risk weighting for a species	The proposed development cannot avoid 0.29 ha of PCT 849 (CPW – CEEC) and 0.61 ha of PCT 835 will be affected	The development footprint is predominantly located in areas containing no biodiversity values. The area of CPW and RFEF to be affected represents the community in poor condition.
Locating the project such that connectivity enabling movement of species and genetic material between areas of adjacent or nearby habitat is maintained	The proposed development will not impact connectivity, given the extent of impacts is limited to the edge of a patch.	The area to be removed is located on the edge of a patch and is bordered by a major road and rural land. The removal of this area would not affect connectivity.

2.1.2 Designing a Project to Avoid and Minimise Impacts on Vegetation and Habitat

The development has been designed in a way which avoids and minimises impacts as outlined in Table 20.

Table 20: Designing a project to avoid and minimise impacts on vegetation and habitat

Approach	How addressed	Justification
Reducing the clearing footprint of the project	The clearing footprint cannot be reduced because the development will utilise the site	The proposed development will remove some entire patches. One patch would be partially retained as it is outside the development site.

Approach	How addressed	Justification
Locating ancillary facilities in areas where there are no biodiversity values	Ancillary services would be contained within the development footprint and would not require removal of any additional areas containing biodiversity values.	Ancillary features are located within the operational footprint and will not result in additional impacts to biodiversity values. The proposed development will impact 0.61 ha of CPW and 0.29 ha of RFEF.
Locating ancillary facilities in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower vegetation integrity score)	Ancillary services would be contained within the development footprint and would not require removal of any additional areas containing biodiversity values	Ancillary features are located within the operational footprint and will not result in additional impacts native vegetation or threatened species habitat. The proposed development will impact 0.61 ha of CPW and 0.29 ha of RFEF.
Locating ancillary facilities in areas that avoid habitat for species and vegetation in high threat status categories (e.g. an EEC or CEEC)	Ancillary services would be contained within the development footprint and would not require removal of any additional areas containing biodiversity values	Ancillary features are located within the operational footprint and will not result in additional impacts to habitat for species or vegetation in high threat categories. The proposed development will impact 0.61 ha of CPW and 0.29 ha of RFEF.
Providing structures to enable species and genetic material to move across barriers or hostile gaps	Transfer of materials would rely on birds moving through the development footprint to other areas.	The development footprint is already highly isolated given major roads and rural land acting as a barrier to nearby vegetation. The development would not exacerbate the existing isolation such that transfer of genetic material is prevented.
Making provision for the demarcation, ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on the development site.	No native vegetation will be retained on site.	No vegetation will be retained within the development site.
Efforts to avoid and minimise impacts through design must be documented and justified	The clearing footprint cannot be reduced because the development will utilise the entire development site.	The proposed development will remove some entire patches; however these are already highly fragmented within the landscape. One patch will partially remain which extends beyond the development footprint into neighbouring land.

2.1.3 Prescribed Biodiversity Impacts

The development site does not have any prescribed biodiversity impacts. The development site contains human made structures. These are currently occupied as houses or are used for rearing poultry and are not considered to be a prescribed biodiversity impact. The hardstand surfaces and cleared land in the development site does not provide any habitat for any threatened flora and fauna. The waterbodies were considered potential foraging habitat for species where relevant, and impacts assessed in sections 2.2, 2.4 and 2.5.1.

2.2 Assessment of Impacts

2.2.1 Direct Impacts

The direct impacts of the development on:

- native vegetation and threatened ecological communities are outlined in Table 21
- threatened species and threatened species habitat is outlined in Table 22

Direct impacts including the final project footprint (construction and operation) are shown on Figure 8.

Table 21: Direct impacts to native vegetation and threatened ecological communities

PCT ID	PCT Name	BC Act	EPBC Act listing	Direct impact (ha)
835	Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats (poor)	E	-	0.29
849	Grey Box – Forest Red Gum grassy woodland on flats (poor)	CE	-	0.69
849	Grey Box – Forest Red Gum grassy woodland on flats (paddock trees)	CE	-	0.06
849	Grey Box – Forest Red Gum grassy woodland on flats (planted)	-	-	0.23

Table 22: Direct impacts on threatened species and threatened species habitat

Species	Common Name	Direct impact number of individuals / habitat (ha)	BC listing	EPBC Listing
<i>Myotis macropus</i>	Southern Myotis	0.84	V	-

2.2.2 Change in Vegetation Integrity

The change in vegetation integrity as a result of the development is outlined in Table 23.

Table 23: Change in vegetation integrity

Veg Zone	PCT ID	Condition	Area (ha)	Current vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity
1	835	Poor	0.29	7.2	0	-7.2
2	849	Poor	0.55	9.5	0	-9.5
3	849	Paddock tree	0.06	N/A	N/A	N/A
4	849	Planted	0.23	15.4	0	-15.4

2.2.3 Indirect Impacts

The indirect impacts of the development are outlined in Table 24.

Table 24: Indirect impacts

Indirect impact	Project phase	Nature	Extent	Frequency	Duration	Timing
Sedimentation and contaminated and/or nutrient rich run-off	Construction	Runoff during works	downhill from existing hardstand surfaces	During heavy rainfall or storm events	During rainfall events	Short term
Inadvertent impacts on adjacent habitat or vegetation	Construction	damage to adjacent habitat or vegetation	10 m within boundary of development footprint	Daily, during construction	Occasionally throughout the construction period	Short term
Transport of weeds and pathogens from the development site to adjacent vegetation	Construction	Spread of weed seed or pathogens	Potential for spread into adjacent habitat	Daily, during construction works	Sporadic throughout construction period	Short-term impacts
Rubbish dumping	Construction / operation	Dumping by contractors and future site occupants	within the development site and potential in adjacent areas	Daily, during construction works and operation	Occasionally throughout the construction period and operation period	Long-term impacts
Increase in pest animal populations	Construction / operation	Negligible likelihood of impact occurring because only a small degraded area of native vegetation will be removed	N/A	N/A	N/A	N/A
Disturbance to specialist breeding and foraging habitat, e.g. beach nesting for shorebirds.	Construction / operation	removal of hollow bearing trees assumed breeding habitat for Southern Myotis	Prior to construction	Once	during tree removal	Long-term impacts

2.2.4 Prescribed Biodiversity Impacts

The development does not have any prescribed biodiversity impacts. See section 2.1.3.

2.2.5 Mitigating and Managing Impacts

Measures proposed to mitigate and manage impacts at the development site before, during and after construction are outlined in Table 25.

Table 25: Measures proposed to mitigate and manage impacts

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
Displacement of resident fauna and instigating clearing protocols including pre-clearing surveys, daily surveys and staged clearing, the presence of a trained ecological or licensed wildlife handler during clearing events	Minor	Minor	Pre-clearance survey of hollow-bearing trees to be removed and supervision of felling to prevent injury/relocate any resident	Limit harm to resident fauna during construction	Prior to/during clearance works	Project Manager, Ecologist
Timing works to avoid critical life cycle events such as breeding or nursing	Minor	Minor	10 hollow bearing trees were identified within the development footprint. Removal should not take place in spring and summer. If removal takes place in summer a detailed pre-clearance inspection must take place, including visually inspecting all hollows for the presence of microbats. If microbats are present at the time of inspection, then the suitably qualified ecologist will advise of a suitable methodology for tree removal.	limit harm to breeding individuals	Autumn and winter	Project Manager, Ecologist
Installing artificial habitats for fauna in adjacent retained vegetation and habitat or human made structures to replace the habitat resources lost and encourage animals to move from the impacted site, e.g. nest boxes	Minor	Minor	10 hollow bearing trees were identified within the development footprint. Replace with 10 nest boxes within the future riparian corridor.	Compensatory habitat provided.	Prior to clearing of native vegetation	Project Manager

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
Clearing protocols that identify vegetation to be retained, prevent inadvertent damage and reduce soil disturbance; for example, removal of native vegetation by chain-saw, rather than heavy machinery, is preferable in situations where partial clearing is proposed	Moderate	Minor	Install No Go fencing prior to construction works adjacent to the retained vegetation adjoining the patch of PCT 849 in the north east.	Vegetation to be retained outside of the development site boundary (north eastern boundary) and retained vegetation within the Development Site will not be disturbed/impacted	Fencing to be set up prior to any works occurring on site and to remain and be maintained throughout duration of construction works	Project Manager
Sediment barriers or sedimentation ponds to control the quality of water released from the site into the receiving environment	Minor	Negligible	Appropriate controls will be utilised and maintained to manage exposed soil surfaces and stockpiles to prevent sediment discharge into waterways	Erosion and sedimentation will be controlled	For the duration of construction works	Project Manager
Noise barriers or daily/seasonal timing of construction and operational activities to reduce impacts of noise	Minor	Negligible	Daily timing of construction activities is recommended in accordance with Table 1 of Interim Noise Guidelines (2009) Monday to Friday 7.00am to 6.00pm Saturday 8.00am to 1.00pm No work on Sunday or public holidays	Noise impacts associated with the development will be managed in accordance with guidelines	For the duration of construction works	Project Manager
Adaptive dust monitoring programs to control air quality	Minor	Negligible	Dust suppression measures will be implemented during construction works to limit dust on site	Mitigate dust created during construction activities	For the duration of construction works	Project Manager

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
Hygiene protocols to prevent the spread of weeds or pathogens between infected areas and uninfected areas	Moderate	Minor	Vehicles, machinery and building refuse associated with the development construction should remain only within construction footprint areas, avoiding weed or pathogen related impacts to vegetation outside of the development site consist with Arrive Clean Leave Clean (DotEE 2015)	Prevent spread of weeds or pathogens	For the duration of construction works	Project Manager
Staff training and site briefing to communicate environmental features to be protected and measures to be implemented	Minor	Negligible	All staff working on the development will undertake an environmental induction as part of their site familiarisation. This induction will include items such as: - avoiding indirect impacts to offsite adjacent vegetation - correct storage of chemicals to prevent runoff into adjacent vegetation	All staff entering the development site are fully aware of the presence of native vegetation adjacent to the site what to do in case of any environmental emergencies	To occur for all staff entering/working at the development site. Site briefings should be updated based on phase of the work and when environmental issues become apparent.	Project Manager
Development control measures to regulate activity in vegetation and habitat adjacent to residential development including controls on pet ownership, rubbish disposal, wood collection, fire management and disturbance to nests and other niche habitats	Minor	Negligible	Temporary fencing to be placed around adjacent to the retained vegetation adjoining the patch of PCT 849 in the north east.	Protect vegetation and habitat adjacent to Development Site.	During operational phase	Client

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
Making provision for the ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on or adjacent to the development site	Minor	Negligible	Any landscape planting in the development site is to use locality derived native species and those found within CPW.	Areas within the development site will be landscaped using appropriate species	Following completion of construction activities.	Project Manager

2.2.6 Serious and Irreversible Impacts (SAII)

The development footprint contains one Serious and Irreversible Impacts (SAII) candidate entity identified in Table 26. Detailed consideration of whether impacts on candidate TECs are serious and irreversible is included in Table 26.

Table 26: Candidate Serious and Irreversible Impacts

Community	Principle	Direct impact individuals / area (ha)	Threshold
Cumberland Woodland in the Sydney Basin Bioregion	Principle 1 and 2	0.61	No threshold has been set for this candidate SAII.

Table 27: Evaluation of an impact on a TEC

Impact Assessment Provisions	Assessment
1. The action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII	No measures to avoid direct impacts to SAII entity as the vegetation is in poor condition and the site is identified for future employment land development.
2. The area and condition of the TEC to be impacted directly and indirectly by the proposed development. The condition of the TEC is to be represented by the vegetation integrity score for each vegetation zone	The proposed development will directly impact 0.61 ha of the community in poor condition with a vegetation integrity score of 8.6. Indirect impacts on this community within adjacent lands would be managed through strict sediment and erosion control measures
3. A description of the extent to which the impact exceeds the threshold for the potential entity that is specified in the Guidance to assist a decision-maker to determine a serious and irreversible impact	A SAII threshold has not yet been published for Cumberland Plain Woodland.
4. An estimate of the extent and overall condition of the TEC within an area of 1,000 ha, and then 10,000 ha, surrounding the proposed development footprint.	It is estimated that there is 260.03 ha of CPW within 1,000 ha of the development site and 757.83 ha within 10,000 ha. The removal of 0.61 ha would result in a reduction of 0.23 % of CPW within 1,000 ha around the development site and 0.08% of CPW within 10,000 ha of the development site.
5. An estimate of the area of the potential TEC that is in the reserve system within the IBRA region and the IBRA subregion	Within the Cumberland Plain IBRA subregion there is also an estimated 1291.53 ha of Cumberland Plain Woodland remaining within the reserve system. It is estimated that the Cumberland subregion contains a total of approximately 22,158.8 ha of Cumberland Plain Woodland.
6. The development proposal's impact on:	
a. abiotic factors critical to the long-term survival of the TEC; for example, will the impact lead to a reduction of groundwater levels or substantial alteration of surface water patterns; will it alter natural disturbance regimes that the TEC depends upon, e.g. fire, flooding etc.?	The proposal is unlikely to impact abiotic factors critical to the long-term survival of the TEC. There is potential for areas directly adjacent to the development site to be impacted by salinity following clearing and soil disturbance.
b. characteristic and functionally important species through impacts such as, but not limited to, inappropriate fire/flooding regimes, removal of under-storey species or harvesting of plants	The proposal will not impact characteristic and functionally important species outside of the proposed impact area.
c. the quality and integrity of an occurrence of the TEC through threats and indirect impacts including, but not	The development has the potential to assist the spread of exotic flora in CPW adjacent to the development footprint.

Impact Assessment Provisions	Assessment
limited to, assisting invasive flora and fauna species to become established or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants which may harm or inhibit growth of species in the TEC	This potential impact will be controlled during the construction phase. The development is unlikely to have additional impacts to the quality and integrity of the occurrence of CPW outside of the proposed impact area.
7. Direct or indirect fragmentation and isolation of an area of the TEC	The development will not cause direct or indirect fragmentation or isolation of any area of CPW.
8. The measures proposed to contribute to the recovery of the TEC in the IBRA subregion.	Offsets for the development should be sourced from within the Cumberland IBRA subregion to contribute to the recovery of the TEC in the subregion.

2.3 Risk assessment

A risk assessment has been undertaken for any residual impacts likely to remain after the mitigation measures have been applied. Likelihood criteria, consequence criteria and the risk matrix are provided in Table 28, Table 29 and Table 30 respectively.

Table 28: Likelihood criteria

Likelihood criteria	Description
Almost certain (Common)	Will occur, or is of a continuous nature, or the likelihood is unknown. There is likely to be an event at least once a year or greater (up to ten times per year). It often occurs in similar environments. The event is expected to occur in most circumstances.
Likely (Has occurred in recent history)	There is likely to be an event on average every one to five years. Likely to have been a similar incident occurring in similar environments. The event will probably occur in most circumstances.
Possible (Could happen, has occurred in the past, but not common)	The event could occur. There is likely to be an event on average every five to twenty years.
Unlikely (Not likely or uncommon)	The event could occur but is not expected. A rare occurrence (once per one hundred years).
Remote (Rare or practically impossible)	The event may occur only in exceptional circumstances. Very rare occurrence (once per one thousand years). Unlikely that it has occurred elsewhere; and, if it has occurred, it is regarded as unique.

Table 29: Consequence criteria

Consequence category	Description
Critical (Severe, widespread long-term effect)	Destruction of sensitive environmental features. Severe impact on ecosystem. Impacts are irreversible and/or widespread. Regulatory and high-level government intervention/action. Community outrage expected. Prosecution likely.
Major (Wider spread, moderate to long term effect)	Long-term impact of regional significance on sensitive environmental features (e.g. wetlands). Likely to result in regulatory intervention/action. Environmental harm either temporary or permanent, requiring immediate attention. Community outrage possible. Prosecution possible.

