



Peat Island Mooney Mooney Planning Proposal
Biodiversity Certification Assessment Report

Property & Development NSW

DOCUMENT TRACKING

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Template 2.8.1

Executive Summary

This Biodiversity Certification Assessment Report (BCAR) has been prepared by Eco Logical Australia Pty Ltd (ELA) to accompany a planning proposal by Property & Development NSW for the rezoning of a land parcel (the subject land) to align with the proposed concept plan for the redevelopment of Mooney Mooney and Peat Island.

Property & Development NSW propose to biodiversity certify those parts of the site that are proposed for development. These lands are proposed to be zoned R1 – General Residential, R2 – Low Density Residential, RE1 – Public Recreation, RE2 – Private Recreation, SP2 - Infrastructure and SP3 – Tourist. Additional lands are proposed for rezoning as E2- Environmental Conservation and are not proposed to be biodiversity certified.

In 2018, ELA prepared a Flora and Fauna Assessment to accompany the planning proposal, with the intention to prepare and submit a Biodiversity Development Assessment Report (BDAR) at the development application stage. However, Central Coast Council requested that a BCAR be submitted with the planning proposal, thereby finalising impact footprints and determining biodiversity offsets during the planning proposal stage. At the request of Central Coast Council, additional survey was undertaken for *Litoria aurea* (Green and Golden Bell Frog) and *Tyto novaehollandiae* (Masked Owl) to comply with State and Commonwealth guidelines. Neither of these species were recorded in the additional survey. A Riparian and Aquatic Constraints Assessment has also been prepared by ELA to be submitted with the planning proposal which addresses impacts associated with aquatic flora and fauna and the riparian zone.

This report has been prepared to meet the requirements of the Biodiversity Assessment Method established under Section 6.7 of the NSW *Biodiversity Conservation Act 2016* (BC Act) including minimum plot and threatened species surveys.

The following Plant Community Types (PCTs) were mapped in the subject land in various conditions:

- *PCT 1557 - Rough-barked Apple – Forest Oak – Grey Gum grassy woodland on sandstone ranges of the Sydney Basin*
- *PCT 1083 – Red Bloodwood – scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion*
- *PCT 1183 – Smooth-barked Apple – Sydney Peppermint – Turpentine heathy open forest on plateaux areas of the Sydney Basin Bioregion*
- *PCT 1232 – Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion*
- *PCT 1071 – Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion*
- *PCT 920 – Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion*

Part of PCT 1232 is consistent with the threatened ecological community *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*, listed as an endangered ecological community under the BC Act. Planted areas of PCT 1232 were not consistent

with the threatened ecological community. It is noted that this community is also listed as endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as *Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community*, however, this PCT within the biocertification area was not consistent with the Commonwealth listed community as it did not meet the condition thresholds required due to small patch sizes and low cover of native understorey (<20%).

PCT 1071 is consistent with the threatened ecological community *Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*, listed as endangered under the BC Act.

Five threatened microchiropteran bat species were positively identified during the bat call survey (*Chalinolobus dwyeri* (Large-eared Pied Bat), *Micronomus norfolkensis* (Eastern Coastal Freetail Bat), *Miniopterus australis* (Little Bentwing Bat), *Miniopterus schreibersii oceanensis* (Eastern Bentwing Bat) and *Myotis macropus* (Southern Myotis). One additional threatened microchiropteran bat, *Vespadelus troughtoni* (Eastern Cave Bat), could only be potentially identified due to similar call frequencies between other bats of the same genus, however, this species was later identified during the harp trapping survey and roost search. Large-eared Pied Bat, Southern Myotis and Eastern Cave Bat have been included as species credit species in the assessment. Little Bentwing Bat and Eastern Bentwing Bat are both ecosystem credit species and species credit species, however, no potential breeding habitat was identified as present within or adjacent to the biocertification area, therefore these species have only been assessed as ecosystem credit species. Eastern Coastal Freetail Bat is an ecosystem credit species only. Eastern Cave Bat was found to be roosting within buildings on Peat Island and on the mainland and the buildings provide potential breeding habitat for this species.

One other threatened fauna species, *Haliaeetus leucogaster* (White-bellied Sea-eagle) was recorded flying adjacent to the biocertification area. This species is both an ecosystem credit species and species credit species, however, this species was not nesting in the biocertification area and therefore species credits do not apply. No other threatened flora or fauna species were recorded during the field surveys. Suitable habitat is present in parts of the biocertification area for *Cercartetus nanus* (Eastern Pygmy Possum). This species has been assumed present in accordance with the BAM and included as a species credit species and will require offsets.

This BCAR outlines the measures taken to avoid, minimise and mitigate impacts on the vegetation and species habitat present within the biocertification area and measures to minimise impacts during construction and operation of the development. The biocertification area has taken into account advice provided by ELA during the design phase regarding impacts to vegetation and sensitive riparian areas. As a result, the biocertification area has been located to minimise impacts on riparian areas and avoid impacts to good condition native vegetation. A total of 10.96 ha of native vegetation will be protected within conservation zones in the north of the development site. This land is proposed to be zoned E2 - Environmental Conservation. 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 (BAMC).

A land-based marina (subject to a future planning proposal) is shown on the Indicative Concept Plan located on the foreshore of the Hawkesbury River adjacent to Peat Island. It does not form part of the

planning proposal and would be subject to a separate future planning proposal if it is to proceed. This would include a detailed environmental assessment of the impacts. Although it is intended to not require removal of *PCT 920 – Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion*, for the purposes of the BCAR, an impact area of 0.03 ha has been included as a precautionary measure.

A total of 50 ecosystem credits are required to offset the residual impacts of the proposed project. This has been outlined in the table below.

PCT ID	PCT Name	Condition	Vegetation Zone	Area (ha)	Vegetation Integrity Score	Credits
Ecosystem Credits						
1557	<i>Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin</i>	Moderate	2	0.53	63.7	13
1557	<i>Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin</i>	Gully Influence	3	0.26	38.2	4
1557	<i>Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin</i>	Poor	4	1.84	37.1	26
1557	<i>Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin</i>	Acacia Regrowth	5	0.17	8.9	0
1557	<i>Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin</i>	Planted	6	0.38	29.4	4
1232	<i>Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion</i>	Degraded	9	0.16	25.6	2
920	<i>Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion</i>	Moderate	12	0.03	47.2	1
				Total	3.37	50

In accordance with the BAM (Section 10.3.1.1), no ecosystem credits are required to be offset for the removal of 0.20 ha within vegetation zone 5. With a vegetation integrity score of 8.9, this is lower than the offsetting threshold of 20 for a PCT that is not representative of a threatened ecological community.

A total of 268 species credits are required to offset the residual impacts of the proposed project. This is outlined in the table below.

Species Name	Common Name	Direct Impact Area (ha)	Credits
Species Credits			
<i>Cercartetus nanus</i>	Eastern Pygmy Possum	0.52	17
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	3.37	96

Species Name	Common Name	Direct Impact Area (ha)	Credits
<i>Myotis macropus</i>	Southern Myotis	2.89	59
<i>Vespadelus troughtoni</i>	Little Cave Bat	3.37	96
		Total	268

The BCAR must also consider potential for 'serious and irreversible impacts' (SAII) on biodiversity values. Four candidate species for SAII were recorded in the development site: Large-eared Pied Bat, Little Bentwing Bat, Eastern Bentwing Bat and Eastern Cave Bat. Any impacts to these species within 100 m of breeding habitat must be assessed as a potential SAII. Breeding habitat is unlikely to occur within proximity to the development site for Little Bentwing Bat and Eastern Bentwing Bat, as only a small number of large maternity caves are known for these species. Considering the abundance of sandstone escarpment along the Hawkesbury River, potential breeding habitat for Large-eared Pied Bat is available within proximity to the development site, however, no potential breeding caves were recorded within 100 m of the biocertification area.

Potential breeding habitat was identified for Eastern Cave Bat within abandoned buildings in the biocertification area. Individuals were recorded within a building on Peat Island and within the nurses quarters during harp trapping surveys and roost searches. A maternal (lactating) female was caught flying out a building on Peat Island during the breeding season, and additional maternal females were recorded adjacent to buildings. It is considered that these buildings form part of the breeding habitat for this species in the locality. The proposed biocertification will result in the loss of two known roost sites in buildings and five additional potential roost sites in buildings. No permanent maternity roosts were evident in any buildings, these would have been indicated by a build-up of guano or deceased bats, however, it is noted that these buildings contain many cavities within the external and internal brick layers, which cannot be accessed for inspection and may contain additional roosts. A Microbat Management Plan (MMP) has been prepared to mitigate impacts to bats during construction works and to prevent and injury or death or disturbance during the breeding season. The MMP should be reviewed and revised at the development application (DA) stage when the final detailed design, construction details and timing is known for the repurposed buildings.

Property & Development NSW will offset the unavoidable impacts of development through the purchase and retirement of the above credits from the market, or via the Biodiversity Conservation Trust.

It is recommended that a Vegetation Management Plan be prepared at the DA stage to protect and enhance retained vegetation and riparian areas. Detailed design should include a biofiltration system to treat stormwater on site and prevent pollution of the adjacent Hawkesbury River.

Potential habitat was available in the development site for several threatened species listed under the EPBC Act including *Pteropus poliocephalus* (Grey-headed Flying-fox), *Anthochaera phrygia* (Regent Honeyeater), *Lathamus discolor* (Swift Parrot), *Numenius madagascariensis* (Eastern Curlew) and *Chalinolobus dwyeri* (Large-eared Pied Bat). The proposal is considered unlikely to significantly affect any Matter of National Environmental Significance listed under the EPBC Act. Therefore a referral to the Commonwealth is not recommended.

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Abbreviations

Abbreviation	Description
BAM	Biodiversity Assessment Method
BAMC	Biodiversity Assessment Method Credit Calculator
BC Act	NSW Biodiversity Conservation Act 2016

Abbreviation	Description
BCAR	Biodiversity Certification Assessment Report
BDAR	Biodiversity Development Assessment Report
BOS	Biodiversity Offsets Scheme
BSSAR	Biodiversity Stewardship Site Assessment Report
CMA	Catchment Management Authority
CMP	Conservation Management Plan
CEEC	Critically Endangered Ecological Community
DNG	Derived Native Grassland
DAWE	Commonwealth Department of Agriculture Water and Environment
DoEE	Commonwealth Department of Environment and Energy (now DAWE)
DPE	NSW Department of Planning and Environment
EEC	Endangered Ecological Community
ELA	Eco Logical Australia Pty Ltd
EP&A Act	NSW Environmental Planning and Assessment Act 1979
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
FM Act	NSW Fisheries Management Act 1994
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
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 Water Management Act 2000

1. Stage 1: Biodiversity assessment

1.1 Introduction

This Biodiversity Certification Assessment Report (BCAR) has been prepared by Mike Lawrie who is an Accredited Person (BAAS18162) under the NSW *Biodiversity Conservation Act 2016* (BC Act). The contents of this BCAR complies with the requirements outlined in Table 25 of the Biodiversity Assessment Methodology (BAM: Office of Environment and Heritage (OEH) now Department of Planning Industry and Environment (DPIE) 2017).

In July 2018, Eco Logical Australia Pty Ltd (ELA) prepared a Flora and Fauna Assessment (FFA) for Property & Development NSW to accompany a planning proposal for the rezoning of a NSW Government owned parcel of land at Mooney Mooney. It was intended that detailed assessment and reporting in the form of a Biodiversity Development Assessment Report (BDAR) be undertaken later at the development application stage. However, following review of the FFA, Central Coast Council requested that a Biodiversity Certification Assessment Report (BCAR), including the determination of biodiversity offset requirements in accordance with the Biodiversity Offsets Scheme (BOS), be submitted with the planning proposal. The area covered by the biodiversity certification proposal is hereafter referred to as the 'biocertification area'. This term is used to describe all areas directly impacted by the proposal.

Specific details of the BAM assessment and offsetting requirements are detailed in Section 1 and 2. The areas proposed for biocertification and those proposed for detailed assessment at a later stage are shown in Figure 1. The detailed Concept Plan is shown in Figure 2 and proposed zonings are shown in Figure 3.

A Riparian and Aquatic Constraints Assessment has also been prepared by ELA to accompany the planning proposal. The Riparian and Aquatic Constraints Assessment included mapping and discussion of riparian constraints.

Definitions relevant to this report are provided in Appendix A.

1.1.1 General description of the development site

The subject land is 34 ha in size, is located on the Mooney Mooney Peninsula within the Central Coast Council local government area, and is in the ownership of Property & Development NSW. The subject land in this report refers to the wider subject land, and is not confined to areas that will be impacted by the development. The subject land comprises a mixture of development, cleared land and native vegetation of varying quality within the subject site and surrounding lands. The biocertification area refers to the area that will be directly impacted by the proposal. The subject land encompasses the area covered by the planning proposal, which includes the following lots:

- Lot 7302 DP 1151629
- Lot 10, 11 & 12 DP 863305
- Lot 2 DP 431999
- Lot 7, 8 & 9 DP 1180499
- Lot 11, 12, 13 & 14 DP 1158746
- Lot 10 & 11 DP 1157280

- Lot 2 & 4 DP 239249
- Lot 1 DP 597504
- Lot 21 DP 836628
- Lot 1 DP 431780
- Lot 2 DP 1205588
- Lot 1 DP 945014
- Lot 7011 DP 1057994

The development site is adjacent to the Hawkesbury River. In addition to the river, only one mapped first order stream is present in the north-west of the development site, outside of the biocertification area.