Consequence category	Description
Moderate (Localised, short-term to moderate effect)	Short term impact on sensitive environmental features. Triggers regulatory investigation. Significant changes that may be rehabilitated with difficulty. Repeated public concern.
Minor (Localised short-term effect)	Impact on fauna, flora and/or habitat but no negative effects on ecosystem. Easily rehabilitated. Requires immediate regulator notification.
Negligible (Minimal impact or no lasting effect)	Negligible impact on fauna/flora, habitat, aquatic ecosystem or water resources. Impacts are local, temporary and reversible. Incident reporting according to routine protocols.

Table 30: Risk matrix

Consequence	Likelihood				
	Almost certain	Likely	Possible	Unlikely	Remote
Critical	Very High	Very High	High	High	Medium
Major	Very High	High	High	Medium	Medium
Moderate	High	Medium	Medium	Medium	Low
Minor	Medium	Medium	Low	Low	Very Low
Negligible	Medium	Low	Low	Very Low	Very Low

Table 31: Risk assessment

Potential impact	Project phase	Risk (pre-mitigation)	Risk (post mitigation)
Vegetation clearing	Construction / operation	High	Very low
sedimentation and contaminated and/or nutrient rich run-off	Construction	Medium	Low
noise, dust or light spill	Construction	High	Low
inadvertent impacts on adjacent habitat or vegetation	Construction	N/A	N/A
transport of weeds and pathogens from the site to adjacent vegetation	Construction	N/A	N/A
trampling of threatened flora species	Construction / operation	Low	Very low
rubbish dumping	Construction / operation	Low	Very low
increase in pest animal populations	Construction / operation	Low	Very low

Potential impact	Project phase	Risk (pre-mitigation)	Risk (post mitigation)
disturbance to specialist breeding and foraging habitat, e.g. beach nesting for shorebirds.	Construction / operation	High	Very low
sedimentation and contaminated and/or nutrient rich run-off	Construction	Medium	Low



Figure 8: Final project footprint including construction and operation

2.4 Impact Summary

Following implementation of the BAM and the BAMC, the following impacts have been determined.

2.4.1 Serious and Irreversible Impacts (SII)

The development has candidate Serious and Irreversible Impacts (SII) values as outlined in Table 26 and shown on Figure 9. Detailed consideration of whether impacts on candidate species are serious and irreversible is included in Table 27.

2.4.2 Impacts Requiring Offsets

The impacts of the development requiring offset for native vegetation are outlined in Table 32 and shown on Figure 10. The impacts of the development requiring offset for threatened species and threatened species habitat are outlined in Table 33 and on Figure 10.

Table 32: Impacts to native vegetation that require offsets

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)
849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion Paddock Tree	Coastal Valley Grassy Woodland	Grassy Woodland	1 tree

Table 33: Impacts on threatened species and threatened species habitat that require offsets

Species	Common Name	Direct impact number of individuals / habitat (ha)	BC listing	EPBC Listing
<i>Myotis macropus</i>	Southern Myotis	0.84	V	-

2.4.3 Impacts Not Requiring Offsets

The impacts of the development not requiring offset for native vegetation are outlined in Table 34 and shown on Figure 11. The impacts of the development not requiring offset for threatened species and threatened species habitat is outlined in Table 34 and shown on Figure 11.

Table 34: Impacts to native vegetation that do not require offsets

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)	Rationale
PCT 835	Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats	Coastal Floodplain Wetland	Forested Wetland	0.29	Vegetation integrity score <15
PCT 849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Coastal Valley Grassy Woodland	Grassy Woodland	0.79	Vegetation integrity score < 15

2.4.4 Areas not Requiring Assessment

A majority of the development footprint contains hardstand infrastructure or exotic pasture where no native vegetation is present. These areas do not require assessment. Areas not requiring assessment are shown in Figure 12.

2.4.5 Credit Summary

The number of ecosystem credits required for the development are outlined in Table 35. The number of species credits required for the development are outlined in Table 36. A biodiversity credit report is included in Appendix B.

Table 35: Ecosystem credits required

PCT ID	PCT Name	Vegetation Formation	Direct impact (ha)	Credits required
849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion Paddock Tree	Grassy Woodland	1 paddock tree	1

Table 36: Species credit summary

Species	Common Name	Direct impact number of individuals / habitat (ha)	Credits required
<i>Myotis macropus</i>	Southern Myotis	0.84	3

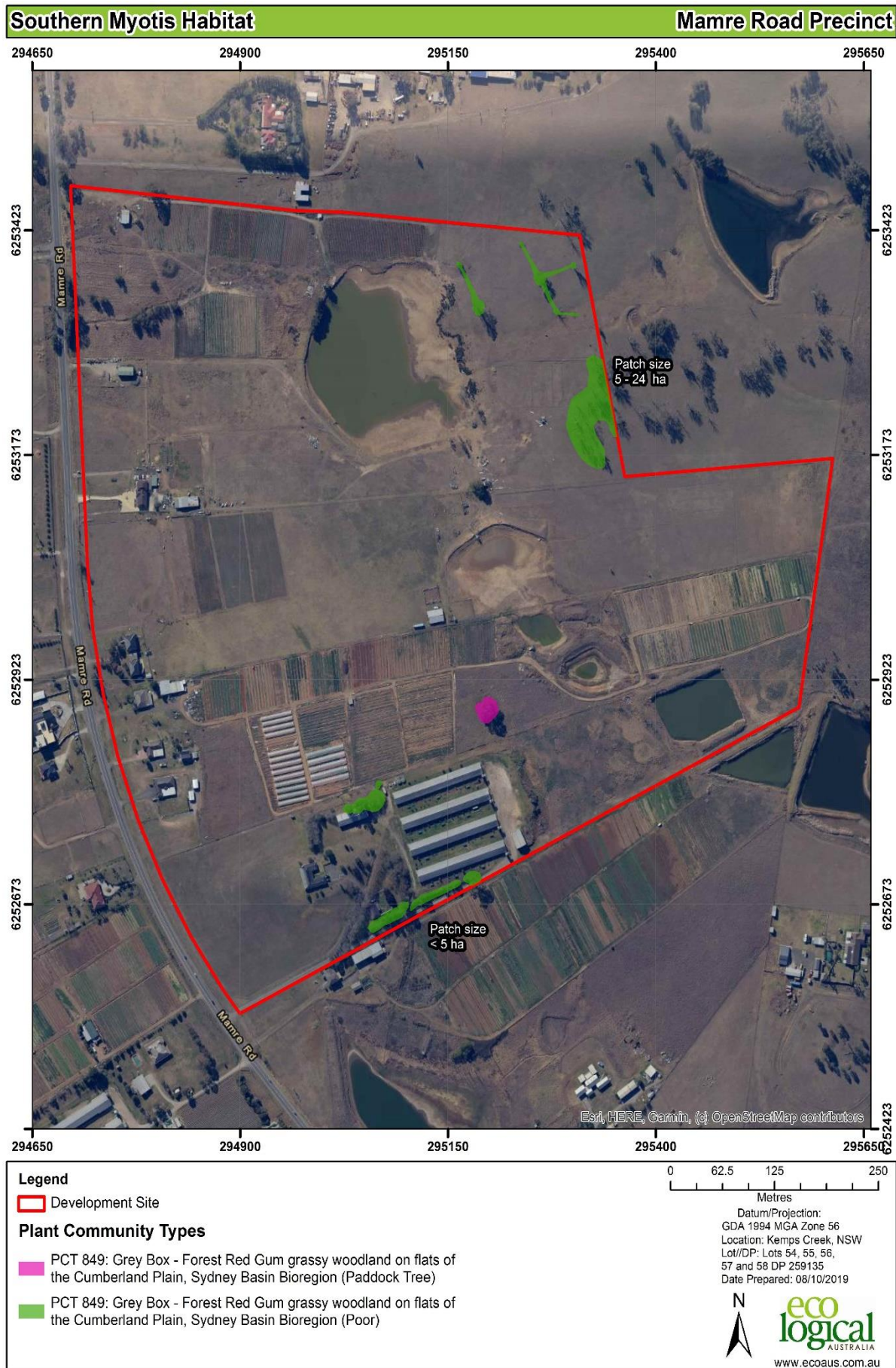


Figure 9: Serious and Irreversible Impacts

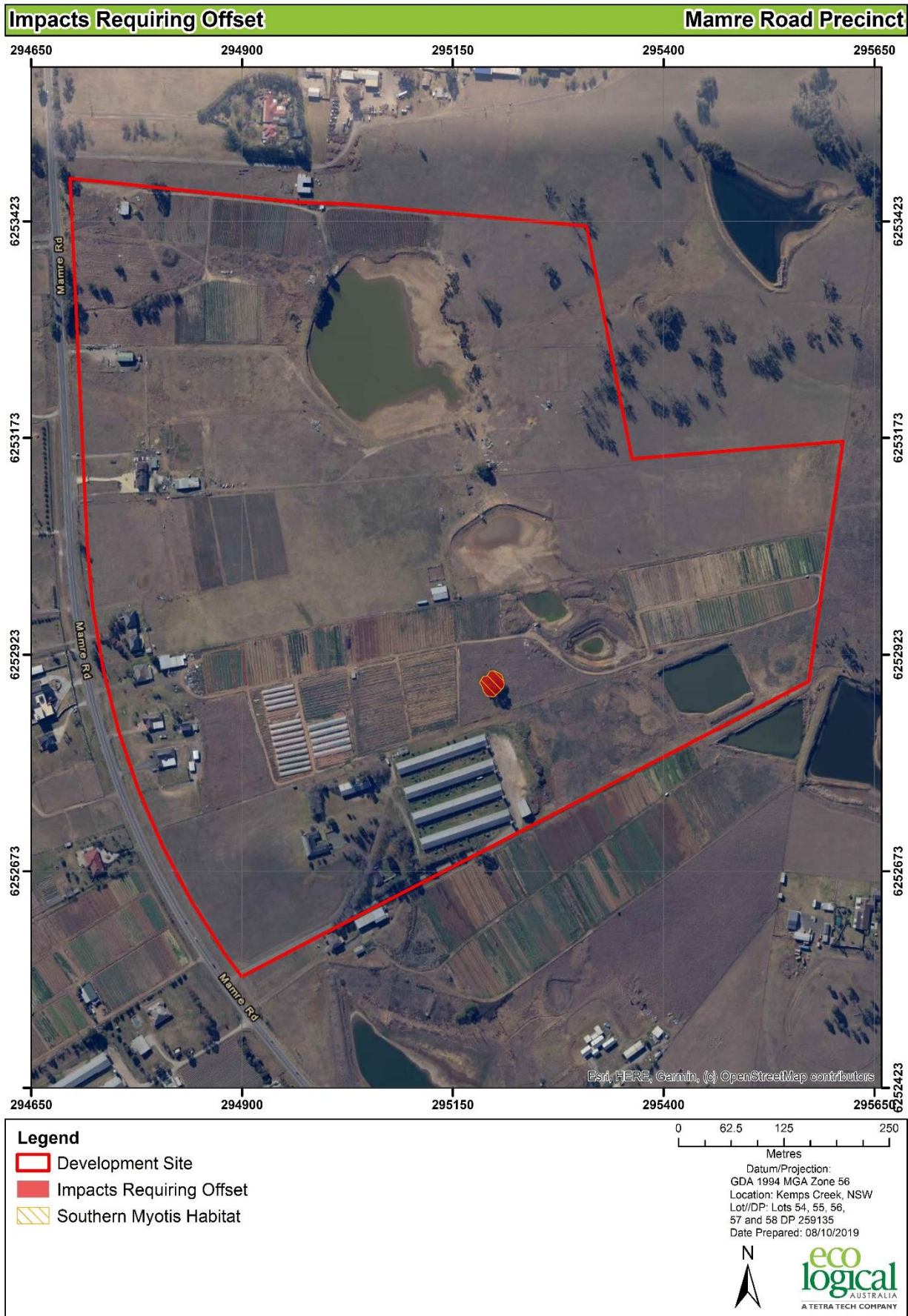


Figure 10: Impacts requiring offset

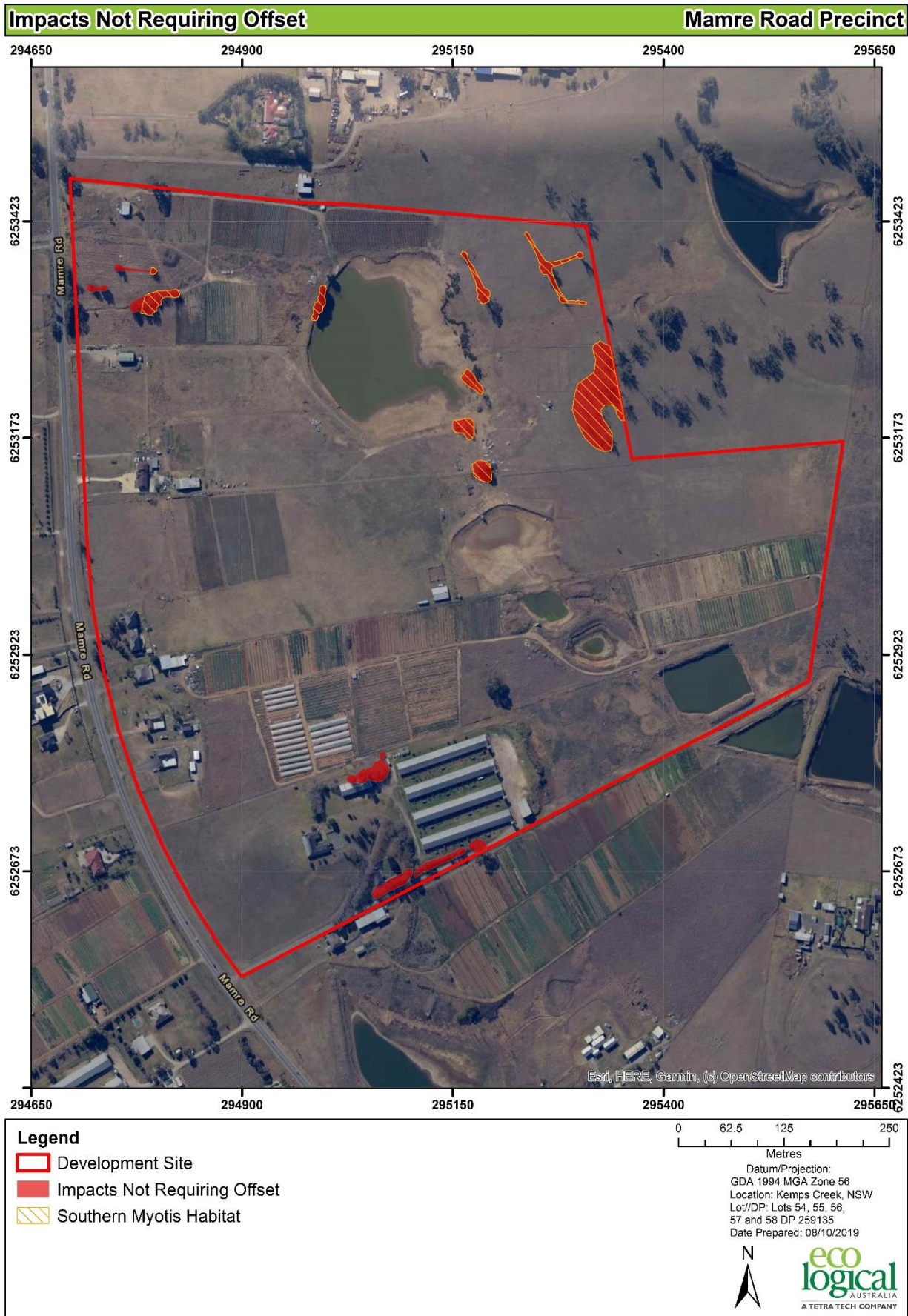


Figure 11: Impacts not requiring offset

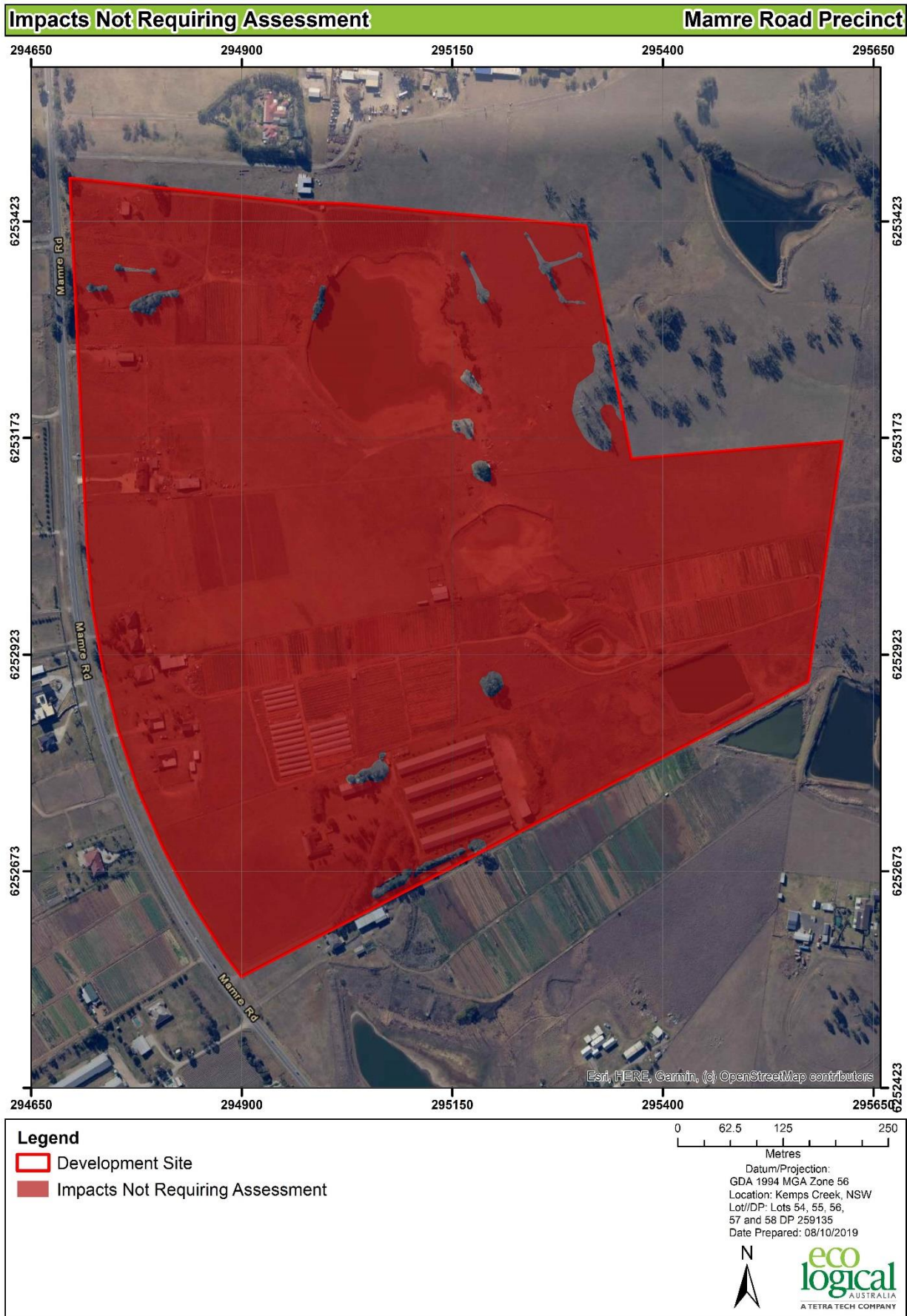


Figure 12: Areas not requiring assessment

2.5 Consistency with Legislation and Policy

2.5.1 Draft Cumberland Plain Conservation Plan

The Draft Cumberland Plain Conservation Plan maps land as 'Certified – urban capable' and other areas (for conservation) as Non-certified. The entire site other than the E2 zoned land is shown as 'Certified – Urban Capable'. However, during consultation with DPIE prior to lodgement of the SSDA, the Departments Cumberland Plain Conservation Plan team stated that this site is to be excluded from the final CPCP on the basis that its assessment was being undertaken via an SSDA.

The development is however consistent with the strategic intent of the draft CPCP as it proposes an east-west ecological corridor of the same width across the site.

2.5.2 Western Sydney Employment Area SEPP Clause 33K

Clause 33K of the Western Sydney Employment Area SEPP requires consent for clearing of native vegetation in E2 and RE1 zoned land. The proposed development would impact land currently zoned E2 to allow for the realignment of a second order stream. These impacts are considered minor given:

- a majority of the vegetation within the E2 land to be affected consists of exotic pasture
- a marginal amount of native vegetation would be affected
- the stream to be realigned is in poor condition and does not function as a fully structured riparian corridor.

In addition, the proposed development would increase the amount of land zoned E2 within the development site. There is currently 2.5 ha of land zoned as E2. The proposed development would realign the riparian corridor and revegetate 3.33 ha of land within the development footprint. This provides a net increase in native vegetation in the development site that would be zoned E2. The 3.33 ha of land would be revegetated with native trees, shrubs and groundcover at varying densities.

2.5.3 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act establishes a process for assessing the environmental impact of activities and developments where "Matters of National Environmental Significance" (MNES) may be affected. Under the Act, any action which "has, will have, or is likely to have a significant impact on a matter of MNES" is defined as a "controlled action", and requires approval from the Commonwealth Department of the Environment and Energy (DotEE), which is responsible for administering the EPBC Act (DotEE 2014).

The process includes conducting an Assessment of Significance for listed threatened species and ecological communities that represent a matter of MNES that will be impacted as a result of the proposed action. Significant impact guidelines (DotEE 2014) that outline a number of criteria have been developed by the Commonwealth, to provide assistance in conducting the Assessment of Significance and help decide whether or not a referral to the Commonwealth is required.

A habitat assessment was undertaken and the following MNES were assessed consistent with the Significant Impact Guidelines 1.1:

- *Gallinago hardwickii* (Latham's Snipe)
- *Pteropus poliocephalus* (Grey-headed Flying-fox).

Application of the significant impact criteria for Latham's Snipe and the Grey-headed Flying-fox concluded that the proposed action is unlikely to constitute a significant impact on either of these species.

Table 37: Significant impact assessment for Latham's Snipe

Question	Response
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	The proposed action would involve dewatering four dams that may provide potential foraging habitat for Latham's Snipe. The foraging habitat to be removed is not considered important for this species. This is because the development site is not at the limit of the species range, the development site would not be used for breeding purposes as this species does not breed in Australia. The development site would be used as marginal foraging habitat. Although there are waterbodies present, they contain minimal to no foraging or sheltering vegetation and would be only used occasionally. There is no evidence to suggest that Kemps Creek is supporting an ecologically significant proportion of the population. The population is said to be declining over NSW with no specific information on the Sydney region. As such, the proposed action is unlikely to modify an area of important habitat.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	There are no invasive species listed as harmful to Latham's Snipe.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	Latham's Snipe does not breed in Australia but may utilise the dams in the development site on an occasional basis for foraging purposes. The dams contained minimal to no fringing vegetation which typically provides resting habitat for this species. As such, the vegetation in the development site is marginal and would not be relied upon. In addition, any individuals that would utilise the site are not likely to be an ecologically significant population, as the site does not provide enough habitat features to support multiple life stages of Latham's Snipe.

Table 38: Significant Impact Assessment on Grey-headed Flying-fox

Criterion	Question	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1)	Lead to a long-term decrease in the size of an important population of a species	<p>The closest known Grey-headed Flying fox camp as identified on the National Flying-fox monitoring viewer (DotEE 2019) is approximately 7 km north of the development site at Ropes Creek. The largest estimated size of this camp is 500-2,499 individuals. Foraging for this species occurs within a 20 km radius around camp sites. Available foraging resources include street trees, urban bushland and conservation reserves.</p> <p>Under the proposed works approximately 1.31 ha of native vegetation is proposed to be removed representing potential foraging habitat for the GHFF. The amount of habitat to be affected is relatively small compared to the amount of vegetation available in the locality for this highly mobile species. No camps will be impacted by the proposed development.</p> <p>Given that foraging habitat exists in the surrounding landscape, and that this species is wide-ranging (traveling up to 50 km in one night), the proposed works are unlikely to affect any</p>

Criterion	Question	Response
		populations of this species that would lead to a long-term decrease in the size of an important population of this species.
2)	Reduce the area of occupancy of an important population	<p>Native vegetation in Sydney is important for the Grey-headed Flying-fox as individuals are known to move up to 20 km a night between camps to forage. This species is highly mobile and populations at each camp may change during seasonal fluctuations.</p> <p>Under the proposal approximately 1.31 ha of potential habitat would be removed, which may cause a temporary disturbance to the Grey-headed Flying-fox. However, these impacts are unlikely to reduce the area of occupancy this highly mobile species given that no camps will be impacted and only a relatively small area of foraging habitat is to be removed.</p>
3)	Fragment an existing important population into two or more populations	<p>The Grey-headed Flying-fox population across camps in Sydney is highly dynamic and individuals move between permanent camps to utilise foraging resources. They will return to permanent camps to rear offspring. Individuals are highly mobile, and populations are not static.</p> <p>The closest known camp is approximately 7 km north of the development site in Ropes Creek and would not be fragmented into two or more populations. The Sydney population is dynamic and individuals move between camps. The proposed action will result in approximately 1.31 ha of potential foraging habitat which would not fragment the existing important population into two or more populations.</p>
4)	Adversely affect habitat critical to the survival of a species	Foraging habitat within a 20 km radius of a roost site with greater than 30,000 individuals is foraging habitat critical to the survival of this species. There are no camps within a 20 km radius of the development site that contain >30,000 individuals. There, the site does not form critical habitat for this species.
5)	Disrupt the breeding cycle of an important population	As no breeding habitat would be removed or disturbed, it is unlikely the proposed work would disrupt the breeding cycle of the important population.
6)	Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No campsites would be removed, or disturbed, and abundant foraging habitat will be retained within the foraging range of nearby camps, which may forage up to 20 km from camps in a night. The proposed action would therefore be unlikely to modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
7)	result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposal would not result in invasive species, such as weeds, that would be harmful to Grey-headed Flying Fox. It is unlikely that the proposed action will result in a large increase in the number of weeds due to the current disturbed nature of the site.
8)	introduce disease that may cause the species to decline, or	Grey-headed Flying-foxes are reservoirs for the Australian bat lyssavirus (ABL) and can cause clinical disease and mortality in GHFF (DECCW 2009). The proposed action is unlikely to present a significant ecological stress on any camps or on individuals that may utilise the development site and therefore the works are

Criterion	Question	Response
		unlikely to introduce or exacerbate this virus or any other disease that may cause this species to decline.
9)	interfere substantially with the recovery of the species.	A Draft National Recovery Plan for the Grey-headed Flying-fox was developed in 2017. The maternity camps 7 km north of the development site would not be removed and the proposed action will remove a relatively small amount of potential foraging habitat. Foraging habitat will be retained in the adjacent riparian corridor and larger amounts of habitat are available in the wider locality. It is therefore unlikely the proposed action would interfere with the recovery of this species.
Conclusion	Is there likely to be a significant impact?	The action will not affect known breeding habitat and will only impact on a relatively small amount of potential foraging for this highly mobile species. No important populations would be isolated or fragmented and the life cycle of this species is not likely to be affected. Therefore, the action is not likely to have a significant impact on this species.

3. References

BAM Calculator. <https://www.lmbc.nsw.gov.au/bamcalc/home/AssessmentCal>

BioNet Threatened Biodiversity profiles.

<https://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx>

BioNet Vegetation Classification.

<https://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx>

Cropper, S.C. 1993. Management of Endangered Plants. CSIRO Australia, Melbourne.

Threatened Species Scientific Committee. 'Commonwealth Listing Advice on Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest'. Department of the Environment, Water, Heritage and the Arts.

Department of Environment, Climate Change and Water (NSW) 2010. 'Cumberland Plain Recovery Plan', Department of Environment, Climate Change and Water (NSW), Sydney.

Department of Environment and Conservation, 2004, Threatened Species Survey and Assessment: Guidelines for developments and activities (working draft), New South Wales Department of Environment and Conservation, Hurstville, NSW.

Department of Environment and Energy (DotEE) 2015. Arrive Clean, Leave Clean. Guidelines to help prevent the spread of invasive plant, diseases and weeds threatening our native plants, animals and ecosystems. Available at <https://www.environment.gov.au/system/files/resources/773abcad-39a8-469f-8d97-23e359576db6/files/arrive-clean-leave-clean.pdf>

Department of the Environment and Energy (DotEE) 2019. National Flying-fox monitoring viewer. Australian Government. Available at <https://www.environment.gov.au/webgis-framework/apps/ffc-wide/ffc-wide.jsf>

Department of the Environment and Energy (DotEE) 2019b. Species Profile and Threats Database. Available <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>.

DEWHA 2010. 'Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest. Commonwealth of Australia 2010.

Land and Property Information. 2015, 'SIX maps aerial imagery'.

NSW Flora Online 2017. Available: www.plantnet.rbgsyd.nsw.gov.au.

OEH 2013. 'Vegetation of the western Cumberland subregion, 2013 Update'.

OEH 2016. 'The Native Vegetation of the Sydney Metropolitan Area'.

OEH 2017. 'Guidance to assist a decision-maker to determine a serious and irreversible impact.'

OEH 2019b. Threatened Species Profiles. Available:

<http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?>

OEH 2018. "Species credit' threatened bats and their habitats – NSW survey guide for the Biodiversity Assessment Method'.

Jackson, C. and Groves, S. (2015). *Taxonomy of Australian Mammals*. CSIRO Publishing.

Law, B. S., Anderson, J., and Chidel, M. (1999). Bat communities in a fragmented forest landscape on the south-west slopes of New South Wales, Australia. *Biological Conservation* 88, 333-345.

Lloyd, A.M., Law, B.S., and Goldingay, R. (2006) Bat activity on riparian zones and upper slopes in Australian timber production forests and the effectiveness of riparian buffers. *Biological Conservation* 129, 207-220.

McKenzie, N. L., Start, A. N., and Bullen, R. D. (2002). *Foraging ecology and organisation of a desert bat fauna*. *Australian Journal of Zoology* 50, 529-548.

Mills, D. J., Norton, T. W., Parnaby, H. E., Cunningham, R. B., and Nix, H. A. (1996). *Designing surveys for microchiropteran bats in complex forest landscapes - a pilot study from south-east Australia*. Special issue: Conservation of biological diversity in temperate and boreal forest ecosystems 85, 149-161.

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

Reardon, T.B., McKenzie, N.L., Cooper, S.J.B., Appleton, B., Carthew, S. and 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 – 136.

Reinhold, L., Law, B., Ford, G., and Pennay, M. (2001). Key to the bat calls of south-east Queensland and north-east New South Wales. 2001. Queensland, DNR.

Bannerman, S.M. and Hazelton, P. A. 1990. 'Soil Landscapes of the Penrith 1:100 000 Sheet'. Soil Conservation Service of NSW, Sydney.