Mangroves (*PCT 920 - Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion*) are present along most banks of the Hawkesbury River. Parts of the river in the west and south of the development site are also lined with seawalls, jetties and M1 bridge infrastructure. Small patches of *PCT 1232 Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion* and *PCT1071 Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion* are present adjacent to mangroves in low lying areas. Large areas in the west of the development site have been cleared and comprise exotic grassland. In the south-west and north-west of the site where the topography slopes upwards, Wet Sclerophyll Forest (*PCT 1557 - Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin*) is the dominant vegetation class. A large knoll in the north of the development site is comprised of Wet Sclerophyll Forest on the steep lower to mid slopes, the upper slopes and plateaux is comprised of Dry Sclerophyll Forest (*1083 - Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion*).

The majority of the biocertification area is located within the Erina erosional soil landscape. Higher elevation areas in the north of the development site are located within the Watagan colluvial landscape. These landscapes are characterised by Narrabeen Group sandstone and siltstone. Several large cliffs are present along the Hawkesbury River escarpment, adjacent to the development site. Sandstone outcrops and some small cliffs are present within the development site, however these are outside of the biocertification area.

Peat Island is present in the west of the development site, connected to the mainland by a single lane causeway. The island contains several abandoned buildings, planted vegetation and a small amount of native vegetation along the waters edge including Mangroves and Swamp Oak Floodplain Forest.

This report includes two base maps, the Site Map (**Figure 4**) and the Location Map (Figure 5).

1.1.2 Project Description

This Planning Proposal has been prepared on behalf of Property & Development NSW that seeks amendments to the Gosford Local Environmental Plan 2014 (GLEP 2014) for surplus Government owned land at Peat Island and Mooney Mooney (the Site).

The aim of the Planning Proposal is to facilitate the future redevelopment of the site, for a mix of residential, community, tourism and employment generating land uses.

This Planning Proposal was first submitted to Central Coast Council in November 2016. Gateway Determination was issued by the Department of Planning, Industry and Environment (DPIE) on 10 August 2017 (PP_2017_CCPAS_006_00 (17/06254). The Gateway Determination stated that while the supporting studies were sufficient, a number of conditions are required to be addressed prior to progressing the Planning Proposal further. Since August 2017, Property & Development NSW has undertaken a significant amount of consultation with public authorities and Central Coast Council (Council), including the submission of a revised Planning Proposal to Council in December 2018 for review and comments.

Post the 2018 submission, Property & Development NSW has engaged technical consultants to undertake further environmental investigations to respond to Council's and public authorities feedback.

The indicative Concept Plan has been revised in accordance with the additional technical investigations post 2018 submission. The revised indicative Concept Plan comprehensively evaluated the additional environmental and physical constraints, and responded to site's context, future amenity and connectivity.

The revised indicative Concept Plan is attached at Figure 2.

Lot 9 DP 863305 is excluded from the Planning Proposal, given it is under the care, control and management of Central Coast Council and will be retained as RE1 Public Recreation Zone. The indicative Concept Plan identifies a proposed Rural Fire Services (RFS) at this location. This RFS facility does not form part of this Planning Proposal, and is subject to further stakeholder consultation and a separate planning proposal.

The indicative Concept Plan also identifies a proposed location for a Marine Rescue NSW facility. This facility is subject to further stakeholder consultation and a separate proposal.

A land-based marina is shown on the Indicative Concept Plan located on the foreshore of the Hawkesbury River adjacent to Peat Island. It does not form part of the planning proposal and would be subject to a separate future planning proposal if it is to proceed. This would include a detailed environmental assessment of the impacts.

This part of the site is currently zoned partly RE1 Public Recreation and partly SP2 Infrastructure (for the purpose of hospital) under GLEP 2014, and is proposed to be rezoned to RE2 Private Recreational Zone. A car park is proposed to be an Additional Permitted Use under Schedule 1 of GLEP 2014 on a portion of the site as part of the Planning Proposal.

- This BCAR has been prepared based on the revised indicative Concept Plan and the draft LEP zoning maps. The Planning Proposal is seeking to amend the following provisions of the GLEP 2014: Amend Clause 2.1 Land Use Zones of the GLEP 2014 to include SP3 Tourist zone listed under Special Purpose Zones. The proposed SP3 Tourist Zone objectives and proposed permissible uses are consistent with the draft SP3 Tourist zone within the draft Consolidated Central Coast Consolidated Local Environmental Plan (CCLEP). Therefore, this Planning Proposal will be consistent with draft CCLEP, subject to gazettal.

- Amend the GLEP 2014 Land Zoning Map applicable to the site, and rezone SP2 Infrastructure and RE1 Public Recreation zones to E2 Environmental Conservation, R1 General Residential, R2 Low Density Residential, RE1 Public Recreation, RE2 Private Recreation, and SP3 Tourist zones.
- Amend the GLEP 2014 Height of Buildings Map to reflect the maximum height of the buildings proposed (8.5m, 12m and 15m) across selected areas of the site as indicated on the proposed Height of Buildings Map.
- Amend the GLEP 2014 Lot Size Map to allow minimum lots size of 150sqm, 220sqm, 300sqm and 450sqm across selected areas of the site as indicated on the proposed Minimum Lot Size Map.
- Amend the GLEP 2014 Additional Permitted Uses Map and amend the GLEP 2014 Schedule 1 Additional permitted uses to include the use of certain land at Mooney Mooney, including:
 - RE2 Private Recreation zoned land, being portion of Lot 11, DP 1157280 and Lot 12, DP 1158746 as identified on the Additional Permitted Uses Map.
 - To include 'car parks' as additional permitted use on this part of the site.
 - R1 General Residential zoned land, being the southern portion of Lot 14, DP1158746 as identified on the Additional Permitted Uses Map.
 - Development for the purposes of emergency services facility is permitted with development consent. The proposed emergency services facility is permissible with consent within the proposed R1 General Residential zone under the draft CCLEP. Therefore, this Planning Proposal will be consistent with draft CCLEP, subject to gazettal).
 - RE1 Public Recreational zoned land, being the southern portion of lot 4 DP239249 as identified on the Additional Permitted Uses Map.
 - Development for the purposes of emergency services facility is permitted with development consent. The proposed emergency services facility is permissible with consent within the proposed RE1 zone under the draft CCLEP. Therefore, this Planning Proposal will be consistent with draft CCLEP, subject to gazettal.
 - R1 General Residential zoned land, being the south eastern portion of lot 12, DP1158746 located along Peats Ferry Road, lot 12, DP863305 and the southernmost portion of lot 14DP1158746, as identified on the Additional Permitted Uses Map:
 - Development for the purpose of 'food and drink premises' and 'shops' are permitted with development consent.
 - The indicative Concept Plan comprises local shops/restaurants and cafes in the form of shop top housing within the Southern Foreshore precinct and the Chapel precinct, which has an area of approximately 200sqm. The proposed shops and food and drinks premises are of a scale that is better suited for this local area. Shops. Restaurants and cafes are prohibited under the R1 zone of the Gosford LEP and the draft CCLEP. Given the proposal no longer includes a service station and a neighbourhood centre, it is proposed to include food and drink premises and local shops to provide sufficient and much needed local retail services for exiting and incoming residents.
- RE1 Public Recreation zoned land, being Lot 11 DP863305 as identified on the Additional Permitted Uses Map.

- Development for the purpose of electricity generating works is permitted with development consent.

In addition, consistent with the recommendation of the CMP, this Planning Proposal includes the proposed LEP amendment to include Peat Island as an Item of Environmental Heritage (Item - General) under Part 1 - Heritage Items, Schedule 5 of the Gosford LEP.

The proposal will continue to contribute to a range of key economic and community benefits for the local community and wider Central Coast Local Government Area, including:

- Injection of capital investment into the economy from expenditure on housing, infrastructure services both internal and external to the site including road, energy services, water, sewer and communication works.
- Provision of more than **2.7 km** of foreshore access around Peat Island and along the river foreshore.
- Provision of up to **269** new dwellings to help meet regional housing needs.
- Preservation of the historical significance of Peat Island through the implementation of a Conservation Management Plan and the retention of 9 non-listed historical buildings on Peat Island for adaptive re-use.
- The retention of the Chapel to serve the local community.
- Protection of sensitive mangroves area, thus protecting natural attributes of the site and the visual aesthetics of the site.
- Dedication of **10.5 ha** of heavily vegetated land to be dedicated as Environmental Conservation area to conserve significant bushland in perpetuity.

Following our analysis of the site and its surrounding context, we are firmly of the view that there is clear planning merit to the Planning Proposal and the revised Planning Proposal has appropriately addressed agencies concerns and the Gateway Determination conditions.

1.1.3 Sources of information used

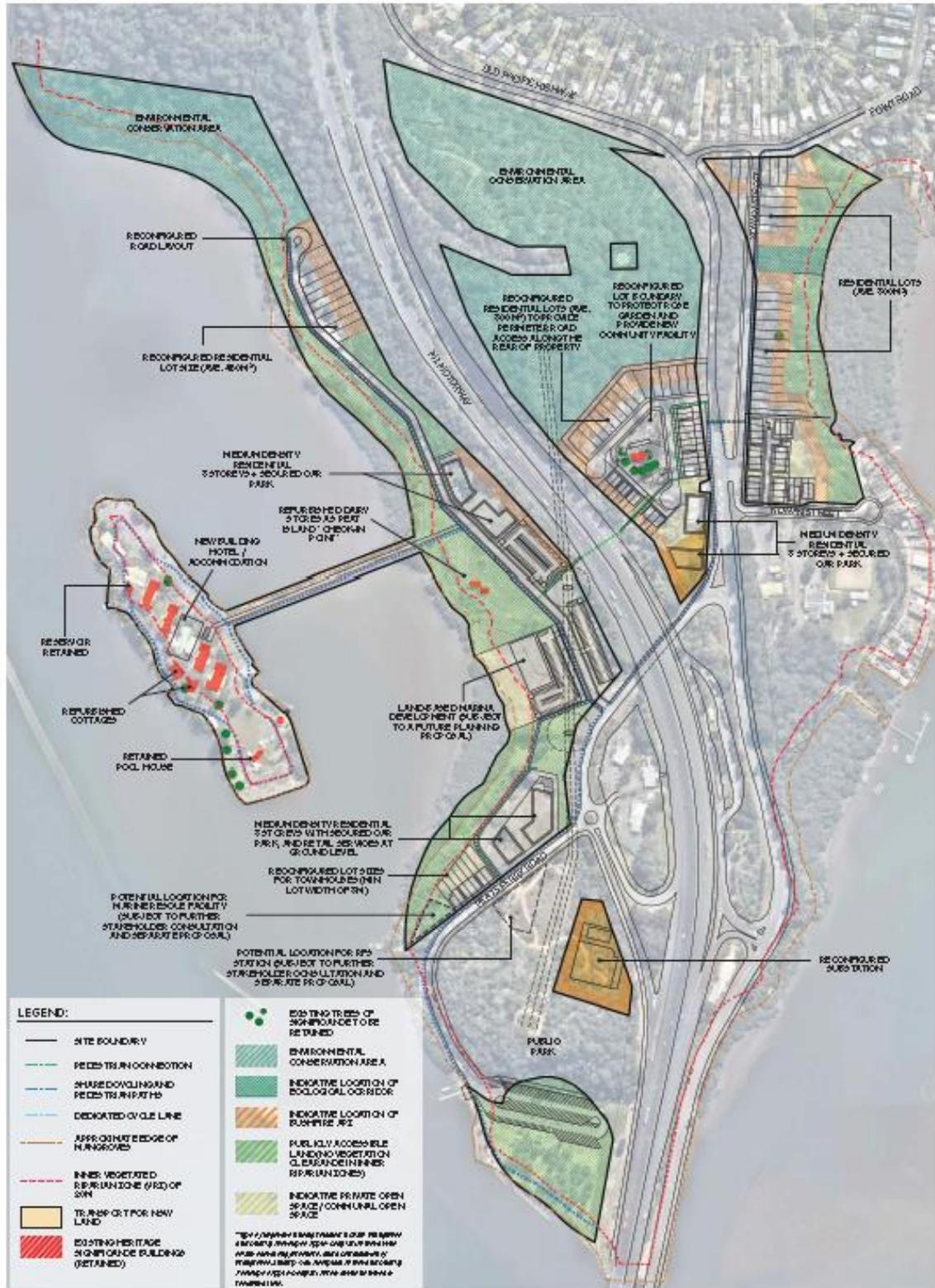
The following data sources were reviewed as part of this report:

- Biodiversity Assessment Methodology Calculator
- BioNet Vegetation Classification
- BioNet / Atlas of NSW Wildlife 5 km database search (DPIE 2020a)
- Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool (PMST) 5 km database search (Department of Agriculture Water (DAWE) 27 September 2020)
- Hunter Biometric Vegetation Layer (Department of the Environment and Climate Change (DECC) 2009).
- The Native Vegetation of the Sydney Metropolitan Area (OEH 2016)
- Aerial mapping (SIXMaps and Nearmap).
- Ecological Review of Concept Plan – Rezoning Proposal Mooney Mooney (Travers Bushfire & Ecology 2016).
- Additional Geographic Information System (GIS) datasets including soil, topography, geology and drainage

Biodiversity Certification Area Peats Island Mooney Mooney Planning Proposal

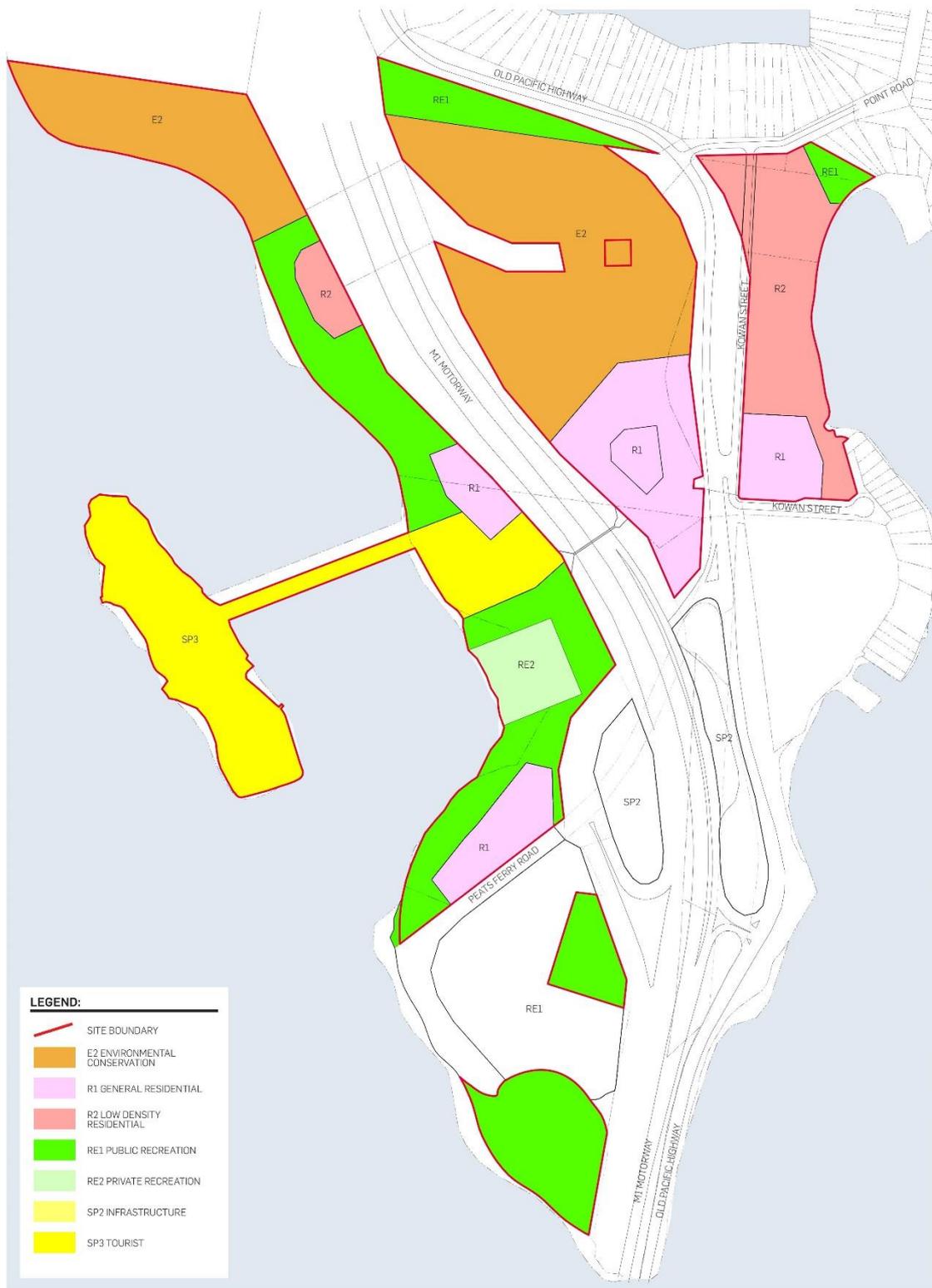


Figure 1: Land proposed for Biodiversity Certification



MOONEY MOONEY & PEAT ISLAND
FINAL CONCEPT PLAN

Figure 2: Concept Plan



MOONEY MOONEY & PEAT ISLAND
LEP PLANS - ZONING PLAN

DATE: 21.09.2020
 JOB NO: P0020554
 DWG NO: PP04
 REV: J

1:4000 @ A3
 0 50 100 150 200

Figure 3: Proposed Zoning Plan

Site Map

Peat Island Mooney Mooney Planning Proposal

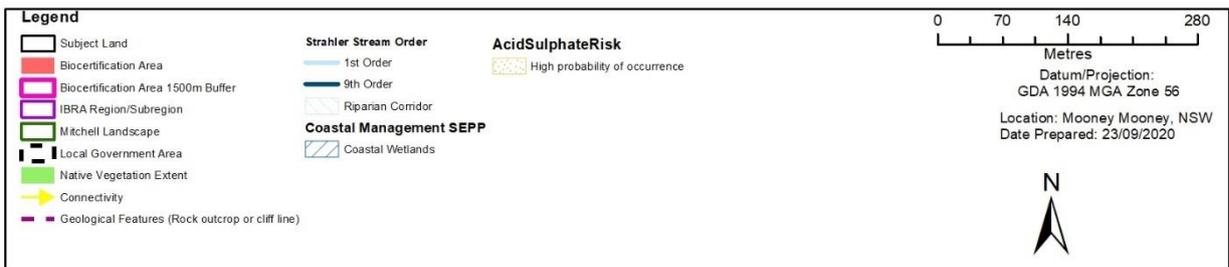


Figure 4: Site Map

Location Map **Peat Island Mooney Mooney Planning Proposal**

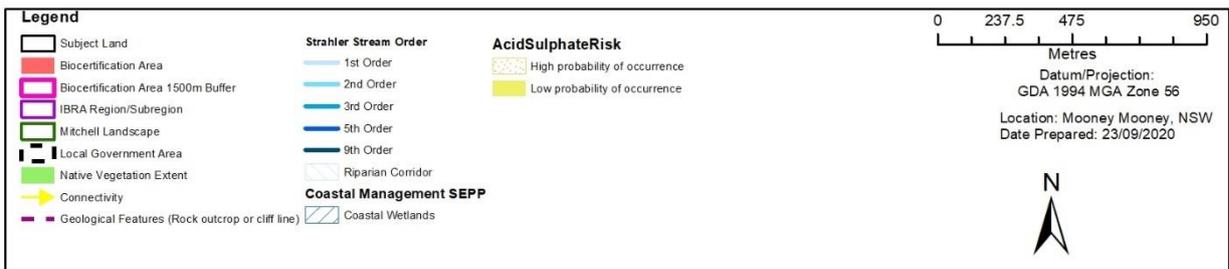
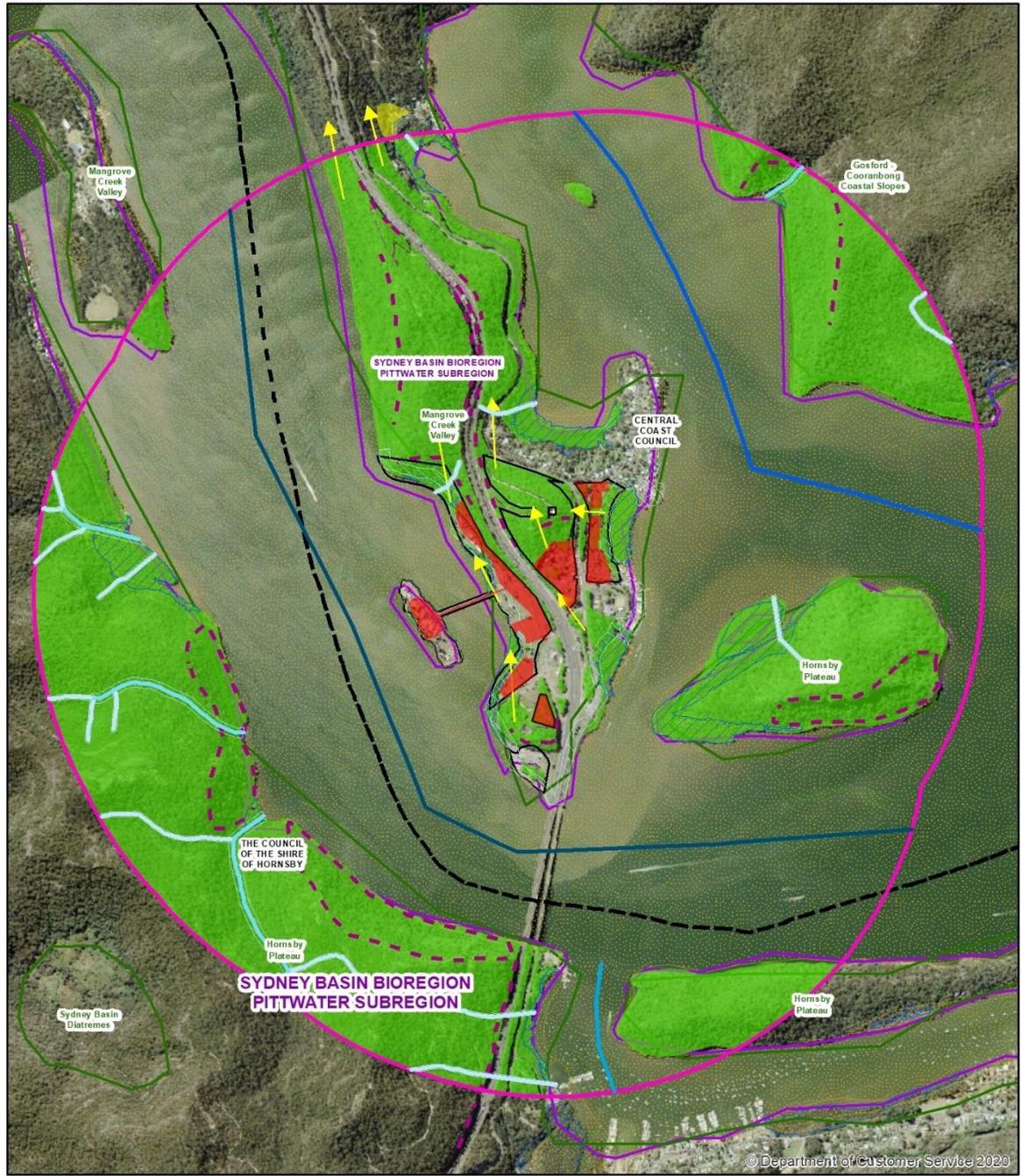


Figure 5: Location Map

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)	Matters of National Environmental Significance have been identified on or near the development site. Whilst a planning proposal is not considered an 'action' under the EPBC Act, it is prudent to consider EPBC matters early in the planning process. This report assesses impacts to MNES and concludes that the development is not likely to have a significant impact on MNES.	Section 3
State		
<i>Environmental Planning and Assessment Act 1979</i> (EP& A Act)	This planning proposal is to be submitted for Gateway Determination under s56 of the EP&A Act. This assessment has considered the Directions issued by the Minister for Planning to relevant planning authorities under section 9.1(2) of the EP&A Act.	All report
<i>Biodiversity Conservation Act 2016</i> (BC Act)	The BC Act (Part 8) and <i>Biodiversity Conservation Regulation 2017</i> provide the statutory requirements for Biodiversity Certification.	All report
<i>Fisheries Management Act 1994</i> (FM Act)	This report is for a Gateway Determination and therefore will not result in any direct impacts to matters addressed in the FM Act. If future development of the site involves harm to marine vegetation, a permit under s205 of the FM Act may be required. Permits in accordance with the FM Act may be required at the development application (DA) stage.	Riparian and Aquatic Constrains Assessment (separate report prepared by ELA)
<i>Water Management Act 2000</i> (WM Act)	The planning proposal does not involve works on waterfront land and therefore a Controlled Activity Approval under s91 of the WM Act is not required at this stage. However, future development of the site will involve works on waterfront land and may require a Controlled Activity Approval at the DA stage.	Riparian and Aquatic Constrains Assessment (separate report prepared by ELA)
Planning Instruments		
State Environmental Planning Policy (SEPP) (Coastal Management) 2018	Proposed future development of the development site will involve impacts to areas mapped as Coastal Wetlands, Coastal Wetlands Proximity Area and Coastal Use Area under SEPP (Coastal Management) 2018.	Section 3.2
State Environmental Planning Policy (Koala Habitat Protection) 2019 (effective 1 March 2020)	This SEPP aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas to support a permanent free-living population over their present range and reverse the current trend of koala population decline. The proposed biocertification is located within a local government area (LGA) to which the Koala Habitat Protection SEPP applies, and the development site is mapped on the Koala Development Application Map (accessed 22 September 2020). The development site also contained feed tree species such as <i>Eucalyptus punctata</i> (Grey Gum). While the Koala SEPP applies only to DAs (not biocertifications), the SEPP assessment is not technically required. However, the purpose of the biocertification is to assess all biodiversity related matters at the planning proposal stage, so that additional	Appendix F

Name	Relevance to the project	Report Section
	biodiversity assessment is not required at the DA stage. Therefore, this assessment has been included in the biocertification stage to avoid the requirement for future assessment of the SEPP during the DA stage.	
Sydney Environmental (SREP) No Hawkesbury-Nepean River	Regional Plan 20— This plan applies to certain land in the Greater Metropolitan Region that is within the following local government areas: Baulkham Hills, Blacktown, Blue Mountains, Camden, Campbelltown, Fairfield, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Liverpool, Penrith, Pittwater, Warringah, Wollondilly. It is note that the biocertification area is not within these listed LGAs, however, this SREP has been addressed at the request of DPIE. The aim of this plan is to protect the environment of the Hawkesbury-Nepean River system by ensuring that the impacts of future land uses are considered in a regional context.	Section 3.3

1.3 Landscape features

1.3.1 Interim Biogeographic Regionalisation for Australia (IBRA) regions and subregions

The entire development site falls within the IBRA region of Sydney Basin and subregion of Pittwater.