Department of the Environment and Energy (DotEE) 2019a. Protected Matters Search Tool [online]. Available: <http://www.environment.gov.au/epbc/protect/index.html> (Accessed: 25 July 2019).

OEH 2019a. Threatened Species Database (5 km radius search). OEH Sydney, NSW. (Accessed May 2019).

Appendix A Definitions

Terminology	Definition
Biodiversity credit report	The report produced by the Credit Calculator that sets out the number and class of biodiversity credits required to offset the remaining adverse impacts on biodiversity values at a development site, or on land to be biodiversity certified, or that sets out the number and class of biodiversity credits that are created at a biodiversity stewardship site.
BioNet Atlas	The BioNet Atlas (formerly known as the NSW Wildlife Atlas) is the OEH database of flora and fauna records. The Atlas contains records of plants, mammals, birds, reptiles, amphibians, some fungi, some invertebrates (such as insects and snails) and some fish
Broad condition state:	Areas of the same PCT that are in relatively homogenous condition. Broad condition is used for stratifying areas of the same PCT into a vegetation zone for the purpose of determining the vegetation integrity score.
Connectivity	The measure of the degree to which an area(s) of native vegetation is linked with other areas of vegetation.
Credit Calculator	The computer program that provides decision support to assessors and proponents by applying the BAM, and which calculates the number and class of biodiversity credits required to offset the impacts of a development or created at a biodiversity stewardship site.
Development	Has the same meaning as development at section 4 of the EP&A Act, or an activity in Part 5 of the EP&A Act. It also includes development as defined in section 115T of the EP&A Act.
Development footprint	The area of land that is directly impacted on by a proposed development, including access roads, and areas used to store construction materials.
Development site	An area of land that is subject to a proposed development that is under the EP&A Act.
Ecosystem credits	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at a biodiversity stewardship site.
High threat exotic plant cover	Plant cover composed of vascular plants not native to Australia that if not controlled will invade and outcompete native plant species.
Hollow bearing tree	A living or dead tree that has at least one hollow. A tree is considered to contain a hollow if: (a) the entrance can be seen; (b) the minimum entrance width is at least 5 cm; (c) the hollow appears to have depth (i.e. you cannot see solid wood beyond the entrance); (d) the hollow is at least 1 m above the ground. Trees must be examined from all angles.
Important wetland	A wetland that is listed in the Directory of Important Wetlands of Australia (DIWA) and SEPP 14 Coastal Wetlands
Linear shaped development	Development that is generally narrow in width and extends across the landscape for a distance greater than 3.5 kilometres in length
Local population	The population that occurs in the study area. In cases where multiple populations occur in the study area or a population occupies part of the study area, impacts on each subpopulation must be assessed separately.
Local wetland	Any wetland that is not identified as an important wetland (refer to definition of Important wetland).
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000.

Terminology	Definition
Multiple fragmentation impact development	Developments such as wind farms and coal seam gas extraction that require multiple extraction points (wells) or turbines and a network of associated development including roads, tracks, gathering systems/flow lines, transmission lines
Operational Manual	The Operational Manual published from time to time by OEH, which is a guide to assist assessors when using the BAM
Patch size	An area of intact native vegetation that: a) occurs on the development site or biodiversity stewardship site, and b) includes native vegetation that has a gap of less than 100 m from the next area of native vegetation (or ≤ 30 m for non-woody ecosystems). Patch size may extend onto adjoining land that is not part of the development site or stewardship site..
Proponent	A person who intends to apply for consent to carry out development or for approval for an activity.
Reference sites	The relatively unmodified sites that are assessed to obtain local benchmark information when benchmarks in the Vegetation Benchmarks Database are too broad or otherwise incorrect for the PCT and/or local situation. Benchmarks can also be obtained from published sources.
Regeneration	The proportion of over-storey species characteristic of the PCT that are naturally regenerating and have a diameter at breast height < 5 cm within a vegetation zone.
Remaining impact	An impact on biodiversity values after all reasonable measures have been taken to avoid and minimise the impacts of development. Under the BAM, an offset requirement is calculated for the remaining impacts on biodiversity values.
Retirement of credits	The purchase and retirement of biodiversity credits from an already-established biobank site or a biodiversity stewardship site secured by a biodiversity stewardship agreement.
Riparian buffer	Riparian buffers applied to water bodies in accordance with the BAM
Sensitive biodiversity values land map	Development within an area identified on the map requires assessment using the BAM.
Site attributes	The matters assessed to determine vegetation integrity. They include: native plant species richness, native over-storey cover, native mid-storey cover, native ground cover (grasses), native ground cover (shrubs), native ground cover (other), exotic plant cover (as a percentage of total ground and mid-storey cover), number of trees with hollows, proportion of over-storey species occurring as regeneration, and total length of fallen logs.
Site-based development	a development other than a linear shaped development, or a multiple fragmentation impact development
Species credits	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection.
Subject land	Is land to which the BAM is applied in Stage 1 to assess the biodiversity values of the land. It includes land that may be a development site, clearing site, proposed for biodiversity certification or land that is proposed for a biodiversity stewardship agreement.
Threatened Biodiversity Data Collection	Part of the BioNet database, published by OEH and accessible from the BioNet website.
Threatened species	Critically Endangered, Endangered or Vulnerable threatened species as defined by Schedule 1 of the BC Act, or any additional threatened species listed under Part 13 of the EPBC Act as Critically Endangered, Endangered or Vulnerable.

Terminology	Definition
Vegetation Benchmarks Database	A database of benchmarks for vegetation classes and some PCTs. The Vegetation Benchmarks Database is published by OEH and is part of the BioNet Vegetation Classification.
Vegetation zone	A relatively homogenous area of native vegetation on a development site, land to be biodiversity certified or a biodiversity stewardship site that is the same PCT and broad condition state.
Wetland	An area of land that is wet by surface water or ground water, or both, for long enough periods that the plants and animals in it are adapted to, and depend on, moist conditions for at least part of their life cycle. Wetlands may exhibit wet and dry phases and may be wet permanently, cyclically or intermittently with fresh, brackish or saline water
Woody native vegetation	Native vegetation that contains an over-storey and/or mid-storey that predominantly consists of trees and/or shrubs

Appendix B Credit Report Summary



BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00017889/BAAS18162/19/00017890		27/09/2019
Assessor Name	Report Created	BAM Data version *
	15/10/2019	15
Assessor Number	BAM Case Status	Date Finalised
	Open	To be finalised
Assessment Revision	Assessment Type	
0	Part 4 Developments (General)	

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

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

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAIL	Ecosystem credits
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion								
1	835_Poor	5.7	0.3	0.25	High Sensitivity to Potential Gain	2.00		0
							Subtotal	0

Assessment Id
00017889/BAAS18162/19/00017890

Proposal Name

Page 1 of 2



BAM Credit Summary Report

Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion

2	849_Poor	8.6	0.6	0.25	High Sensitivity to Potential Gain	2.50	TRUE	0
3	849_Planted	12.9	0.2	0.25	High Sensitivity to Potential Gain	2.50	TRUE	0
							Subtotal	0
							Total	0

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Potential SAIL	Species credits
<i>Myotis macropus</i> / <i>Southern Myotis</i> (Fauna)						
835_Poor	5.7	0.23	0.25	2	False	1
849_Poor	8.6	0.55	0.25	2	False	2
					Subtotal	3

Assessment Id

00017889/BAAS18162/19/00017890

Proposal Name

Page 2 of 2

Appendix C Vegetation plot data

Species name	Exotic (* high threat weed)	Form	Plot 1 cover %	Plot 2 cover %	Plot 3 cover %	Plot 4 cover %	Plot 5 cover %	Plot 6 cover %	Plot 7 cover %
<i>Araujia sericifera</i> *	Y	G	0.1	0.1				0.1	
<i>Asteraceae spp.*</i>		G						0.1	
<i>Austrostipa spp.</i>		G				0.1			
<i>Avena barbata</i> *		G	2					0.1	
<i>Axonopus fissifolius</i> *	Y	G							0.1
<i>Bidens pilosa</i> *		G	0.1					0.1	
<i>Bothriochloa macra</i>		G				0.1			
<i>Brassica fruticulosa</i> *		G						0.1	
<i>Briza minor</i> *		G					0.1		10
<i>Bromus catharticus</i> *		G	1	0.1	70			0.1	
<i>Bromus hordeaceus</i> *		G				0.1			10
<i>Casuarina glauca</i>		U	5	5					
<i>Chloris gayana</i> *	Y	G		2	0.1				
<i>Chloris truncata</i>		G			1	0.5			

Species name	Exotic (* high threat weed)	Form	Plot 1 cover %	Plot 2 cover %	Plot 3 cover %	Plot 4 cover %	Plot 5 cover %	Plot 6 cover %	Plot 7 cover %
<i>Cirsium</i> spp.*		G					0.1		
<i>Cirsium vulgare</i> *		G		0.1	0.1	0.1		0.1	
<i>Conyza bonariensis</i> *		G			0.1	0.1	0.1	0.1	0.1
<i>Cotula australis</i> *		G			0.1	0.1		0.1	0.1
<i>Crassula sieberiana</i>		G			0.1			0.1	0.1
<i>Cynodon dactylon</i> (listed as <i>Chloris virgata</i> because this species is exotic in this context)*		G	5	1	1	5		0.1	0.1
<i>Cyperus gracilis</i>		G		0.1				0.1	
<i>Daucus carota</i> *		G					0.1		
<i>Desmodium brachypodium</i>		G			0.1				
<i>Dichondra repens</i>		G			0.1	0.1		0.1	
<i>Ehrharta erecta</i> *	Y	G						0.1	
<i>Einadia hastata</i>		G	0.1		0.1	0.1			0.1
<i>Einadia nutans</i> subsp. <i>nutans</i>		G			0.1	0.1		0.1	
<i>Eragrostis brownii</i>		G				0.5			1

Species name	Exotic (* high threat weed)	Form	Plot 1 cover %	Plot 2 cover %	Plot 3 cover %	Plot 4 cover %	Plot 5 cover %	Plot 6 cover %	Plot 7 cover %
<i>Eragrostis curvula</i> *	Y	G				0.1			
<i>Eucalyptus microcorys</i>		U						10	
<i>Eucalyptus moluccana</i>		U			5	10			
<i>Eucalyptus saligna</i>		U						5	
<i>Foeniculum vulgare</i> *		G	0.1					0.1	
<i>Fraxinus spp.*</i>		M						1	
<i>Gamochaeta spp.*</i>		G							0.1
<i>Geranium homeanum</i>		G			0.1				
<i>Glycine tabacina</i>		G			0.1	0.1			
<i>Hypericum spp.</i> (listed as <i>H. perforatum</i> to indicate exotic)*	Y	G							0.1
<i>Hypochaeris glabra</i> *		G	0.1	0.1					
<i>Hypochaeris radicata</i> *		G				0.1	0.1		0.1
<i>Juncus usitatus</i>		G					0.1		
<i>Lepidium bonariense</i> *		G	0.1	0.1	0.1	0.1			
<i>Lysimachia arvensis</i> *		G			0.1	0.1			0.1

Species name	Exotic (* high threat weed)	Form	Plot 1 cover %	Plot 2 cover %	Plot 3 cover %	Plot 4 cover %	Plot 5 cover %	Plot 6 cover %	Plot 7 cover %
<i>Malva preissiana</i> *		G			0.1	0.1		2	
<i>Medicago sativa</i> *		G							0.1
<i>Medicago spp.*</i>		G					0.1		
<i>Microlaena stipoides</i> var. <i>stipoides</i>		G	1						
<i>Modiola caroliniana</i> *		G	0.1		0.1	0.1	0.1	0.5	
<i>Nassella neesiana</i> *	Y	G	2			0.5			
<i>Osteospermum spp.*</i>		G				0.1			
<i>Oxalis perennans</i>		G		0.1	0.1	0.1	0.1	0.1	0.1
<i>Panicum repens</i> *	Y	G				50			
<i>Panicum miliaceum</i> (listed as this species to indicate exotic)*		G							2
<i>Paspalum dilatatum</i> *	Y	G	15	15	15	10	0.5		5
<i>Pennisetum spp.*</i> (listed as <i>Cenchrus clandestinus</i>)		G	70	80	15		95	5	40
<i>Plantago lanceolata</i> *		G	0.1	0.1	0.1	0.1	0.1	0.1	0.1
<i>Plantago spp.*</i>		G							0.1
<i>Prunus persica</i> *		G						5	

Species name	Exotic (* high threat weed)	Form	Plot 1 cover %	Plot 2 cover %	Plot 3 cover %	Plot 4 cover %	Plot 5 cover %	Plot 6 cover %	Plot 7 cover %
<i>Romulea rosea</i> var. <i>australis</i> *	Y	G							0.1
<i>Rumex crispus</i> *		G	0.1	0.1					
<i>Senecio madagascariensis</i> *	Y	G	0.1	0.1	0.1	0.1	0.5	0.1	0.1
<i>Setaria parviflora</i> *		G			1				0.2
<i>Sida rhombifolia</i> *		G	0.1		0.1	0.1		0.1	
<i>Solanum linnaeanum</i> *		G	0.1		0.5	0.5	0.2	0.1	0.1
<i>Solanum nigrum</i> *		G	0.1	0.1					
<i>Soliva sessilis</i> *		G						0.1	0.1
<i>Sonchus oleraceus</i> *		G	0.1		0.1	0.1	0.1	0.1	0.1
<i>Sporobolus africanus</i> *		G			0.5		0.1		0.2
<i>Stellaria media</i> *		G					0.1		
<i>Taraxacum officinale</i> *		G						0.1	
<i>Themeda triandra</i>		G							0.1
<i>Trifolium repens</i> *		G	0.1	0.1	0.1		0.1	0.1	
<i>Verbena bonariensis</i> *		G	0.1	0.1		0.1			

Species name	Exotic (* high threat weed)	Form	Plot 1 cover %	Plot 2 cover %	Plot 3 cover %	Plot 4 cover %	Plot 5 cover %	Plot 6 cover %	Plot 7 cover %
<i>Vicia sativa</i> subsp. <i>sativa</i> *		G	0.1	0.1					0.1
<i>Vittadinia</i> spp.		G							0.1
<i>Vulpia bromoides</i> *		G							0.1
<i>Wahlenbergia gracilis</i>		G			0.1				0.1

Table 39: Composition, structure and function exported from plot data

plot	Composition						Structure						Function				
	Tree	Shrub	Grass	Forbs	Ferns	Other	Tree	Shrub	Grass	Forbs	Ferns	Other	Large trees	Hollows	Litter cover	Fallen logs	Regen
Plot 1	1	0	1	1	0	0	5.0	0.0	1.0	0.1	0.0	0.0	0	0	0.6	0	1
Plot 2	1	0	1	1	0	0	5.0	0.0	0.1	0.1	0.0	0.0	0	0	0.2	0	1
Plot 3	1	0	1	9	0	1	5.0	0.0	1.0	0.9	0.0	0.1	1	0	1.6	0	0
Plot 4	1	0	4	5	0	1	10.0	0.0	1.2	0.5	0.0	0.1	2	4	7.6	0	0
Plot 5	0	0	1	1	0	0	0.0	0.0	0.1	0.1	0.0	0.0	0	0	0	0	0
Plot 6	2	0	1	5	0	0	10.0	0.0	0.1	0.5	0.0	0.0	2	1	38.2	0	0
Plot 7	0	0	2	7	0	0	0.0	0.0	1.1	0.7	0.0	0.0	0	0	0	0	0

Appendix D Ultrasonic analysis report

PROJECT BACKGROUND AND SITE DESCRIPTION

A previously conducted field assessment determined that the subject site contains habitat features that could support threatened flora or fauna. These habitat features included hollow bearing trees (HBTs) and farm dams. These features represent potential foraging and roosting habitat of the *Myotis macropus* (Southern Myotis) as well as several other microbats that are listed as vulnerable under the NSWs BC Act.