1.3.2 Native vegetation extent

The percent native vegetation and extent of native vegetation within the biocertification area and buffer is outlined in Table 2 and shown in **Figure 4** and **Figure 5**.

Table 2: Native vegetation extent

Area of native vegetation within the biocertification area (ha)	Area of native vegetation within the 1,500 m buffer area (ha)	Total area within the 1,500 m buffer area (ha)	Percent native vegetation over within the 1,500 m buffer area (ha)
3.37	418.14	1200.87	34.82

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

1.3.3 Patch size

Patch size was calculated using available vegetation mapping for all patches of intact native vegetation on and adjoining the development site. All vegetation within the development site is contiguous (i.e. within 100 m) and therefore considered part of the same patch. The patch within the development site is contiguous with extensive areas of vegetation outside of the development site. The patch size is >100 ha.

1.3.4 Rivers and streams

The development site contains rivers and streams as outlined in Table 3 and shown in **Figure 4** and **Figure 5**.

Table 3: Rivers and streams

River/stream	Order	Riparian buffer
Hawkesbury River	9	40 m
Tributary of Hawkesbury River	1	10 m

1.3.5 Wetlands

The development site contains the wetlands outlined in Table 4 and shown in **Figure 4** and **Figure 5**.

Table 4: Wetlands

Wetland name	Wetland type
SEPP (Coastal Management) 2018 – Coastal Wetland	Important Wetland
Freshwater Wetland	Local Wetland

1.3.6 Connectivity features

Northern areas of the development site are well connected to large areas of vegetation within the adjacent Popran National Park to the north. The southern parts of the development site are fragmented due to roads and cleared areas and have limited connectivity to more intact vegetation in the north. A narrow corridor of vegetation runs along the western edge of the M1 to the north of the development site. Narrow corridors of vegetation are located along the edges of the Hawkesbury River which provide connectivity along the waterfront throughout the majority of the development site.

Connectivity to the south of the development site is not available for species other than highly mobile species, as the only terrestrial crossing available for the Hawkesbury River is across the M1 Hawkesbury Bridge. Flyways for migratory birds are available adjacent to the development site along the Hawkesbury River. Connectivity has been mapped on **Figure 4** and **Figure 5**.

1.3.7 Areas of geological significance and soil hazard features

The development site contains areas of geological significance and soil hazard features as outlined below.

1.3.7.1 Soil-hazard features

The Hawkesbury River is mapped as having high probability of occurrence of acid sulphate soils. The majority of the development site does not contain acid sulphate soil risk.

1.3.7.2 Areas of geological significance

Several large cliffs are present along the Hawkesbury escarpment adjacent to the development site. Smaller cliff faces and rock outcrops are present within the development site, however, no significant rock features are present in the biocertification area. No significant caves were noted within 100 m of the biocertification area.

1.3.8 Method applied

The site based method has been applied to this development.

1.4 Native vegetation

1.4.1 Survey effort

The development site was traversed using the random meander method (Cropper 1993) to verify the presence of native vegetation and threatened ecological communities (TECs). Previous mapping undertaken by Travers (2016) and DECC (2009) was utilised for comparison during validation. Where the boundaries of vegetation communities differed from existing vegetation mapping, these were

modified on hard copy maps and marked with a hand-held Global Positioning System (GPS). Native vegetation communities were classified into Plant Community Types (PCTs) using the BioNet Vegetation Classification. PCTs were further delineated into different vegetation zones based on differing conditions of vegetation communities.

A total of 17 full-floristic and vegetation integrity plots were surveyed to identify PCTs and TECs on the development site in accordance with the BAM (Table 6). Sufficient plots were undertaken to satisfy minimum requirements of the BAM for the biocertification area. For the wider development site, minimum plot numbers are not required.

Details of survey dates, personnel and weather conditions are provided in Table 5. All field data collected at full-floristic and vegetation integrity plots is included in Appendix B.

Table 5: Vegetation survey effort and weather conditions

Date	Survey Task	Survey Effort (person hours)	Personnel	Temperature °C (Min)	Temperature °C (Max)	Max Wind Speed km/h	Rainfall (mm)
7/06/18	Vegetation validation and BAM plots	16 hours	Jennie Powell and Mitchell Scott	9.3	19.7	22	12
8/06/18	Vegetation validation and BAM plots	16 hours	Jennie Powell and Mitchell Scott	8.9	17.4	19	0
21/06/18	Vegetation validation and BAM plots	14 hours	Jennie Powell and Mike Lawrie	10.8	16.1	11	4.6
25/06/18	BAM plots	10 hours	Belinda Failles and Mike Lawrie	4.3	16.2	13	0
07/09/18	Aquatic vegetation validation, riparian corridor mapping	16 hours	Claire Wheeler and Ian Dixon	13.2	22.4	26	4.4
24/07/19	BAM plots	1 hour	Mike Lawrie and Stacey Wilson	6.5	20.1	37	0
06/07/20	BAM plots	2 hours	Mike Lawrie	5.6	17.6	15	0

Table 6: Vegetation integrity plots

Veg Zone	PCT ID	PCT Name	Condition	Total area (ha) within subject land	Area within biocertification area (ha)	Plots required	Plots surveyed	Plot No.
1.	1557	Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	Good	2.47	0	0	0	N/A Areas originally mapped as good condition in the biocertification area were determined moderate due to Veg Integrity Score
2	1557	Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	Moderate	0.85	0.53	1	2	Plot 2, Plot 3, Plot 8
3	1557	Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	Gully Influence	0.57	0.26	1	1	Plot 11
4	1557	Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	Poor Condition	4.29	1.84	1	2	Plot 13, Plot 15
5	1557	Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on	Acacia Regrowth	0.31	0.17	1	1	Plot 9

Veg Zone	PCT ID	PCT Name	Condition	Total area (ha) within subject land	Area within biocertification area (ha)	Plots required	Plots surveyed	Plot No.
		sandstone ranges of the Sydney Basin						
6	1557	Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	Planted	0.38	0.38	1	1	Plot 14
7	1083	Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	Intact	4.68	0	0	1	Plot 10
8	1183	Smooth-barked Apple - Sydney Peppermint - Turpentine heathy open forest on plateaux areas of the Sydney Basin Bioregion	Intact	1.41	0	0	1	Plot 1
9	1232	Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion	Degraded	0.86	0.16	1	1	Plot 5
10	1232	Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East	Planted	0.46	0	0	1	Plot 12

Veg Zone	PCT ID	PCT Name	Condition	Total area (ha) within subject land	Area within biocertification area (ha)	Plots required	Plots surveyed	Plot No.
		Corner Bioregion						
11	1071	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Degraded	0.07	0	0	1	Plot 6
12	920	Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Intact	1.11	0.03	1	1	Plot 4
13	N/A	Cleared/Exotic	Poor	16.15	9.76	0 – not required for exotic vegetation	3	Plot 7, Plot 16, Plot 17

1.4.2 Plant Community Types present

A total of six PCTs were identified on the development site (Table 7, Figure 19). Justification for the selection of PCTs occurring on the development site is based on a qualitative and quantitative analysis of full-floristic plot data and is provided in Table 8.

Table 7: Plant Community Types

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Total area within subject land (ha)	Area within biocertification area (ha)	Percent cleared
1557	Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	Northern Hinterland Wet Sclerophyll Forests	Wet Sclerophyll Forests (Grassy sub-formation)	8.87	3.19	35
1083	Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux	Sydney Coastal Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	4.68	0	17

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Total area within subject land (ha)	Area within biocertification area (ha)	Percent cleared
	of the Sydney Basin Bioregion					
1183	Smooth-barked Apple - Sydney Peppermint - Turpentine heathy open forest on plateaux areas of the Sydney Basin Bioregion	Sydney Coastal Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	1.41	0	30
1232	Swamp Oak floodplain forest, Sydney Basin Bioregion and South East Corner Bioregion	Coastal Swamp Forests	Forested Wetlands	1.32	0.16	95
1071	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Coastal Freshwater Lagoons	Freshwater Wetlands	0.07	0	75
920	Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Mangrove Swamps	Saline Wetlands	1.11	0.03	86
N/A	Exotic/Cleared	N/A	N/A	18.87	9.76	N/A

Table 8: PCT selection justification

PCT ID	PCT Name	Selection criteria / justification
1557	Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	This PCT encompasses the vegetation type previously mapped as Dharug Foothills Apple-Redgum Forest. Hunter Central Rivers (HCR) Biometric mapping assigned this community to the Biometric Vegetation Type to Rough-barked Apple - Grey Gum grassy open forest of the hinterland hills of the Central Coast, Sydney Basin Bioregion. The equivalent PCT for this Biometric type is PCT 1385 - <i>Rough-barked Apple - Grey Gum grassy open forest of the hinterland hills of the Central Coast, Sydney Basin Bioregion</i> . Plot data was run through the BioNet quantitative analysis tool for two different plots in this community which both contained a higher number of diagnostic species for PCT 1557 than for PCT 1385. According to the BioNet Vegetation Classification, both PCTs are essentially the same, except PCT

PCT ID	PCT Name	Selection criteria / justification
		<p>1385 contains <i>Eucalyptus globoidea</i> (White Stringybark), which was not recorded in the subject land. Furthermore, according to BioNet, the distribution of PCT 1385 is restricted to Mangrove Creek Catchment and Dharug National Park. The subject land does not fall within these areas. Therefore, it was considered that this community is most consistent with PCT 1557.</p> <p>Dominant canopy species within this community include <i>Eucalyptus punctata</i> (Grey Gum) and <i>Angophora floribunda</i> (Rough-barked Apple). <i>Corymbia gummifera</i> (Red Bloodwood) also occurs commonly. Additional diagnostic species recorded in this PCT in the subject land include <i>Allocasuarina torulosa</i> (Forest Oak), <i>Glochidion ferdinandi</i> (Cheese Tree), <i>Breynia oblongifolia</i> (Coffee Bush), <i>Bursaria spinosa</i> subsp. <i>spinosa</i> (Blackthorn), <i>Themeda triandra</i> (Kangaroo Grass), <i>Imperata cylindrica</i> (Blady Grass), <i>Brunoniella australis</i> (Blue Trumpet) and <i>Lepidosperma laterale</i>.</p>
1083	Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	<p>HCR Biometric mapping previously assigned this community to the Biometric vegetation type Red Bloodwood – scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion. A quantitative analysis of plot data in BioNet found this community had 11 species in common with PCT 1912 - <i>Smooth-barked Apple - Yellow Bloodwood - Grey Gum open forest on sandstone slopes along the Hawkesbury River</i> and nine species in common with PCT 1083. It was determined that the community is more consistent with PCT 1083 due to the presence of <i>Eucalyptus piperita</i> (Sydney Peppermint) and absence of <i>Corymbia eximia</i> (Yellow Bloodwood), which is described as dominating the canopy in PCT 1912.</p> <p>The canopy consists of <i>Angophora costata</i> (Smooth-barked Apple), <i>Corymbia gummifera</i> (Red Bloodwood) and <i>Eucalyptus piperita</i> (Sydney Peppermint). The mid-storey is dominated by <i>Banksia serrata</i> (Old Man Banksia) and contains several additional diagnostic species including <i>Acacia ulicifolia</i> (Prickly Moses), <i>Dillwynia retorta</i>, <i>Lambertia formosa</i> (Mountain Devil) and <i>Persoonia linearis</i> (Narrow-leaved Geebung). The groundcover is dominated by the diagnostic species <i>Entolasia stricta</i> (Wiry Panic) and contains several other diagnostic species including <i>Lomandra glauca</i> (Pale Mat-rush) and <i>Platysace linearifolia</i>.</p>
1183	Smooth-barked Apple - Sydney Peppermint - Turpentine heathy open forest on plateau areas of the Sydney Basin Bioregion	<p>The north-west of the subject land adjacent to Popran National Park has been previously mapped as Dharug Foothills Apple-Redgum Forest (PCT 1385), however, a BAM plot in this area found the vegetation was not consistent with other areas mapped as Dharug Foothills Apple-Redgum Forest (which has been assigned to PCT 1557). The plot data was run through the BioNet Vegetation Classification tool which determined the community was most consistent with PCT 1183. This vegetation type has been previously mapped by HCR Biometric Mapping approximately 300 m to the north and west of the plot location and has been extensively mapped in the area on slopes adjacent to the Hawkesbury River. Within the Hawkesbury Nepean</p>

PCT ID	PCT Name	Selection criteria / justification
		<p>Catchment Management Authority (CMA), this PCT encompasses the TEC Sydney Turpentine-Ironbark Forest.</p> <p>The canopy consists of <i>Eucalyptus piperita</i> (Sydney Peppermint), <i>Angophora costata</i> (Smooth-barked Apple) and <i>Corymbia gummifera</i> (Red Bloodwood). Additional diagnostic species recorded include <i>Persoonia linearis</i> (Narrow-leaved Geebung), <i>Lepidosperma laterale</i>, <i>Lomandra longifolia</i> (Spiny-headed Mat-rush) and <i>Pteridium esculentum</i> (Bracken).</p>
1232	Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion	This community was highly degraded and was characterised by a canopy of <i>Casuarina glauca</i> (Swamp Oak) with a predominantly exotic understorey. Due to the high level of modification and lack of species diversity, accurate quantitative floristic analysis could not be undertaken. This PCT was assigned based on previous mapping, the dominance of <i>C. glauca</i> in the canopy and the position on the landscape in low-lying, waterlogged areas adjacent to the Hawkesbury River.
1071	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	A small patch of this PCT occurs within waterlogged soils landward from the mangroves. This PCT is dominated by dense stands of <i>Typha orientalis</i> (Broad-leaf Cumbungi) and low abundance of other native species with a preference for wet habitats including <i>Juncus usitatus</i> , <i>Persicaria decipiens</i> (Slender Knotweed) and <i>Alternanthera denticulata</i> (Lesser Joyweed). This PCT has been classified based on the BioNet Vegetation Classification descriptive attributes and landscape position which describes the PCT as occurring in “man-made water bodies, drainage lines and depressions across a wide variety of environments”. This PCT is most consistent with vegetation in the subject land.
920	Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Mangroves are present in several areas along of the banks of the Hawkesbury River. This community consists almost entirely of <i>Avicennia marina</i> var. <i>australasica</i> (Grey Mangrove). Groundcover and native understorey is sparse within Mangrove Forest, species present include <i>Tetragonia tetragonioides</i> (New Zealand Spinach).

1.4.3 Vegetation Zones

A description of vegetation zones is provided below.

VEGETATION ZONE 1	
PCT #	1557
PCT Name	Rough-barked Apple – Forest Oak – Grey Gum grassy woodland on sandstone ranges of the Sydney Basin
Condition	Good
TEC	No
Direct impact area (ha)	0
Plots	0
Vegetation Integrity Score	N/A – not required for vegetation zones outside impact area
Description / Justification	This zone is in good condition and dominated by native species in all stratum. Minimal weed incursion is present, those areas affected are generally located near tracks or edges. The canopy is dominated by <i>Eucalyptus punctata</i> (Grey Gum) and <i>Angophora floribunda</i> (Rough-barked Apple). The mid-storey is dominated by <i>Allocasuarina torulosa</i> (Forest Oak), <i>Allocasuarina littoralis</i> (Black Sheoak), <i>Alphitonia excelsa</i> (Red Ash) and <i>Pittosporum undulatum</i> (Sweet Pittosporum). The shrub layer is dominated by <i>Acacia longissima</i> (Long-leaf Wattle). The groundcover is dominated by <i>Lomandra longifolia</i> (Spiny-headed Mat-rush), <i>Entolasia marginata</i> (Bordered Panic) and <i>Entolasia stricta</i> (Wiry Panic). Weeds present include <i>Olea europaea</i> subsp. <i>cuspidata</i> (African Olive) and <i>Lantana camara</i> (Lantana).



Figure 6: Zone 1 - PCT 1557 - Good Condition

VEGETATION ZONE 2

PCT # 1557

PCT Name Rough-barked Apple – Forest Oak – Grey Gum grassy woodland on sandstone ranges of the Sydney Basin

Condition Moderate

TEC No

Direct impact area (ha) 0.53

Plots 2

Vegetation Integrity Score 63.7

Description / Justification This zone is in moderate condition. The understorey appears to have been previously cleared and is predominantly regenerating with natives, however, there is a moderate level of weed incursion. The canopy is dominated by *Eucalyptus punctata* (Grey Gum) and *Angophora floribunda* (Rough-barked Apple). The mid-storey is dominated by *Allocasuarina littoralis* (Black Sheoak), *Glochidion ferdinandi* (Cheese Tree), *Pittosporum undulatum* (Sweet Pittosporum) and *Angophora bakeri* (Narrow-leaved Apple). In the west of the subject land the shrub layer is dominated by regrowth *Kunzea ambigua* (Tick Bush). Other commonly occurring shrubs include *Breynia oblongifolia* (Coffee Bush), *Acacia longissima*, (Long-leaf Wattle) and *Dodonaea triquetra* (Large-leaf Hop-bush). The groundcover is dominated by *Imperata cylindrica* var. *major* (Blady Grass), *Cymbopogon refractus* (Barbed Wire Grass) and *Entolasia stricta* (Wiry Panic). *Lantana camara* (Lantana) is prevalent in some parts of this zone.



Figure 7: Zone 2 - PCT 1557 - Moderate Condition

VEGETATION ZONE 3

PCT # 1557

PCT Name Rough-barked Apple – Forest Oak – Grey Gum grassy woodland on sandstone ranges of the Sydney Basin

Condition Gully Influence

TEC No

Direct impact area (ha) 0.26

Plots 2

Vegetation Integrity Score 38.2

Description / Justification This vegetation zone is present in the east of the subject land and is distinguished from other zones within the same PCT due to the gully influence and dominance of species favouring wetter habitat. The canopy is dominated by large, sparsely distributed *Eucalyptus punctata* (Grey Gum). A thick mid-storey dominated by *Glochidion ferdinandi* (Cheese Tree) is present. Other mid-storey species include *Elaeocarpus reticulatus* (Blueberry Ash) and *Pittosporum undulatum* (Sweet Pittosporum). The shrub layer is dominated by the exotic *Ligustrum sinense* (Small-leaf Privet) and other invasive species including *Lantana camara* (Lantana), *Ochna serrulata* and *Hedychium gardnerianum* (Wild Ginger).



Figure 8: Zone 3 - PCT 1557 – Gully Influence

VEGETATION ZONE 4

PCT # 1557

PCT Name Rough-barked Apple – Forest Oak – Grey Gum grassy woodland on sandstone ranges of the Sydney Basin

Condition Poor Condition

TEC No

Direct impact area (ha) 1.66

Plots 2

Vegetation Integrity Score 37.1

Description / Justification This zone is located in proposed residential areas to the east of the M1 at the bottom of Tank Hill, in proposed residential areas in the north of Deerubbin Reserve. This zone is characterised by a native canopy dominated by *Eucalyptus punctata* (Grey Gum) and *Angophora floribunda* (Rough-barked Apple) with a highly degraded understorey. Parts of this zone, particularly on Deerubbin Reserve are characterised by younger regrowth vegetation. The mid-storey is dominated by *Glochidion ferdinandi* (Cheese Tree). *Pittosporum undulatum* (Sweet Pittosporum) and *Allocasuarina littoralis* (Black She Oak) also occur less commonly. The exotic *Erythrina x sykesii* (Coral Tree) is also prominent in areas of this zone. The shrub layer is dominated by *Lantana camara* (Lantana). Other prominent exotic species include *Asparagus aethiopicus* (Ground Asparagus), *Ipomoea indica* (Coastal Morning Glory), *Olea europaea* subsp. *cuspidata* (African Olive) and *Ochna serrulata*. Commonly occurring native groundcovers include *Imperata cylindrica* (Blady Grass) and *Lomandra longifolia* (Spiny-headed Mat-rush).



Figure 9: Zone 4 - PCT 1557 – Poor Condition

VEGETATION ZONE 5

PCT # 1557

PCT Name Rough-barked Apple – Forest Oak – Grey Gum grassy woodland on sandstone ranges of the Sydney Basin

Condition Acacia Regrowth

TEC No

Direct impact area (ha) 0.17

Plots 1

Vegetation Integrity Score 8.9

Description / Justification This zone is highly degraded and contains few characteristics consistent with PCT 1557, however it has been classified as this PCT due to the dominant canopy species *Acacia implexa* (Hickory Wattle), which is likely a regrowth of the original PCT. *Eucalyptus punctata* (Grey Gum) and the exotic *Pinus radiata* (Radiata Pine) occur very infrequently in this zone to the east of the M1. The understorey is dominated by *Lantana camara* (Lantana). Limited native mid-storey and understorey species are also present including *Pittosporum undulatum* (Sweet Pittosporum) and *Glochidion ferdinandi* (Cheese Tree).



Figure 10: Zone 5 - PCT 1557 – Acacia Regrowth

VEGETATION ZONE 6

PCT # 1557

PCT Name Rough-barked Apple – Forest Oak – Grey Gum grassy woodland on sandstone ranges of the Sydney Basin

Condition Planted

TEC No

Direct impact area (ha) 0.38

Plots 1

Vegetation Integrity Score 29.4

Description / Justification This zone consists of native canopy species in planted or landscaped areas and a generally cleared or exotic understorey. The canopy is dominated by *Corymbia maculata* (Spotted Gum), and *Eucalyptus pilularis* (Blackbutt) in some areas. Several species do not typically occur naturally in PCT 1557, however it is required that native vegetation be assigned a PCT. It is likely that PCT 1557 was previously present where this planted vegetation is currently located. Scattered *Eucalyptus punctata* (Grey Gum) are present in this zone. Some native resilience is also present in the understorey with *Allocasuarina torulosa* (Forest Oak), *Glochidion ferdinandi* (Cheese Tree), *Breynia oblongifolia* (Coffee Bush) and *Microlaena stipoides* (Weeping Meadow Grass) present in low abundance. Weeds are prevalent in this community including *Eragrostis curvula* (African Love Grass) and *Lantana camara* (Lantana).



Figure 11: Zone 6 - PCT 1557 – Planted

VEGETATION ZONE 7

PCT # 1083

PCT Name Red Bloodwood – scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion

Condition Good

TEC No

Direct impact area (ha) 0

Plots 1

Vegetation Integrity Score N/A – not required for vegetation zones outside impact area

Description / Justification This community is found on the upper slopes and plateau of Tank Hill to the east of the M1. This zone is in good condition with generally limited disturbance and weed incursion. The canopy is dominated by *Angophora costata* (Smooth-barked Apple) and *Corymbia gummifera* (Red Bloodwood). The mid-storey is dominated by *Allocasuarina littoralis* (Black Sheoak) and *Banksia serrata* (Old Man Banksia). A diverse shrub layer is present; dominant species are *Lambertia formosa* (Mountain Devils), *Leptospermum polygalifolium* subsp. *polygalifolium* (Lemon-scented Tea-tree), *Acacia ulicifolia* (Prickly Moses) and *Grevillea sericea*. The groundcover is dominated by *Xanthorrhoea arborea*, *Lomandra glauca* (Pale Mat-rush), *Entolasia stricta* (Wiry Panic) and *Entolasia marginata* (Bordered Panic).



Figure 12: Zone 7 - PCT 1083 – Good Condition

VEGETATION ZONE 8

PCT # 1183

PCT Name Smooth-barked Apple – Sydney Peppermint – Turpentine heathy open forest on plateau areas of the Sydney Basin Bioregion

Condition Good

TEC No

Direct impact area (ha) 0

Plots 1

Vegetation Integrity Score N/A – not required for vegetation zones outside impact area

Description / Justification This vegetation zone is present in the north-west corner of the subject land adjacent to Popran National Park on a steep, sheltered slope. This zone is in good condition with generally limited disturbance and weed incursion. The canopy is dominated by *Eucalyptus piperita* (Sydney Peppermint), *Angophora costata* (Smooth-barked Apple) and *Corymbia gummifera* (Red Bloodwood). The shrub layer is dominated by *Monotoca elliptica* (Tree Broom-heath). The understorey is dominated by fern species *Blechnum cartilagineum* (Gristle Fern) and *Pteridium esculentum* (Bracken). Other common groundcovers include *Lepidosperma laterale*, *Xanthorrhoea arborea*, *Calochlaena dubia* (Rainbow Fern) and *Themeda triandra* (Kangaroo Grass). Vines and climbers are also prominent in this zone including *Cissus hypoglauca* (Water Vine), *Pandorea pandorana* (Wong Wonga Vine) and *Smilax glyciphylla* (Sweet Sarsaparilla).