Species credits are likely to be required if there will impacts from the proposed development to potential Southern Myotis breeding habitat (e.g HBTs) that are located within 200 m radius of the farm dams. These surveys have been undertaken in accordance with the '*Species Credit' Threatened Bats and Their Habitats – NSW Survey Guide for the Biodiversity Assessment Method* (OEH, 2018). These guidelines require the deployment of Anabat recorders to record ultrasonic microbat calls during a minimum 16 Anabat nights survey period (e.g. four anabat set over four nights).

The results of the ultrasonic microbat survey will contribute to the development of a Biodiversity Development Assessment Report (BDAR), that is to accompany a State Significant Development Application (SSDA) to develop the area as an industrial site.

METHODS

Four Anabat Swift (©Titley Electronics) ultrasonic microbat recorders were set at four locations within the subject site, as described below:

- SUT01 was set in the middle of the subject site near to a chain of three dams.
- SUT02 was set adjacent to a large farm dam in close proximity to HBTs.
- COF1 was set in the middle of the subject site near to a farm dam.
- COF02 was set on the eastern boundary of the subject site near a patch of scattered paddock trees (some with hollows). These trees are located within a '200m radius' of a waterbody.

Each anabat was set to record for four consecutive nights from 1 October 2019 – 4 October 2019.

DATA ANALYSIS

Bat calls were analysed by Rodney Armistead using the program AnalookW (Version 4.2n 16 March 2017, written by Chris Corben, www.hoarybat.com). Call identifications are made using regional based guides to the echolocation calls of microbats in New South Wales (Pennay et al 2004); and south-east Queensland and north-east New South Wales (Reinhold et al 2001) and the accompanying reference library of over 200 calls from Sydney Basin, NSW (which is available at <http://www.forest.nsw.gov.au/research/bats/default.asp>). Rodney has over five years of experience in the identification of ultrasonic call recordings. This report and a sample of the calls was reviewed by Alicia Scanlon also from ELA, has over twelve years of experience in the identification of ultrasonic call recordings. A sample of the calls were also reviewed externally by Greg Ford of Balance Environmental who has over 20 years of experience in this line of work.

Bat calls are analysed using species-specific call profile parameters including call shape, characteristic frequency, initial slope and time between pulses (Reinhold et al. 2001). To ensure reliable and accurate results the following protocols (adapted from Lloyd et al 2006) are followed:

- Search phase calls are used in the analysis, rather than cruise phase calls or feeding buzzes (McKenzie et al 2002). Cruise phase or feeding calls are labelled as being unidentifiable.
- Recorded calls containing less than three pulses are not analysed and these sequences are labelled as unidentifiable, being too short to confidently determine the identity of the species making the call (Law et al 1999)
- For those calls that are useful to identify the species making the call, two categories of confidence are used (Mills et al 1996):
 - Definitely present – the quality and structure of the call profile is such that the identity of the bat species making the calls is not in doubt
 - Potentially present – the quality and structure of the call profile is such that there is some / low probability of confusion with species that produce similar calls profiles
- Calls made by bats which cannot be used for identification purposes such as social calls, short and low-quality calls, cruise and approach phase calls are labelled as unidentifiable.
- Sequences labelled as unidentifiable are of inferior quality and therefore not able to be identified to any microbat species, they can however be used as an indicator of microbat activity at the site.
- *Nyctophilus* spp. (Long-eared bats) are difficult to identify confidently from their calls and no attempt is made to identify this genus to species level (Pennay et al 2004)
- The Free-tailed Bats (previously referred to as the genus *Mormopterus*) have recently undergone taxonomic revision (Reardon et al 2014) and published reference calls for this group of species (Pennay et al 2004) are believed to contain errors (Greg Ford pers comm.). This report uses nomenclature for Free-tailed bat species as referred to in Jackson and Groves (2015). The correlation between nomenclature used in this report and that used in NSW State legislation is presented in Table 40 below.
- Sequences not attributed to microbat echolocation calls (e.g. insect buzzes, wind, train and vehicle movement) were dismissed from the analysis.

Table 40: Correlations between current and previous nomenclature for the Free-tailed bats of NSW

Jackson and Groves 2015	Previously known as	Common Name	BC Act
<i>Austronomus australis</i>	<i>Tadarida australis</i>	White-striped Free-tailed Bat	-
<i>Micronomus norfolkensis</i>	<i>Mormopterus norfolkensis</i>	Eastern Coastal Free-tailed Bat	Vulnerable
<i>Ozimops petersi</i>	<i>Mormopterus</i> species 3 (small penis)	Inland Free-tailed Bat	-
<i>Ozimops planiceps</i>	<i>Mormopterus</i> species 4 (long penis eastern form)	Southern Free-tailed Bat	-
<i>Ozimops ridei</i>	<i>Mormopterus</i> species 2	Ride's Free-tailed Bat	-
<i>Setirostris eleryi</i>	<i>Mormopterus</i> species 6	Bristle-faced Free-tailed Bat	Endangered

RESULTS

There were 2,654 call sequences recorded during this survey. Of these, 2,366 (89.15%) were deemed useful, because the call profile was of sufficient quality and/or length to enable positive identification of bat species. The remaining 288 (10.15%) call sequences were either too short or of low quality, thus preventing positive identification of bat species.

There were at least eleven (11) and up to thirteen (13) species recorded during this survey (Table 40). This includes up to five (5) species that are listed as Vulnerable under the NSW BC Act (Table 40 and

Figure 13 – Figure 25). Four Vulnerable species were deemed to have been definitely present within the study area;

- *Falsistrellus tasmaniensis* (Eastern False Pipistrelle)
- *Micronomus norfolkensis* (Eastern Coastal Free-tailed Bat)
- *Miniopterus orianae oceanensis* (Eastern Bentwing Bat)
- *Myotis macropus* (Southern Myotis).

One other threatened species, *Scoteanax rueppellii* (Greater Broad-nosed Bat), which is also listed as vulnerable under the BC Act could also be present within the study area. The quality, shape and characteristic frequency (defining features) of calls assigned to the Greater Broad-nosed Bat were such that we cannot be certain of the presence of this species within the study area. The defining features of the Greater Broad-nosed Bat call profile overlap with other more common and non-threatened microbats such as *Scotorepens orion* (Eastern Broad-nosed Bat) and the threatened Eastern False Pipistrelle (see Figure 17). Whilst there were no defining call characteristics that would allow us to confidently attribute to any calls to the Greater Broad-nosed Bat, this species is known to occur within the Sydney basin and consequently, may be present within the study area. See Section 6. Survey Limitations provided below for further information on overlapping calls.

Table 41. Microbat species diversity and number of calls recorded ultrasonically at Lots 54 – 58 Mamre Rd, Kemps Creek between the 30 September and 3 October 2019.

Scientific Name	Common Name	Result
<i>Austronomus australis</i>	White-striped Free-tailed Bat	X
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	X
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	X
<i>Falsistrellus tasmaniensis</i>*	Eastern False Pipistrelle	X
<i>Micronomus norfolkensis</i>*	Eastern Coastal Free-tailed Bat	X
<i>Miniopterus orianae oceanensis</i>*	Eastern Bentwing Bat	X
<i>Myotis macropus</i>*	Southern Myotis	X
<i>Nyctophilus</i> spp. (the non-threatened <i>N. geoffroyi</i> or <i>N. gouldi</i>)	Long-eared Bats (including the non-threatened Lesser Long-eared Bat or Gould's Long-eared Bat)	X
<i>Ozimops ridei</i>	Ride's Free-tailed Bat	X
<i>Scoteanax rueppellii</i> *	Greater Broad-nosed Bat	P

Scientific Name	Common Name	Result
<i>Scotorepens orion</i>	Eastern Broad-nosed Bat	P
<i>Vespadelus vulturnus</i>	Little Forest Bat	X

X = Definitely recorded, P = Potentially recorded. *listed as threatened under the BC Act

INTERPRETATION OF SURVEY RESULTS

Activity and foraging

The most commonly recorded species within the study area included the non-threatened *Austronomus australis* (White-Striped Free-tailed Bat), *Chalinolobus gouldii* (Gould's Wattled Bat) and Eastern Coastal Free-tailed Bat. Collectively, 1195 of the identifiable calls were attributed to these three species, which accounted for 50.51% of the calls that were recorded during this survey.

General microbat activity was regarded as being high across the four survey sites (e.g. at least one call was recorded every two to five minutes at each survey site. Microbat activity was highest on SUT02, which was located near to the largest farm dam and a HBT (Table 42 - Table 45).

Careful interpretation of these results is recommended because microbat activity at a subject site is a result of a multitude of factors. Activity can only be measured in a relative sense since it is impossible to determine whether each call is being made by a different bat or the same bat flying past the recorder on multiple occasions.

Long sequences and feeding buzzes were observed for all of the species. However, feeding buzzes were most prevalent among the calls that were attributed to White-striped Free-tailed Bats, Gould's Wattled Bats, Eastern Coastal Free-tailed Bats and *Ozimops ridei* (Ride's Free-tailed Bat). The presence of feeding buzzes shows that the microbats recorded during this survey were actively foraging across the subject site.

Summary of results and discussion

The presence of those species listed as Vulnerable, including Eastern Bentwing Bat, Eastern Coastal Free-tailed Bat, Eastern False Pipistrelle, Southern Myotis and potentially, the Greater Broad-nosed Bat, within the study area requires further consideration. The reasons for this conclusion are described in the following section.

Greater Broad-nosed Bats have been recorded roosting and breeding in a very similar rural landscape. Greater Broad-nosed Bats are known to forage along riparian corridors in open habitats (lacking or with scattered trees), particularly when they are connected to areas of more extensive forest. It is likely that this species could forage, roost and breed in the HBTs that are present within the study area. If any HBT (potential breeding habitat) are to be impacted, then a test of significance test under s7.3 of the BC Act will be required.

Eastern False Pipistrelles prefer continuous patches of tall wet forest with trees greater than 20 m high (Churchill, 2008). They tend to roost in hollow trunks of large Eucalypts and are known to forage above or just below the canopy or in gaps and spaces within the forest. However, they have been recorded foraging in more open areas, such as those that are present within the subject site. If any HBT (potential

breeding habitat) are to be impacted, then a test of significance test under s7.3 of the BC Act will be required for this species.

Eastern Coastal Free-tailed Bat primarily roosts in tree hollows, but will at times roost in buildings (Churchill, 2008). This species occupies dry sclerophyll forest and woodlands. It is known from this region of the Sydney Basin, particularly from the rural residential and agricultural areas. This species was the most active (or commonly recorded) species with 657 definite calls recorded. The data recorded during this survey also shows that this species forages over the subject site. It is possible that it is roosting in HBTs, buildings and farm sheds that are present within the subject site and surrounding areas. If these habitat features are to be impacted, then a test of significance test under s7.3 of the BC Act will be required.

Calls that were attributed to the Southern Myotis were recorded on three of the Anabats (COF01, COF02 and SUT02). Southern Myotis will roost and breed in hollow bearing trees (that are generally located within 100 m radius of a permanent waterway (lakes, creeks and rivers with pools / stretches of water that $\geq 3\text{m}$ in width) as well as subterranean structures such as old railway tunnels, military bunkers, culverts, bridges, stormwater drains and mines (Churchill, 2008; Richards et al., 2008; Campbell, 2009). It has a unique feeding strategy amongst Australian bats in that this species forages exclusively over water, trawling the surface for small insects and aquatic species such as fish and crustaceans (Anderson et al. 2006). Suitable foraging habitat within and near to the study area includes the open waters of the farm dams. If any HBT (potential Southern Myotis breeding habitat) is to be impacted, then a test of significance test under s7.3 of the BC Act as well as species credits are likely to be required.

Eastern Bentwing Bat is a subterranean roosting species that will roost in cement culverts, stormwater drains, bridges, disused mine shafts and caves (Churchill 2008). Breeding occurs over the summer months and bats disperse to other non-breeding winter and hibernation roosts between March and August each year (Churchill, 2008; Hoyer and Hall 2008a and 2008b). The Eastern Bentwing Bat will forage over the subject site, but it is unlikely to roost at the site, unless there are cement culverts, bridges or other similar structures present with dark cave-like voids.

This species only breeds (e.g gives birth, lactates and provides maternal care) in a small number of caves in the Great Dividing Rang in NSW (Churchill, 2008). Caves provide the perfect microclimatic conditions for rearing of young. Breeding habitat for these species does not occur within the study area.

SURVEY LIMITATIONS

Calls were only positively identified when the defining characteristics were present and there was no chance of confusion between species with overlapping and/or similar calls. In this survey, there were some call sequences that could not be positively identified to species level. Further, some species recorded in this survey can have call profiles that overlap with other species.

When overlap occurs, species with similar call profiles are assigned to multi species groups of two or three potential species depending on the characteristics displayed in the recorded call sequences. Calls with intermediate characteristics were assigned mixed species labels.

The species recorded in this survey with overlapping call profiles are described below.

Chalinolobus gouldii (Gould's Wattled Bat), *Ozimops ridei* (Ride's Free-tailed Bat) and the Eastern Coastal Free-tailed Bat have calls that overlap in the range 28.5 kHz and 32 kHz. Calls were identified as Ride's Free-tailed Bat if the call shape was flat (initial slope S1 of less than 100 octaves per second) and the frequency was between 28 – 32 kHz. Gould's Wattled Bat was distinguished by a frequency of 27.5 – 32.5 kHz and alternation in call frequency between pulses. Eastern Coastal Free-tailed Bat was identified by flat pulses (initial slope S1 of less than 100 OPS), alternation in call frequency between pulses and a frequency range of 31 kHz to 36 kHz. Calls with intermediate characteristics were assigned mixed species labels.

The calls of Eastern False Pipistrelle, Greater Broad-nosed Bat, and Eastern Broad-nosed Bat can be difficult to separate as their call frequencies and some other call characteristics overlap.

- Greater Broad-nosed Bats can be distinguished by a frequency of 32 – 36 kHz, lack of a tail or short down-sweeping tail, frequency of the knee greater than 37 kHz, and drop of more than 3 kHz from the knee to the characteristic section.
- Eastern False Pipistrelle bat calls have a characteristic frequency between 35 and 39 kHz, display curved, often steep pulses without up-sweeping tails and sometimes with down-sweeping tails. The pre-characteristic section is often long (greater than 3 kHz). This species can only be separated from Eastern Broad-nosed Bat when the characteristic frequency is above 37 kHz.
- Eastern Broad-nosed Bat calls fall between 34 and 37 kHz but can only be separated from Eastern False Pipistrelle when calls are between 34 and 35 kHz, and the frequency of the knee is above 38 kHz.

There were several calls recorded that fell in the range of overlap between these species with characteristics intermediate between all species. In most cases calls could not be assigned to any of the three possible species and were labelled as Eastern False Pipistrelle / Greater Broad-nosed Bat / Eastern Broad-nosed Bat or combinations of two of the three where call frequency was too high or too low for Greater Broad-nosed Bat or Eastern False Pipistrelle.

The calls of *Chalinolobus morio* (Chocolate Wattled Bat) and *Vespadelus vulturnus* (Little Forest Bat) overlap in the range 49 kHz to 52 kHz. Chocolate Wattled Bats display a curved call with a down-sweeping tail whereas Little Forest Bats display a curved call with an up-sweeping tail. When no tail is present calls are assigned mixed species labels of Chocolate Wattled Bat / Little Forest Bat.