Figure 13: Zone 8 - PCT 1183 – Good Condition

VEGETATION ZONE 9

PCT # 1232

PCT Name Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion

Condition Degraded

TEC BC Act: Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (EEC)

Direct impact area (ha) 0.16

Plots 1

Vegetation Integrity Score 25.6

Description / Justification It is likely that this vegetation type covered larger areas of the floodplain in the east of the site, however, past clearing has reduced patches to narrow strips of degraded vegetation. The canopy consists almost entirely of *Casuarina glauca* (Swamp Oak). The exotic *Populus* sp. (Poplar) is present in some patches. The mid-storey contains some natives including *Glochidion ferdinandi* (Cheese Tree). The shrub layer consists of the exotic *Lantana camara* (Lantana). The ground layer is disturbed by invasive exotic species, however, several native species are present including *Commelina cyanea* (Scurvy Weed), *Cynodon dactylon* (Common Couch) and *Cayratia clematidea* (Native Grape). Common exotic species in the understorey include *Chloris gayana* (Rhodes Grass), *Asparagus aethiopicus* (Ground Asparagus) and *Ehrharta erecta* (Panic Veldt Grass).



Figure 14: Zone 9 - PCT 1232 - Degraded

VEGETATION ZONE 10

PCT # 1232

PCT Name Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion

Condition Planted

TEC No

Direct impact area (ha) 0

Plots 1

Vegetation Integrity Score 18.2

Description / Justification This zone comprises native plantings representative of this PCT. The canopy is composed of juvenile *Casuarina glauca* (Swamp Oak). A patch in the east of the subject land also contains planted *Allocasuarina littoralis* (Black Sheoak) in the canopy. The patch in the east of the subject land contains a mid-storey dominated by *Acacia saligna* (Golden Wreath Wattle). The groundcover is dominated by exotic species *Eragrostis curvula* (African Lovegrass) and *Hyparrhenia hirta* (Coolatai Grass).



Figure 15: Zone 9 - PCT 1232 - Planted

VEGETATION ZONE 11

PCT # 1071

PCT Name Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion

Condition Moderate

TEC BC Act: Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (EEC)

Direct impact area (ha) 0

Plots 1

Vegetation Integrity Score N/A – not required for vegetation zones outside impact area

Description / Justification Consists predominantly of *Phragmites australis* (Common Reed) and other native aquatic species including *Juncus kraussii* subsp. *australiensis*, *Juncus usitatus* and *Alternanthera denticulata* (Lesser Joyweed). No tree or shrub layer is present in this community, however, there was evidence of regrowth stems of native trees is present including *Glochidion ferdinandi* (Cheese Tree), *Casuarina glauca* (Swamp Oak) and *Pittosporum undulatum* (Sweet Pittosporum). Exotic species present include *Lantana camara* (Lantana), *Pennisetum clandestinum* (Kikuyu) and *Senecio madagascariensis* (Fireweed).



Figure 16: Zone 11 - PCT 1071 - Moderate

VEGETATION ZONE 12

PCT # 920

PCT Name Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion

Condition Good

TEC No

Direct impact area (ha) 0.03*

Plots 1

Vegetation Integrity Score 47.2

Description / Justification Consists almost entirely of *Avicennia marina var. australasica* (Grey Mangrove). Limited native understorey is present in this community, generally present where mangroves intergrade with other communities. Species include *Tetragonia tetragonioides* (New Zealand Spinach), and *Juncus usitatus*. Exotic species also occurred in intergrade areas including *Eragrostis curvula* (African Lovegrass) and *Lantana camara* (Lantana).



Figure 17: Zone 12 - PCT 920 - Good

*Although it is intended to not require removal of PCT 920 – *Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion*, for the purposes of the BCAR, an impact area of 0.03 ha has been included as a precautionary measure.

VEGETATION ZONE 13

PCT # N/A

PCT Name Cleared/Exotic

Condition Moderate

TEC No

Direct impact area (ha) 9.76

Plots 3

Vegetation Integrity Score N/A

Description / Justification Cleared/Exotic vegetation comprises the majority of the subject land. Vegetation is characterised by disturbed grasslands, weeds and exotic plantings. Dominant species in these areas include *Ehrharta erecta* (Panic Veldt Grass), *Eragrostis curvula* (African Lovegrass), *Plantago lanceolata* (Plantain), *Sida rhombifolia* (Paddy's Lucerne), *Senecio madagascariensis* (Fireweed) and seeded *Cynodon dactylon* (Common Couch). While *Cynodon dactylon* is a listed native species, in this context it was seeded or resulting from weed incursion and did not form part of a PCT or Derived Native Grassland. Some areas contained sporadic regrowth native shrubs and groundcover species, however, these areas were too degraded and contained too little native vegetation to be considered part of any PCT zone.



Figure 18: Zone 13 – Cleared/Exotic

1.4.4 Threatened Ecological Communities present

Of the six PCTs recorded in the subject land, two are listed TECs under the BC Act (Table 9, Figure 21). No PCTs were consistent with TECs listed under the EPBC Act. PCT 1232 is associated with *Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community*, listed as an EEC under the BC Act. However, due to the small patch sizes of this PCT within the biocertification area (<0.5 ha), and degraded condition, this PCT was not consistent with the EPBC Act listed community.

Table 9: Threatened Ecological Communities

PCT ID	BC Act			EPBC Act		
	Associated TEC / justification	Listing status	Impact Area (ha)	Associated TEC / justification	Listing status	Impact Area (ha)
1557	No associated TEC	N/A	N/A	No associated TEC	N/A	N/A
1083	No associated TEC	N/A	N/A	No associated TEC	N/A	N/A
1183	Sydney-Turpentine Ironbark Forest This PCT is associated with this TEC listed as a CEEC under the BC Act, however, the subject land is outside the geographic range of occurrence for this TEC.	N/A - not consistent with TEC	N/A	Turpentine-Ironbark Forest in the Sydney Basin Bioregion Subject land is outside the geographic range of occurrence of this TEC.	N/A not consistent with TEC	N/A
1232	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions Zone 9 – PCT 1232 – Degraded is consistent with this TEC. It is noted that Zone 10 is mapped as the same PCT – however, consists of planted <i>Casuarina glauca</i> (Swamp Oak) with a degraded/exotic understorey on modified/landscaped soils and is not a remnant of the TEC.	EEC	0.16	Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community The vegetation within the biocertification area does not meet the condition threshold for the EPBC listed TEC as all patches present are smaller than 0.5 ha.	Not consistent with TEC	N/A
1071	Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions PCT 1071 within the subject land is consistent with this TEC	EEC	0	No associated TEC	N/A	N/A
920	Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions PCT 920 was not consistent with this TEC due to the dominance of mangroves and lack of diagnostic	N/A - not consistent with TEC	N/A	Subtropical and Temperate Coastal Saltmarsh PCT 920 was not consistent with this TEC due to the lack of diagnostic saltmarsh	N/A - not consistent with TEC	N/A

PCT ID	BC Act	EPBC Act
	saltmarsh species within the community.	species within the community.

1.4.5 Vegetation integrity assessment

A vegetation integrity assessment using the BAM Credit Calculator (BAMC) was undertaken for the impacted vegetation zones and the results are outlined in Table 10. Vegetation integrity for the vegetation zones outside of the biocertification area have not been included.

Table 10: Vegetation integrity

Veg Zone	PCT ID	Condition	Biocertification Area (ha)	Composition Condition Score	Structure Condition Score	Function Condition Score	Current vegetation integrity score
2	1557	Moderate	0.53	82.6	86.6	45	63.7
3	1557	Gully Influence	0.26	21.9	47.6	53.5	38.2
4	1557	Poor	1.84	18.5	39.4	69.9	37.1
5	1557	Acacia Regrowth	0.17	1.2	19.5	30	8.9
6	1557	Planted	0.38	8.5	37.1	80	29.4
9	1232	Poor	0.16	25.3	26.1	25.2	25.6
12	920	Good	0.03	23.6	94.4	-	47.2

1.4.6 Use of local data

The use of local data is not proposed.

Plant Community Types **Peat Island Mooney Mooney Planning Proposal**



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Legend		<p>Datum/Projection: GDA 1994 MGA Zone 56</p>
	Subject Land	
	Biocertification Area	<p>Location: Mooney Mooney, NSW Date Prepared: 23/09/2020</p>
PCT		
	1071 - Phragmites australis nad Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	
	1083 - Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	
	1183 - Smooth-barked Apple - Sydney Peppermint - Turpentine heathy open forest on plateaux areas of the Sydney Basin	
	1232 - Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion	
	1557 - Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	
	920 - Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	
	Cleared/Exotic	