The calls of *Myotis* are very similar to all *Nyctophilus* (Long-eared Bat) species and it is often difficult to separate these species on call characteristics alone. Calls can be identified as *Nyctophilus spp.* when the time between calls (TBC) is higher than 95ms and the initial slope S1 is lower than 300 octaves per second (OPS). Calls can be identified as *Myotis* when the time between calls (TBC) is lower than 75ms and the initial slope S1 is greater than 400 (OPS). Where the TBC is between 75 and 95ms and the OPS is between 300 and 400 calls are assigned a mixed species label of *Myotis* / Long-eared Bats (Pennay, Law and Reinhold 2004).

Furthermore, calls produced by different bat species differ in fundamental ways related to the particular foraging mode / activity of each species. Calls of different species and the different types of calls produced by each species (cruise, search, social, approach, attack) are not equally recorded by ultrasonic detectors. Weather and climatic conditions affect the quality and quantity of recorded data as well as

the availability of insect prey and therefore the suitability of each site at a given time as foraging habitat. The survey was conducted in September during a period of mild temperatures.

RESULTS TABLES FOR EACH ANABAT SWIFT

Table 42: Microbat species diversity and number of calls recorded ultrasonically on COF01 at Lots 54 – 58 Mamre Rd, Kemps Creek between 30 September and 3 October 2019.

Scientific Name	Common Name	Definitely present	Potentially present	Total calls
<i>Austronomus australis</i>	White-striped Free-tailed Bat	70	1	71
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	128	11	139
<i>Chalinolobus gouldii</i> / <i>Ozimops ridei</i>	Gould's Wattled Bat / Ride's Free-tailed Bat	0	27	27
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	2	0	2
<i>Micronomus norfolkensis</i>*	Eastern Coastal Free-tailed Bat	38	0	38
<i>Micronomus norfolkensis</i>* / <i>Ozimops ridei</i>	Eastern Coastal Free-tailed Bat / Ride's Free-tailed Bat	0	53	53
<i>Miniopterus orianae oceanensis</i> *	Eastern Bentwing Bat	2	0	2
<i>Myotis macropus</i> *	Southern Myotis	6	0	6
<i>Myotis macropus</i> * / <i>Nyctophilus</i> spp. (non-threatened <i>N. geoffroyi</i> or <i>N. gouldi</i>)	Southern Myotis / Long-eared Bats (including the non-threatened Lesser Long-eared Bat or Gould's Long-eared Bat)	0	224	224
<i>Nyctophilus</i> spp. (non-threatened <i>N. geoffroyi</i> or <i>N. gouldi</i>)	Long-eared Bats (including the non-threatened Lesser Long-eared Bat or Gould's Long-eared Bat)	2	0	2
<i>Ozimops ridei</i>	Ride's Free-tailed Bat	35	0	35
<i>Vespadelus vulturnus</i>	Little Forest Bat	1	0	1
Unidentifiable calls				460
Identifiable calls				600
Total Calls				1060
Percentage usable calls				56.60

* Threatened species listed under BC Act

Table 43: Microbat species diversity and number of calls recorded ultrasonically on COF01 at Lots 54 – 58 Mamre Rd, Kemps Creek between 30 September and 3 October 2019.

Scientific Name	Common Name	Definitely present	Potentially present	Total calls
<i>Austronomus australis</i>	White-striped Free-tailed Bat	33	2	35
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	23	3	26
<i>Chalinolobus gouldii</i> / <i>Ozimops ridei</i>	Gould's Wattled Bat / Ride's Free-tailed Bat		43	43
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	8	2	10
<i>Chalinolobus morio</i> / <i>Vespadelus vulturnus</i>	Chocolate Wattled Bat / Little Forest Bat	0	12	12
<i>Falsistrellus tasmaniensis</i> *	Eastern False Pipistrelle	1	0	1
<i>Falsistrellus tasmaniensis</i> * / <i>Scoteanax rueppellii</i> * / <i>Scotorepens orion</i>	Eastern False Pipistrelle / Greater Broad-nosed Bat / Eastern Broad-nosed Bat	0	19	19
<i>Micronomus norfolkensis</i> *	Eastern Coastal Free-tailed Bat	60	2	62
<i>Micronomus norfolkensis</i> * / <i>Ozimops ridei</i>	Eastern Coastal Free-tailed Bat / Ride's Free-tailed Bat	0	94	94
<i>Miniopterus orianae oceanensis</i> *	Eastern Bentwing Bat	5	1	6
<i>Myotis macropus</i> *	Southern Myotis	2	0	2
<i>Myotis macropus</i> * / <i>Nyctophilus spp. (non-threatened N. geoffroyi or N. gouldi)</i>	Southern Myotis / Long-eared Bats (including the non-threatened Lesser Long-eared Bat or Gould's Long-eared Bat)	0	2	2
<i>Nyctophilus spp. (non-threatened N. geoffroyi or N. gouldi)</i>	Long-eared Bats (including the non-threatened Lesser Long-eared Bat or Gould's Long-eared Bat)	3	0	3
<i>Ozimops ridei</i>	Ride's Free-tailed Bat	14	4	18
<i>Vespadelus vulturnus</i>	Little Forest Bat	61	0	61
Unidentifiable calls				226
Identifiable calls				397
Total Calls				623
Percentage usable calls				63.72

* Threatened species listed under BC Act

Table 44: Microbat species diversity and number of calls recorded ultrasonically on SUT01 at Lots 54 – 58 Mamre Rd, Kemps Creek between 30 September and 3 October 2019.

Scientific Name	Common Name	Definitely present	Potentially present	Total calls
<i>Austronomus australis</i>	White-striped Free-tailed Bat	133	6	139
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	5	0	5
<i>Chalinolobus gouldii</i> / <i>Ozimops ridei</i>	Gould's Wattled Bat / Ride's Free-tailed Bat	0	11	11
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	3	0	3
<i>Chalinolobus morio</i> / <i>Vespadelus vulturnus</i>	Chocolate Wattled Bat / Little Forest Bat	0	1	1
<i>Falsistrellus tasmaniensis</i> * / <i>Scoteanax rueppellii</i> * / <i>Scotorepens orion</i>	Eastern False Pipistrelle / Greater Broad-nosed Bat / Eastern Broad-nosed Bat	0	1	1
<i>Micronomus norfolkensis</i> *	Eastern Coastal Free-tailed Bat	71	0	71
<i>Micronomus norfolkensis</i> * / <i>Ozimops ridei</i>	Eastern Coastal Free-tailed Bat / Ride's Freetail Bat	0	112	112
<i>Miniopterus orianae oceanensis</i> *	Eastern Bentwing Bat	8	1	9
<i>Myotis macropus</i> * / <i>Nyctophilus spp. (non-threatened N. geoffroyi or N. gouldi)</i>	Southern Myotis / Long-eared Bats (including the non-threatened Lesser Long-eared Bat or Gould's Long-eared Bat)	0	2	2
<i>Nyctophilus spp. (non-threatened N. geoffroyi or N. gouldi)</i>	Long-eared Bats (including the non-threatened Lesser Long-eared Bat or Gould's Long-eared Bat)	1	0	1
<i>Ozimops ridei</i>	Ride's Free-tailed Bat	44	0	44
<i>Vespadelus vulturnus</i>	Little Forest Bat	3	0	3
Unidentifiable calls				103
Identifiable calls				402
Total Calls				505
Percentage usable calls				79.60

* Threatened species listed under BC Act

Table 45: Microbat species diversity and number of calls recorded ultrasonically on SUT020 at Lots 54 – 58 Mamre Rd, Kemps Creek between 30 September and 3 October 2019.

Scientific Name	Common Name	Definitely present	Potentially present	Total calls
<i>Austronomus australis</i>	White-striped Free-tailed Bat	88	0	88
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	29	6	35
<i>Chalinolobus gouldii</i> / <i>Ozimops ridei</i>	Gould's Wattled Bat / Ride's Free-tailed Bat	0	20	20
<i>Chalinolobus gouldii</i> / <i>Scotorepens orion</i>	Gould's Wattled Bat / Eastern Broad-nosed Bat	0	2	2
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	9	1	10
<i>Chalinolobus morio</i> / <i>Vespadelus vulturnus</i>	Chocolate Wattled Bat / Little Forest Bat	0	1	1
<i>Falsistrellus tasmaniensis</i> * / <i>Scoteanax rueppellii</i> * / <i>Scotorepens orion</i>	Eastern False Pipistrelle / Greater Broad-nosed Bat / Eastern Broad-nosed Bat	0	3	3
<i>Micronomus norfolkensis</i> *	Eastern Coastal Free-tailed Bat	484	2	486
<i>Micronomus norfolkensis</i> * / <i>Ozimops ridei</i>	Eastern Coastal Free-tailed Bat / Ride's Freetail Bat	0	224	224
<i>Miniopterus orianae oceanensis</i> *	Eastern Bentwing Bat	19	1	20
<i>Myotis macropus</i> *	Southern Myotis	3	0	3
<i>Myotis macropus</i> * / <i>Nyctophilus spp. (non-threatened N. geoffroyi or N. gouldi)</i>	Southern Myotis / Long-eared Bats (including the non-threatened Lesser Long-eared Bat or Gould's Long-eared Bat)	0	8	8
<i>Ozimops ridei</i>	Ride's Free-tailed Bat	11	3	14
<i>Scoteanax rueppellii</i> * / <i>Scotorepens orion</i>	Eastern Broad-nosed Bat / Greater Broad-nosed Bat	0	10	10
<i>Vespadelus vulturnus</i>	Little Forest Bat	0	2	2
Unidentifiable calls				181
Identifiable calls				926
Total Calls				1107
Percentage usable calls				83.64

* Threatened species listed under BC Act

EXAMPLE CALL PROFILES

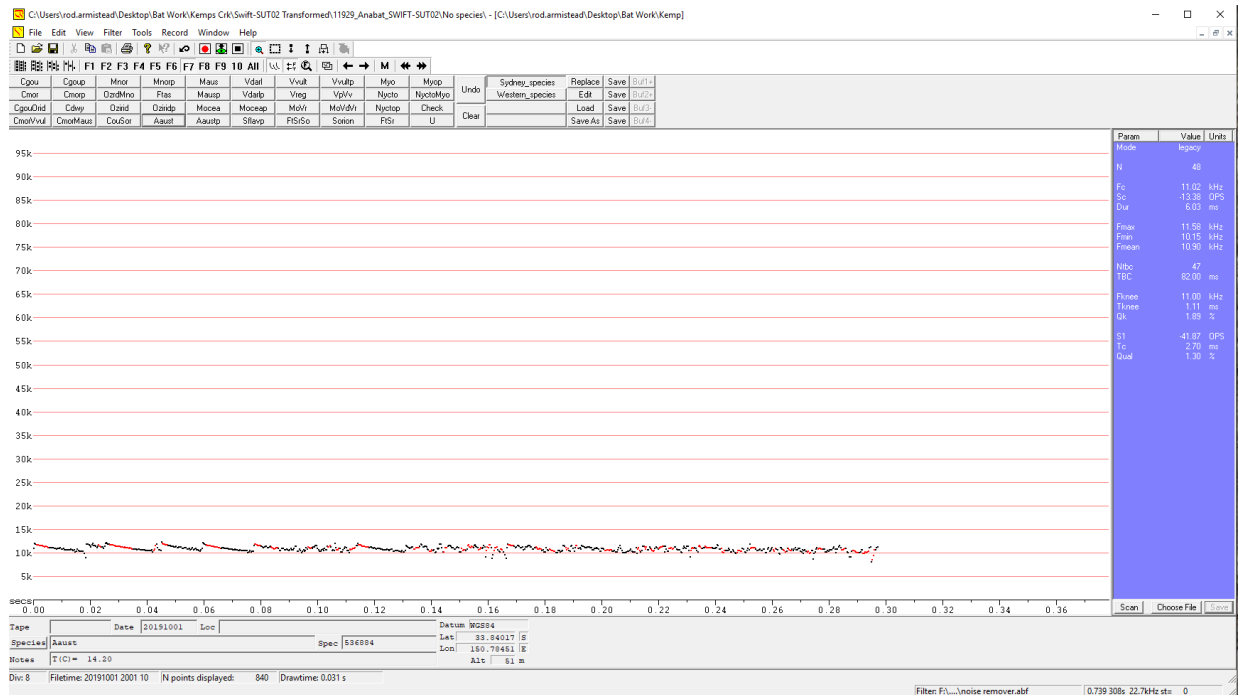


Figure 13. Call profile for *Austronomus australis* (White-striped Free-tailed Bat) recorded on SUT02 at 2001 (8:01 pm) on 1 October 2019.

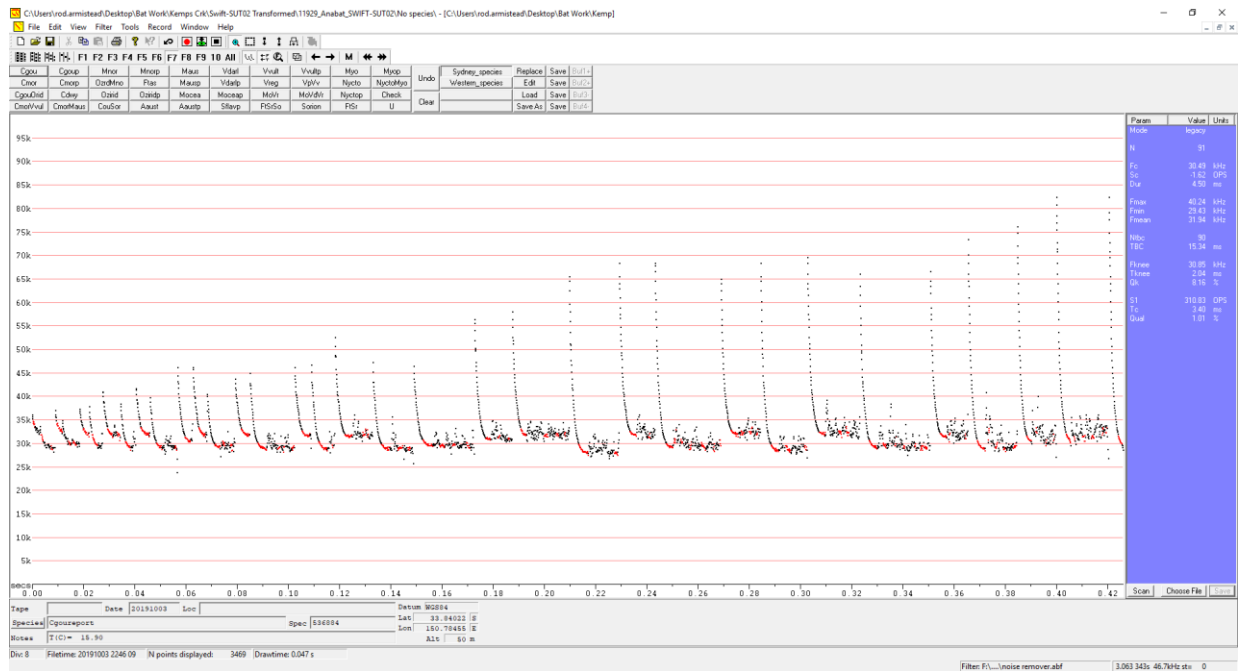


Figure 14. Call profile for *Chalinolobus gouldii* (Gould's Wattled Bat) recorded on SUT02 at 2246 (10:46 pm) 3 October 2019.

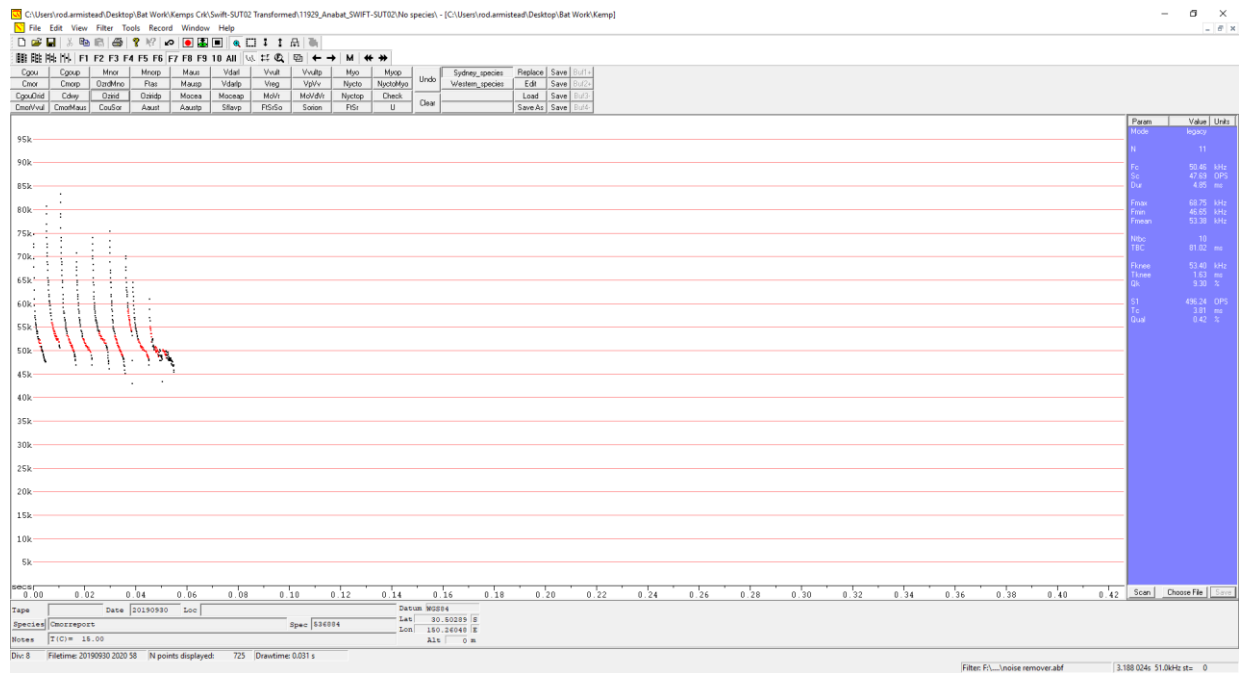


Figure 15. Call profile for *Chalinoblos morio* (Chocolate Wattled Bat) recorded on SUT02 at 2020 (8:20 pm) on 30 September 2019.

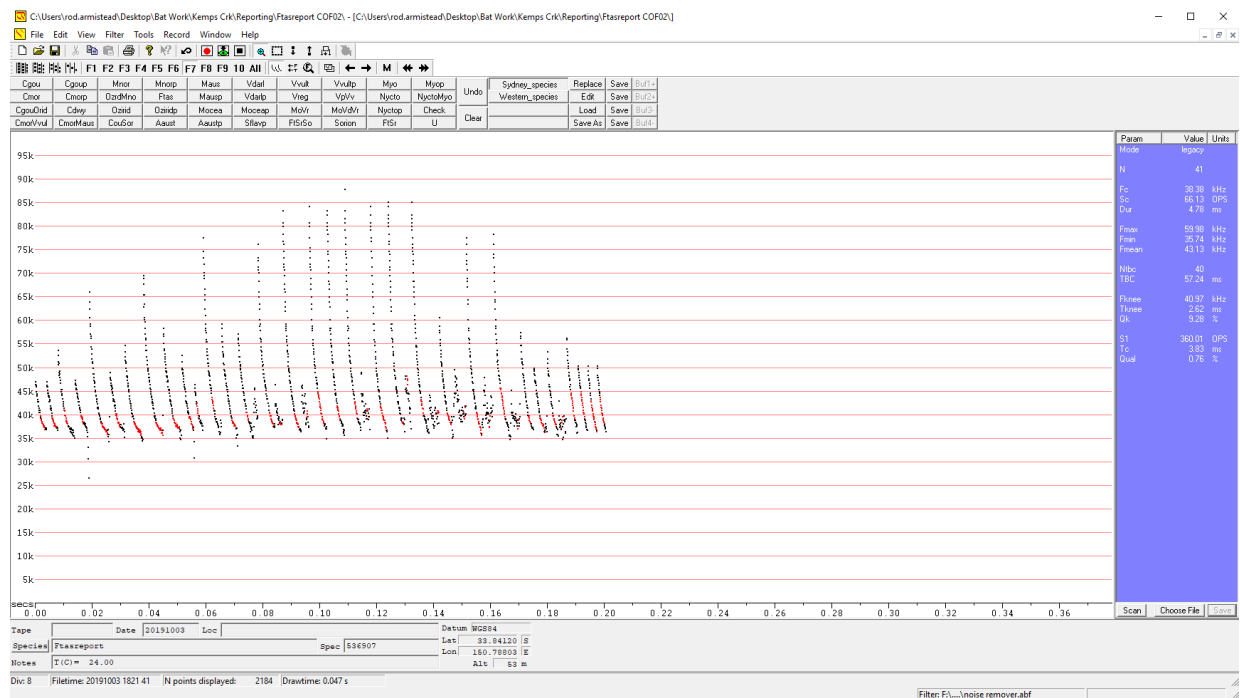


Figure 16. Call profile for *Falsistrellus tasmaniensis* (Eastern False Pipistrelle) recorded at on COF02 at 1821 (6:21 pm) on 3 October 2019.

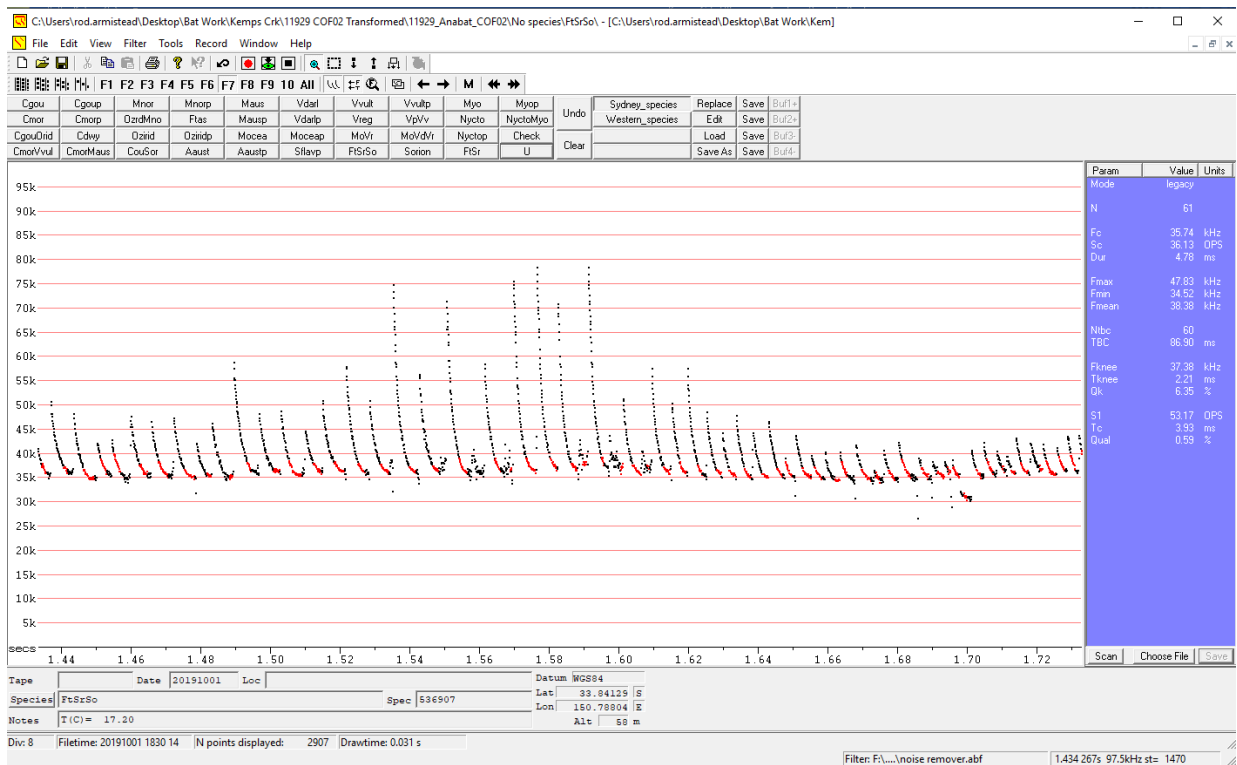


Figure 17: Potential call profile for either *Falsistrellus tasmaniensis* (Eastern False Pipistrelle), *Scoteanax rueppellii* (Greater Broad Nosed Bat) or *Scotorepens orion* (Eastern Broad-nosed Bat) recorded on COF02 at 18:30 (6:30 pm) on 1 October 2019.



Figure 18. Call profile for *Micronomus norfolkensis* (Eastern Coastal Free-tailed Bat) recorded on SUT02 at 1936 (7:36 pm) on 30 September 2019.

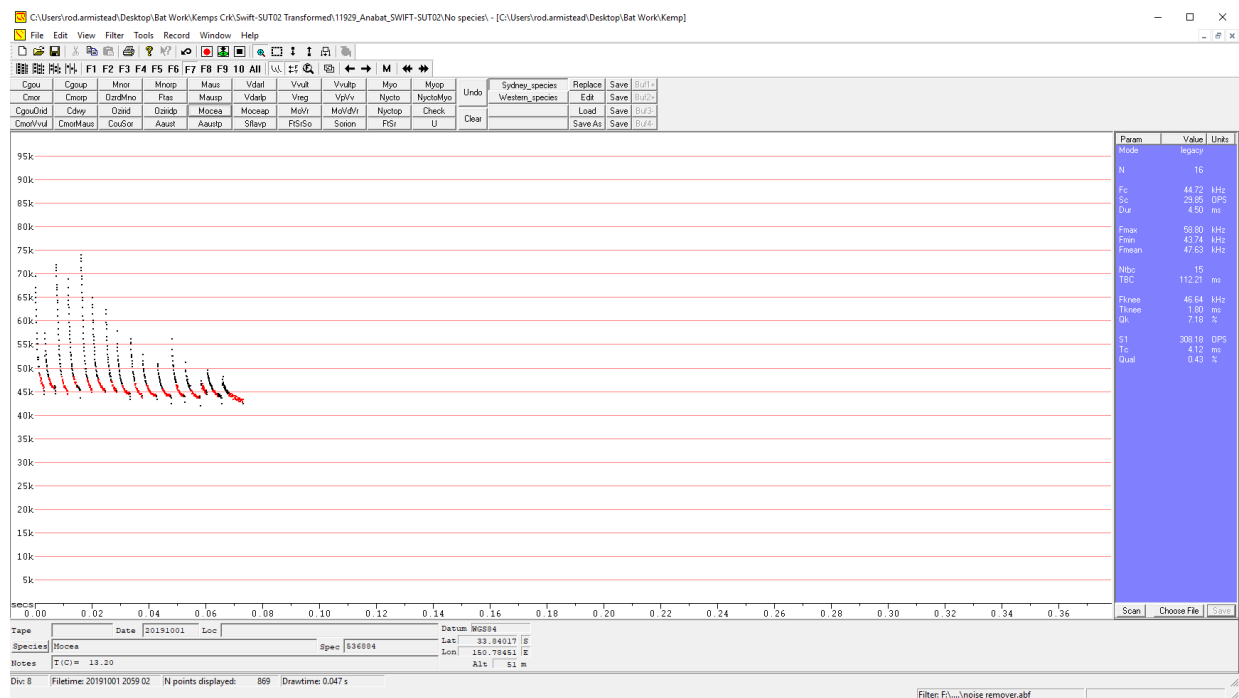


Figure 19. Call profile for *Miniopterus orianae oceanensis* (Eastern Bentwing Bat) recorded on SUT02 at 2059 (8:59 pm) on 1 October 2019.

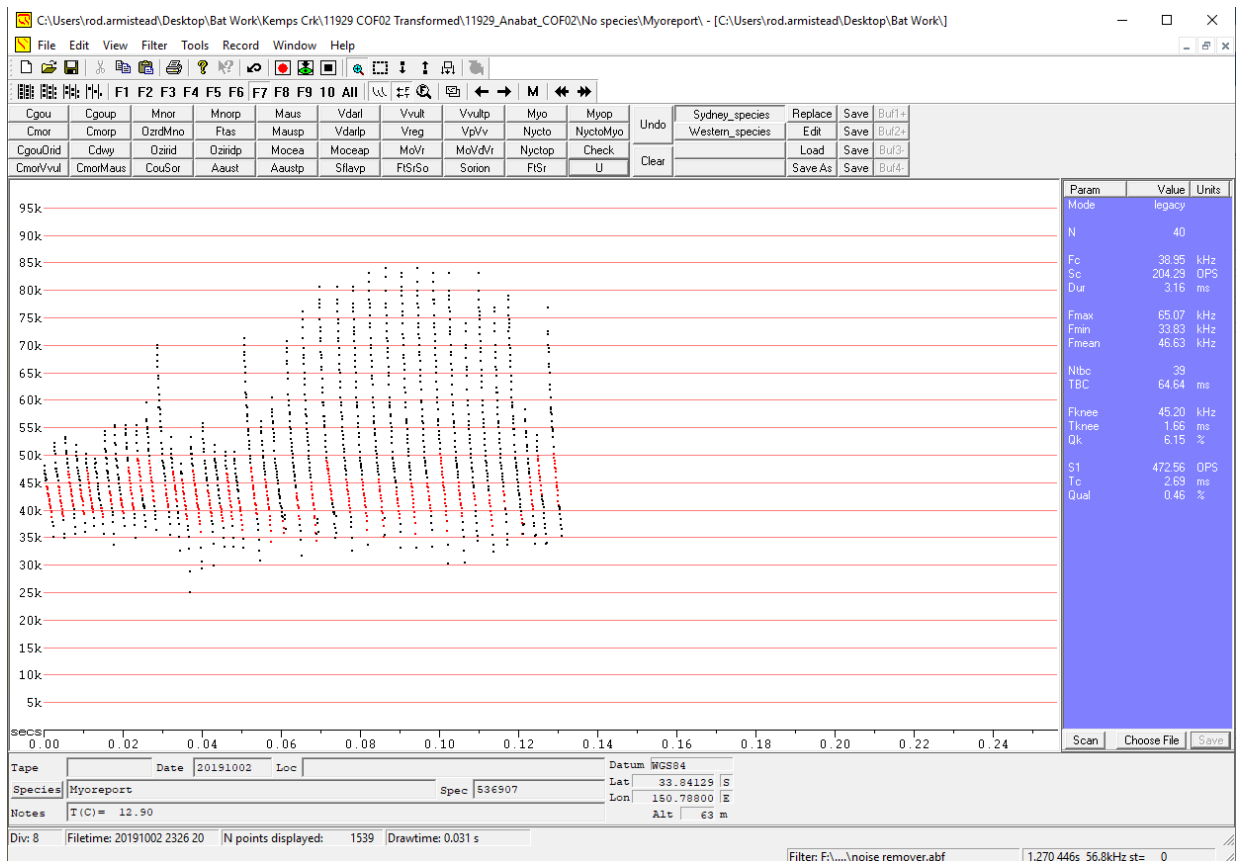


Figure 20. Call profile for *Myotis macropus* (Southern Myotis) recorded on COF02 at 2326 (11:26 pm) on 2 October 2019.