Figure 19: Plant Community Types and native vegetation extent

Vegetation Zones and Survey Plots Peat Island Mooney Mooney Planning Proposal

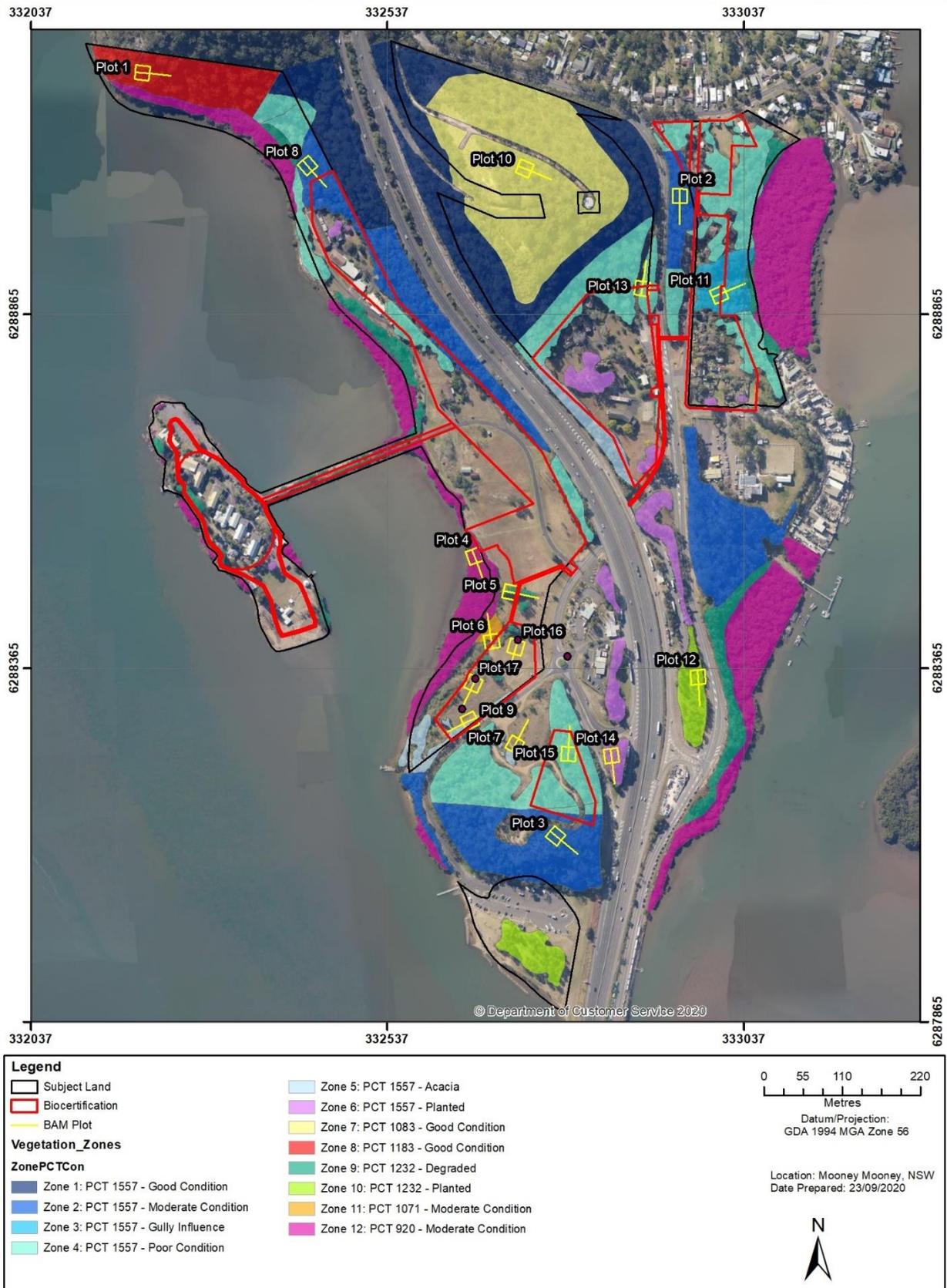


Figure 20: Vegetation zones and plot locations

Threatened Ecological Communities Peat Island Mooney Mooney Planning Proposal

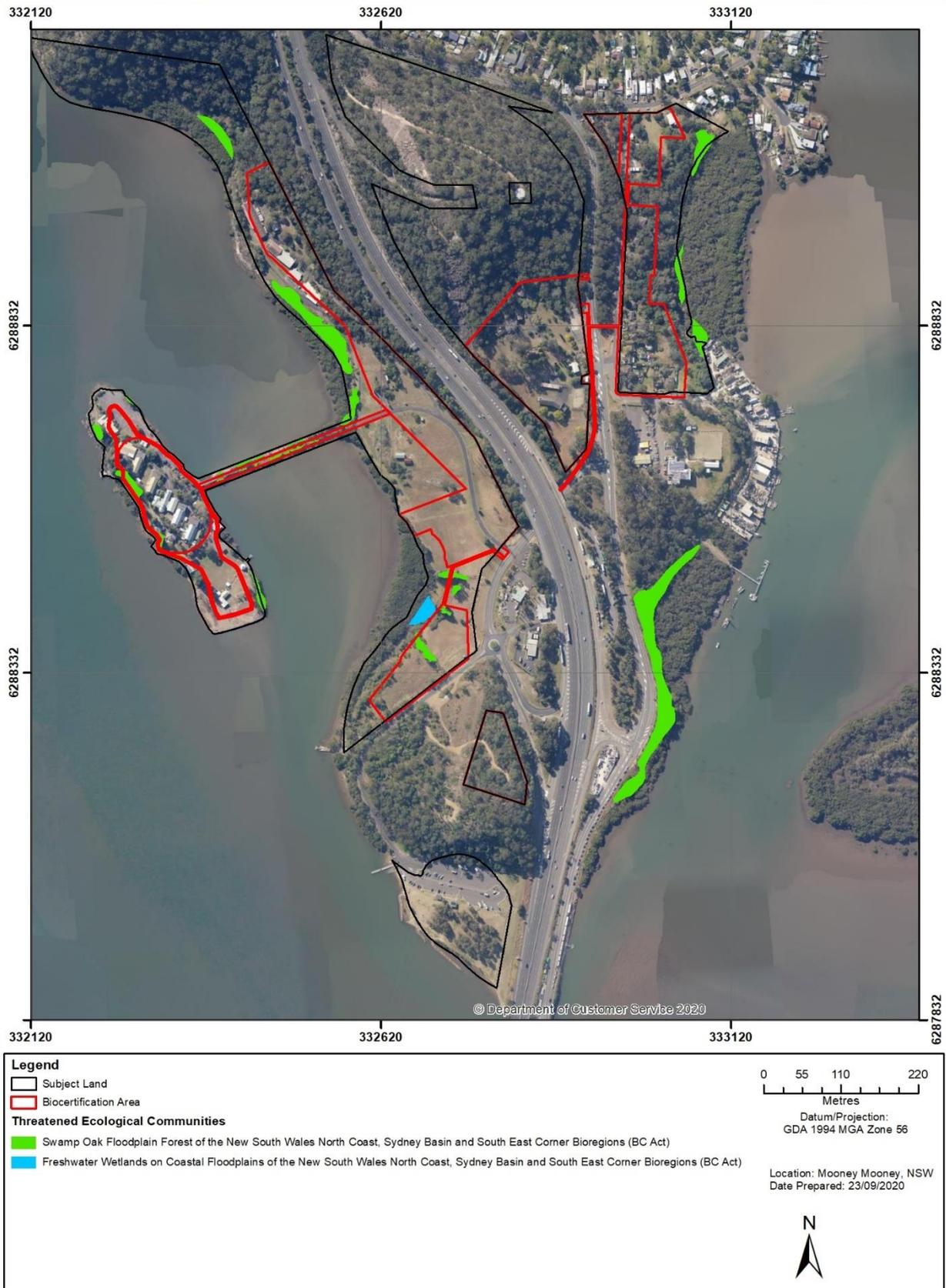


Figure 21: Threatened Ecological Communities

1.5 Threatened species

1.5.1 Ecosystem credit species

Ecosystem credit species predicted to occur at the subject land, their associated habitat constraints, geographic limitations and sensitivity to gain class is included in Table 11.

1.6 Species credit species

Species credit species predicted to occur at the subject land (i.e. candidate species), their associated habitat constraints, geographic limitations and sensitivity to gain class is included in Table 12.

Table 11: Predicted ecosystem credit species

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
<i>Anthochaera phrygia</i>	Regent Honeyeater			High	Critically Endangered	Critically Endangered	<u>Included</u> Marginal transitory foraging habitat available for this species.
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow			Moderate	Vulnerable	Not Listed	<u>Included</u> Potential foraging habitat is available within the biocertification area.
<i>Botaurus poiciloptilus</i>	Australasian Bittern	- Waterbodies - Brackish or freshwater wetlands		Moderate	Endangered	Endangered	<u>Included</u> Potential foraging habitat is available within the mangroves and adjacent mudflats.
<i>Calidris ferruginea</i>	Curlew Sandpiper (Foraging)			High	Endangered	Critically Endangered	<u>Including</u> Potential foraging habitat is available within the mangroves and adjacent mudflats.
<i>Calidris tenuirostris</i>	Great Knot			High	Vulnerable	Critically Endangered	<u>Including</u> Potential foraging habitat is available within the mangroves and adjacent mudflats.
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo (Foraging)			Moderate	Vulnerable	Not Listed	<u>Included</u> Potential foraging habitat is available within the biocertification area.
<i>Calyptorhynchus lathamii</i>	Glossy Black Cockatoo (Foraging)			High	Vulnerable	Not Listed	<u>Included</u> Potential foraging habitat is available within the biocertification area.
<i>Charadrius leschenaultii</i>	Greater Sand-plover			High	Vulnerable	Vulnerable	<u>Included</u> Potential foraging habitat is available within the mangroves and adjacent mudflats.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
<i>Charadrius mongolus</i>	Lesser Sand-plover (Foraging)			High	Vulnerable	Endangered	<u>Included</u> Potential foraging habitat is available within the mangroves and adjacent mudflats.
<i>Circus assimilis</i>	Spotted Harrier			Moderate	Vulnerable	Not Listed	<u>Included</u> Potential foraging habitat is available within the biocertification area.
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)			High	Vulnerable	Not Listed	<u>Included</u> Potential foraging habitat is available within the biocertification area.
<i>Daphoenositta chrysoptera</i>	Varied Sittella			Moderate	Vulnerable	Not Listed	<u>Included</u> Potential habitat is available within the biocertification area.
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll			High	Vulnerable	Endangered	<u>Included</u> Potential habitat is available within the biocertification area.
<i>Esacus magnirostris</i>	Beach-stone Curlew			High	Critically Endangered	Not Listed	<u>Included</u> Potential foraging habitat is available within the biocertification area.
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle			High	Vulnerable	Not Listed	<u>Included</u> Potential habitat is available within the biocertification area.
<i>Glossopsitta pusilla</i>	Little Lorikeet			High	Vulnerable	Not Listed	<u>Included</u> Potential habitat is available within the biocertification area.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle (Foraging)			High	Vulnerable	Not Listed	<u>Included</u> Suitable foraging habitat is available within and adjacent to the biocertification area. Recorded flying over the biocertification area.
<i>Hieraetus morphnoides</i>	Little Eagle (Foraging)			Moderate	Vulnerable	Not Listed	<u>Included</u> Potential foraging habitat is available within the biocertification area.
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake (Foraging)			High	Endangered	Vulnerable	<u>Included</u> Potential foraging habitat is available within the biocertification area.
<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	Vulnerable	Not Listed	<u>Included</u> Potential foraging habitat is available within the biocertification area.
<i>Kerivoula papuensis</i>	Golden-tipped Bat			High	Vulnerable	Not Listed	<u>Included</u> Marginal foraging habitat is available within the biocertification area. No preferred habitat (rainforest) is present in the biocertification area.
<i>Lathamus discolor</i>	Swift Parrot			Moderate	Endangered	Critically Endangered	<u>Included</u> Potential foraging habitat is available within the biocertification area.
<i>Limicola falcinellus</i>	Broad-billed Sandpiper (Foraging)			Moderate	Vulnerable	Not Listed	<u>Included</u> Potential foraging habitat is available within the mangroves and adjacent mudflats.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
<i>Limosa limosa</i>	Black-tailed Godwit (Foraging)			High	Vulnerable	Not Listed	<u>Included</u> Potential foraging habitat is available within the mangroves and adjacent mudflats.
<i>Lophoictinia isura</i>	Square-tailed Kite (Foraging)			High	Vulnerable	Not Listed	<u>Included</u> Potential foraging habitat is available within the biocertification area.
<i>Micronomus norfolkensis</i>	Eastern Freetail-bat			High	Vulnerable	Not Listed	<u>Included</u> Potential foraging and roosting habitat is available within the biocertification area.
<i>Miniopterus australis</i>	Little Bentwing-bat (Foraging)			High	Vulnerable	Not Listed	<u>Included</u> Potential foraging and secondary roosting habitat is available within the biocertification area. Recorded during the Anabat survey.
<i>Miniopterus orianae oceanensis</i>	Eastern Bentwing-bat (Foraging)			High	Vulnerable	Not Listed	<u>Included</u> Potential foraging and secondary roosting habitat is available within the biocertification area. Recorded during the Anabat survey
<i>Neophema pulchella</i>	Turquoise Parrot			High	Vulnerable	Not Listed	<u>Included</u> Potential foraging habitat is available within the biocertification area.
<i>Ninox connivens</i>	Barking Owl (Foraging)			High	Vulnerable	Not Listed	<u>Included</u> Potential foraging habitat is available within the biocertification area.
<i>Ninox strenua</i>	Powerful Owl (Foraging)			High	Vulnerable	Not Listed	<u>Included</u> Potential foraging habitat is available within the biocertification area.
<i>Pandion cristatus</i>	Eastern Osprey			Moderate	Vulnerable	Not Listed	<u>Included</u>

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
							Foraging habitat is available within the Hawkesbury River, adjacent to the biocertification area.
<i>Petaurus australis</i>	Yellow-bellied Glider			High	Vulnerable	Not Listed	<u>Excluded</u> This species has not been recorded within 5 km of the biocertification area. Not recorded during spotlighting surveys.
<i>Petroica boodang</i>	Scarlet Robin			Moderate	Vulnerable	Not Listed	<u>Included</u> Potential foraging habitat is available within the biocertification area.
<i>Petroica phoenicea</i>	Flame Robin			Moderate	Vulnerable	Not Listed	<u>Included</u> Potential foraging habitat is available within the biocertification area.
<i>Phascolarctos cinereus</i>	Koala			High	Vulnerable	Vulnerable	<u>Included</u> Marginal habitat and potential feed trees available.
<i>Phoniscus papuensis</i>	Golden-tipped Bat			High	Vulnerable	Not Listed	<u>Included</u> Marginal foraging habitat is available within the biocertification area. No preferred habitat (rainforest) is present in the biocertification area.
<i>Potorous tridactylus</i>	Long-nosed Potoroo			High	Vulnerable	Vulnerable	<u>Included</u> Marginal habitat is available within the biocertification area.
<i>Pseudomys gracilicaudatus</i>	Eastern Chestnut Mouse			High	Vulnerable	Not Listed	<u>Excluded</u> Suitable heath habitat is not present within the biocertification area.
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox			High	Vulnerable	Vulnerable	<u>Included</u>

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for inclusion or exclusion of species
							Potential foraging habitat is available within the biocertification area. Recorded flying over biocertification area.
<i>Rostratula australis</i>	Australian Painted Snipe		Within 5 kilometres of Homebush Bay	Moderate	Endangered	Endangered	<u>Included</u> Biocertification area not within geographic limitation, however, potential foraging habitat within/adjacent to the biocertification area.
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat			High	Vulnerable	Not Listed	<u>Included</u> Potential foraging and roosting habitat is available within the biocertification area.
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat			High	Vulnerable	Not Listed	<u>Included</u> Potential foraging and roosting habitat is available within the biocertification area.
<i>Sternula albifrons</i>	Little Tern (Foraging)			Moderate	Vulnerable	Not Listed	<u>Included</u> Potential foraging and roosting habitat is available within the biocertification area.
<i>Tyto longimembris</i>	Eastern Grass Owl			Moderate	Vulnerable	Not Listed	<u>Excluded</u> Suitable habitat is not present due to the small area of wetland and degraded nature of grasslands available.
<i>Tyto novaehollandiae</i>	Masked Owl (Foraging)			High	Vulnerable	Not Listed	<u>Included</u> Potential foraging habitat is available within the biocertification area.
<i>Varanus rosenbergi</i>	Rosenberg's Goanna			High	Vulnerable	Not Listed	<u>Included</u> Marginal foraging habitat is available for this species.
<i>Xenus cinereus</i>	Terek Sandpiper			High	Vulnerable	Not Listed	<u>Included</u>

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	to NSW listing status	listing	EPBC status	Listing	Justification for inclusion or exclusion of species
	(Foraging)								Marginal foraging habitat is available for this species.