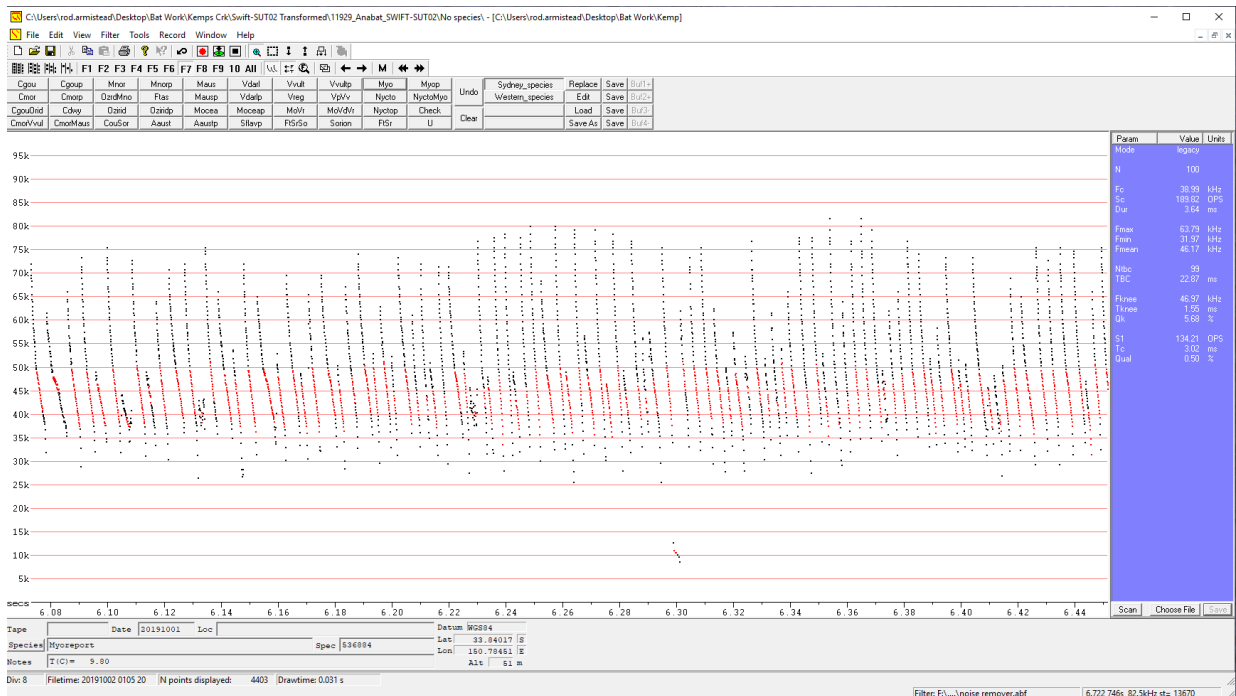


Figure 21. Potential call profile for *Myotis macropus* (Southern Myotis) recorded on SUT02 at 0105 (1:05 am) on 2 October 2019. Please note that it appears that two bats are calling in this recording.

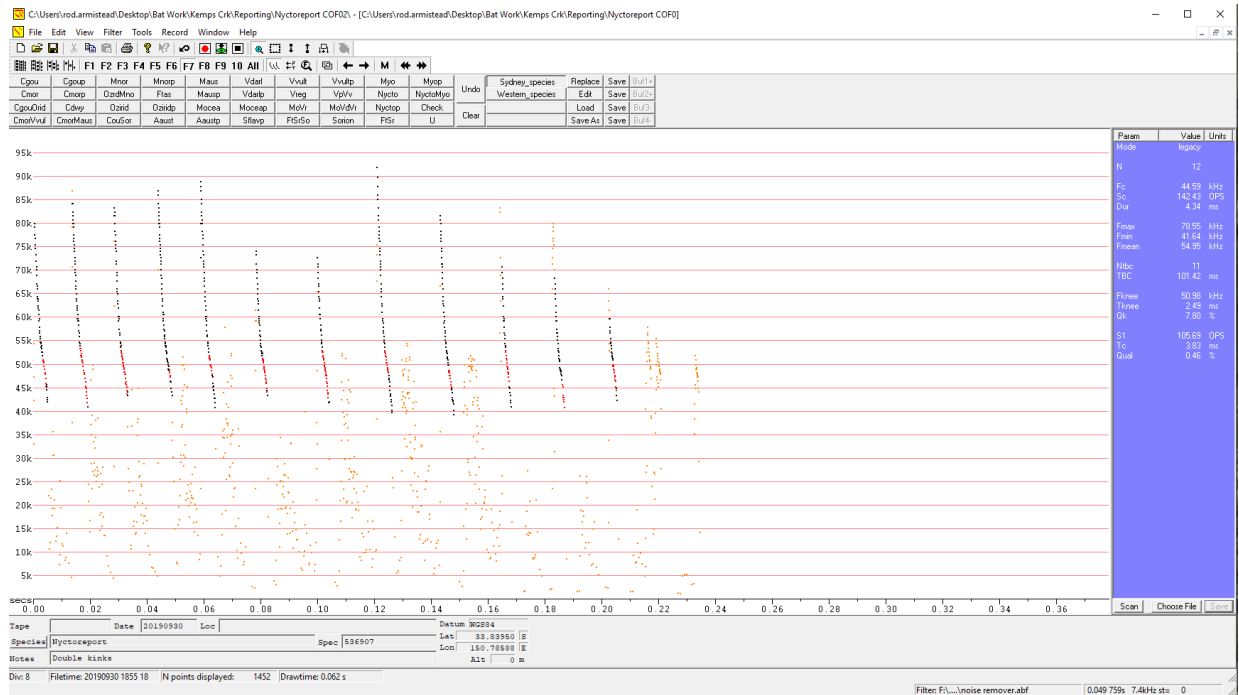


Figure 22. Call profile for either *Nyctophilus gouldii* (Gould's Long-eared Bat) / *Nyctophilus geoffroyi* (Lesser Long-eared Bat) recorded on COF02 at 1855 (6:55 pm) on 30 September 2019.

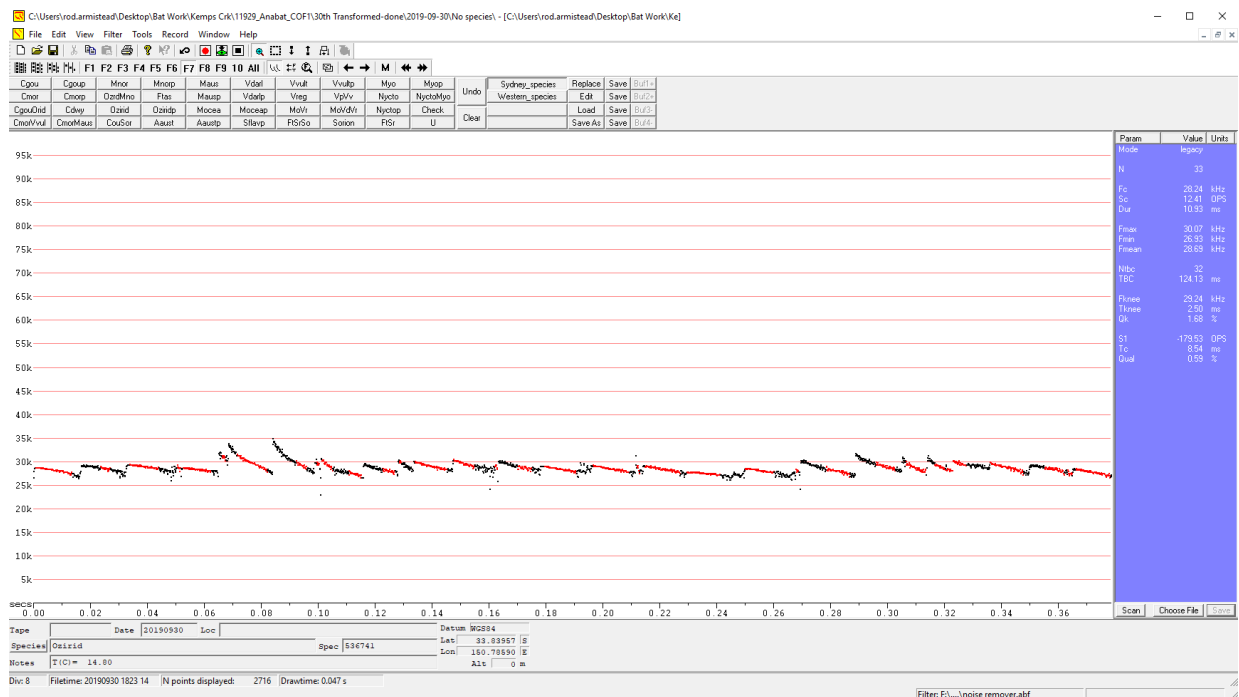


Figure 23. Call profile for *Ozimops ridei* (Ride's Free-tailed Bat) recorded on COF01 at 1823 (6:23 pm) on 30 September 2019.

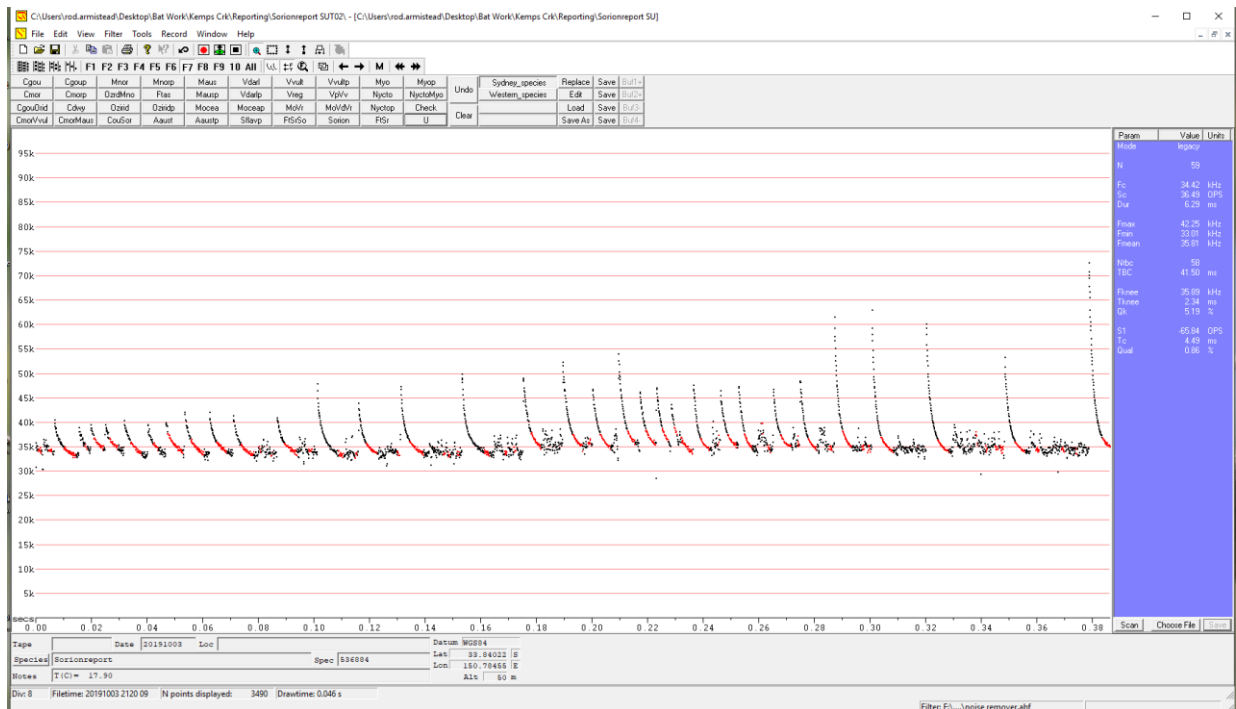


Figure 24. Potential Call profile for *Scotorepens orion* (Eastern Broad-nosed Bat) / recorded on COF02 at 2055 (8:55 pm) on 1 October 2019.

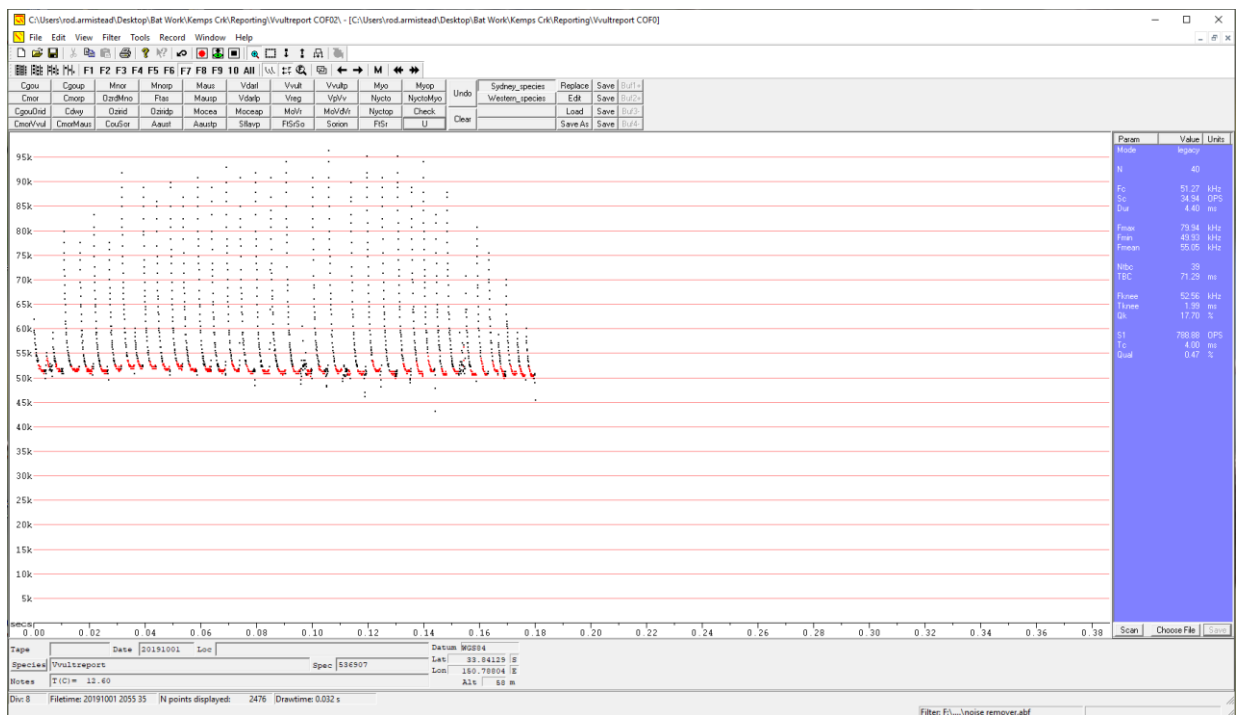


Figure 25. Call profile for *Vespadelus vulturinus* (Little Forest Bat) recorded on COF02 at 2055 (8:55 pm) on 1 October 2019.

Appendix E Plot photos



Plate 5: PCT 835 poor plot 1 start



Plate 6: PCT 835 poor plot 1 end



Plate 7: PCT 835 poor plot 2 start



Plate 8: PCT 835 poor plot 2 end



Plate 9: PCT 849 poor, plot 3 start



Plate 10: PCT 849 poor, plot 3 end



Plate 11: PCT 849 poor, plot 4 start



Plate 12: PCT 849 poor, plot 4 end



Plate 13: Plot 5 - no PCT assigned, pasture grasses



Plate 14: PCT 849 planted, plot 6 start



Plate 15: PCT 849 planted plot 6 end



Plate 16: Plot 7, no PCT assigned, pasture grasses