Table 12: Candidate species credit species

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded
<i>Anthochaera phrygia</i>	Regent Honeyeater	- OEH mapped areas		High	CE	CE	<u>Excluded</u> The biocertification area does not contain mapped important areas (date accessed 16/09/20)
<i>Burhinus grallarius</i>	Bush Stone-curlew	Fallen/standing dead timber including logs		High	E	Not Listed	<u>Included</u> Potential habitat available. Not recorded during nocturnal surveys. Singular record within 5 km of the biocertification area.
<i>Calidris ferruginea</i>	Curlew Sandpiper (Breeding)	- OEH mapped areas		High	E	CE	<u>Excluded</u> Species credit species for Curlew Sandpiper are based on OEH mapped important areas. The biocertification area does not contain mapped important areas (date accessed 16/09/20).
<i>Calidris tenuirostris</i>	Great Knot (Breeding)	- OEH mapped areas		High	V	CE	<u>Excluded</u> Species credit species for Curlew Sandpiper are based on OEH mapped important areas. The biocertification area does not contain mapped important areas (date accessed 16/09/20).
<i>Collocephalon fimbriatum</i> (Breeding)	Gang-gang Cockatoo	- Eucalypt tree species with hollows >9 cm diameter		High	V	Not Listed	<u>Excluded</u> While this species may occasionally forage within the biocertification area, there are

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded
							no records within 5 km and it is considered unlikely that this species would be breeding within the biocertification area due to the degraded nature of vegetation within the footprint. This species is known to breed in tall montane forests. Species not recorded on site during field surveys.
<i>Callocephalon fimbriatum</i> - endangered population	Callocephalon fimbriatum - endangered population in the Hornsby and Kuring-gai Local Government Areas		Hornsby and Kuring-gai Local Government Areas	High	E2	Not Listed	<u>Excluded</u> Biocertification area outside geographic range of this population.
<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo (Breeding)			High	V	Not Listed	<u>Excluded</u> This species requires intact landscapes for breeding. It is considered unlikely that this species would be breeding within the biocertification area due to the degraded nature of vegetation within the footprint. Species not detected within biocertification area during dusk surveys in the breeding season.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded
<i>Cercartetus nanus</i>	Eastern Pygmy Possum			High	V	Not Listed	<u>Included</u> Potential habitat is available within higher quality areas of vegetation in the biocertification area with an intact shrub layer.
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	- Cliffs - Within 2km of rocky areas containing caves, overhangs, escarpments, outcrops or crevices, or within 2km of old mines or tunnels		Very High	V	V	<u>Included</u> Suitable cliffs within 2km of biocertification area along Hawkesbury River escarpment. Species recorded during bat call survey.
<i>Charadrius leschenaultii</i>	Greater Sand-plover (Breeding)	- OEH mapped areas		High	V	V	<u>Excluded</u> Not within DPIE mapped area (date accessed 16/09/20).
<i>Charadrius mongolus</i>	Lesser Sand-plover (Breeding)	- OEH mapped areas		High	V	E	<u>Excluded</u> Not within DPIE mapped area (date accessed 16/09/20).
<i>Crinia tinnula</i>	Wallum Froglet	Kurnell Peninsula, the margins of Botany Bay		Moderate	V	Not Listed	<u>Excluded</u> Biocertification area outside the geographic range.
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid			High	V	V	<u>Excluded</u> Suitable habitat is not present for this species within the biocertification area. No records within 5 km. Marginal habitat was available within PCT

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded
							1083 and 1183 which will not be impacted by the development.
<i>Epthianura albifrons</i> <i>endangered population</i>	White-fronted Chat - Chat population in the Sydney Metropolitan Catchment Management Area			High	E2	Not Listed	<u>Excluded</u> Biocertification area not within Sydney Metropolitan Catchment Management Area
<i>Esacus magirostris</i>	Beach Stone-curlew			High	CE	Not Listed	<u>Excluded</u> Known breeding sites confined to the NSW north coast. No important mapped areas(date accessed 16/09/20) within or in proximity to biocertification area. Potential for vagrant individuals only. No previous records within 5 km.
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	- Within 100 m of estuarine areas and the ocean		High	V	Not Listed	<u>Included</u> Potential winter roosting habitat is available within PCT 920 (Mangroves).
<i>Haematopus longirostris</i>	Pied Oystercatcher	- Within 100 m of estuarine areas and the ocean		High	E	Not Listed	<u>Included</u> Potential winter roosting habitat is available within PCT 920 (Mangroves).

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle (Breeding)	-		High	V	Not Listed	<u>Included</u> Species recorded flying adjacent to biocertification area. Large stick nest recorded adjacent to biocertification area. Nest determined to belong to <i>Haliastur sphenurus</i> (Whistling Kite).
<i>Heleioporus australiacus</i>	Giant Burrowing Frog			Moderate	V	V	<u>Excluded</u> Suitable habitat not present. Species associated with hanging swamps on sandstone plateaus and deeply dissected gullies.
<i>Hieraetus morphnoides</i>	Little Eagle (Breeding)			Moderate	V	Not Listed	<u>Included</u> Large stick nest recorded adjacent to biocertification area. Nest determined to belong to <i>Haliastur sphenurus</i> (Whistling Kite).
<i>Hoplocephalus bitorquatus</i>	Pale-headed Snake			High	V	Not Listed	<u>Excluded</u> No records within 5 km of biocertification area. The biocertification area has been degraded and is located at the edge of cleared areas, it is considered unlikely that this species inhabits the biocertification area.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake			Very High	E	V	<u>Excluded</u> No suitable sandstone outcrops, cliffs or pagodas will be impacted by the development. More suitable breeding sites are available along the Hawkesbury River escarpment outside of the biocertification area.
<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot (eastern)	- Requires a dense groundcover in a variety of habitats		High	E	E	<u>Excluded</u> There are no known populations of this species north of the Hawkesbury River. Habitat degraded within biocertification area such that this species is unlikely to be present.
<i>Lathamus discolor</i>	Swift Parrot (Breeding)	- As per OEH mapped areas		Moderate	E	CE	<u>Excluded</u> Not within OEH mapped area (16/09/20).
<i>Limicola falcinellus</i>	Broad-billed Sandpiper (Breeding)	- As per OEH mapped areas		High	V	Not Listed	<u>Excluded</u> Not within OEH mapped area (16/09/20).
<i>Limosa limosa</i>	Black-tailed Godwit (Breeding)	- As per OEH mapped areas		High	V	Not Listed	<u>Excluded</u> Not within OEH mapped area (16/09/20).
<i>Litoria aurea</i>	Green and Golden Bell Frog	- Within 1km of wet areas - Within 1km of swamp - Within 1km of waterbody		High	E	V	<u>Included</u>

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded
							This species was included in the targeted survey. No individuals were recorded.
<i>Litoria brevipalmata</i>	Green-thighed Frog			Moderate	V	Note Listed	<u>Excluded</u> Suitable habitat not present in the biocertification area.
<i>Lophoictinia isura</i>	Square-tailed Kite (Breeding)	- Nest trees		Moderate	V	Not Listed	<u>Included</u> Large stick nest recorded adjacent to biocertification area. Nest determined to belong to <i>Haliastur sphenurus</i> (Whistling Kite).
<i>Macropus parma</i>	Parma Wallaby			Moderate	V	Not Listed	<u>Excluded</u> No records within 5 km. Species not detected within biocertification area during survey.
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	- Swamps - Swamp margins or creek edges		High	V	V	<u>Included</u> This species was included in the targeted survey. No individuals were recorded.
<i>Miniopterus australis</i>	Little Bentwing-bat (Breeding)	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding		Very High	V	Not Listed	<u>Excluded</u> Species known only to breed in maternity caves. In a small number of locations. No breeding habitat present in the biocertification area.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat (Breeding)	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding		Very High	V	Not Listed	<u>Excluded</u> Species known only to breed in maternity caves in a small number of locations. No breeding habitat present in the biocertification area.
<i>Meridolum maryae</i>	Maroubra Woodland Snail		Within 6 km from ocean shoreline	High	E	Not Listed	<u>Excluded</u> Biocertification area not within geographic range.
<i>Myotis macropus</i>	Southern Myotis	- Hollow-bearing trees - Within 200 m of a riparian zone - Bridges, caves or artificial structures within 200 m of riparian zone		High	V	Not Listed	<u>Included</u> This species was recorded during the targeted survey. Suitable habitat is present due to abundance of foraging habitat within the Hawkesbury River.
<i>Neophema chrysogaster</i>	Orange-bellied Parrot			Moderate	CE	CE	<u>Excluded</u> Northern-most record for this species located at Maroubra, approximately 47 km south of biocertification area. Species not recorded during avifauna surveys.
<i>Ninox connivens</i>	Barking Owl (Breeding)	Living or dead trees with hollows >20cm diameter and >4m above the ground		High	V	Not Listed	<u>Included</u> This species was included in the targeted survey as potential nesting habitat is available within and adjacent to the

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded
							biocertification area. No individuals were recorded.
<i>Ninox strenua</i>	Powerful Owl (Breeding)	Living or dead trees with hollows >20cm		High	V	Not Listed	<u>Included</u> This species was included in the targeted survey as potential nesting habitat is available within and adjacent to the biocertification area. No individuals were recorded.
<i>Pandion cristatus</i>	Eastern Osprey (Breeding)	Living and dead trees (>15m) or artificial structures within 100 m of a floodplain		Moderate	V	Not Listed	<u>Included</u> Large stick nest recorded adjacent to biocertification area. Nest determined to belong to <i>Haliastur sphenurus</i> (Whistling Kite).
<i>Petaurus norfolcensis</i>	Squirrel Glider			High	V	Not Listed	<u>Included</u> Potential habitat available. Not recorded during targeted survey.
<i>Petaurus norfolcensis endangered population</i>	Squirrel Glider – on Barrenjoey Peninsula, north of Bushranger's Hill		Barrenjoey Peninsula	High	E2	Not Listed	<u>Excluded</u> Biocertification area outside geographic range for this population.
<i>Phascolarctos cinereus</i>	Koala (Breeding)	Areas identified as important habitat via survey		High	V	V	<u>Excluded</u> Potential foraging habitat available. Not recorded during surveys. No historic records on

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded
							Mooney Mooney Peninsula. Records within 5 km are separated by major waterways (Hawkesbury River and Mooney Mooney Creek), species unlikely to be present and biocertification area unlikely to provide important habitat.
<i>Potorous tridactylus</i>	Long-nosed Potoroo	Dense shrub layer or alternatively high canopy cover exceeding 70% (i.e. to capture populations inhabiting wet sclerophyll and rainforest))		High	V	Not Listed	<u>Excluded</u> Biocertification area does not contain a shrub layer or canopy > 70% as outlined in habitat constraint.
<i>Prostanthera askania</i>	Tranquility Mintbush		North of the Hawkesbury River	High	E	E	<u>Excluded</u> Occurs in a restricted area of less than 12 km in the upper reaches of Tuggerah Lake and Brisbane Water. Conspicuous shrub not detected during flora surveys.
<i>Pseudophryne australis</i>	Red-crowned Toadlet			Moderate	V	Not Listed	<u>Included</u> This species was included in the targeted survey. No individuals were recorded. No suitable drainage lines were recorded.
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox (Breeding)	- Breeding camps		High	V	V	<u>Excluded</u> No camps present in biocertification area.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded
<i>Rhodamnia rubescens</i>	Scrub Turpentine			High	CE	Not Listed	<u>Included</u> Suitable habitat and associated species not present in biocertification area. Conspicuous species not recorded during flora surveys.
<i>Rhodomyrtus psidioides</i>	Native Guava			High	CE	Not Listed	<u>Included</u> Marginal habitat available in the biocertification area.
<i>Sternula albifrons</i>	Little Tern (Breeding)			High	E	Not Listed	<u>Excluded</u> Suitable breeding habitat not present for this species.
<i>Turnix maculosus</i>	Red-backed Button-quail			High	V	Not Listed	<u>Excluded</u> There are no nearby records for this species. Suitable grasslands associated are not present in the biocertification area.
<i>Tyto novaehollandiae</i>	Masked Owl (Breeding)	Living or dead trees within hollows >20cm diameter		High	V	Not Listed	<u>Included</u> This species was included in the targeted survey as potential nesting habitat is available within and adjacent to the biocertification area. No individuals were recorded.
<i>Vespadelus troughtoni</i>		- Caves - Within 2km of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or		Vert High	V	Not Listed	<u>Included</u> Biocertification area within 2km of cliffs and caves along Hawkesbury River escarpment.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded
		within two kilometres of old mines, tunnels, old buildings or sheds.					Potential calls identified during bat call survey.
<i>Wilsonia backhousei</i>	Narrow-leafed Wilsonia	- Margins of salt marshes and lakes, both coastal and inland		High	V	Not Listed	<u>Included</u> Not recorded within biocertification area.
<i>Xenus cinereus</i>	Terek Sandpiper (Breeding)	- OEH mapped areas		High	V	Not Listed	<u>Excluded</u> Biocertification area not within DPIE mapped area (16/09/20).

1.6.1 Targeted surveys

Targeted surveys for species credit species were undertaken within the subject land on the dates outlined in Table 13. The locations of targeted surveys are shown on Figure 22, with the results of the surveys shown as individual species polygons on Figure 25. Weather conditions during the targeted surveys are outlined in Table 14. Survey effort undertaken at the development is outlined in Table 15.

Table 13: Targeted surveys

Date	Surveyors	Survey type
7/06/18	Jennie Powell and Mitchell Scott	Random meander flora survey and hollow-bearing tree survey
8/06/18	Jennie Powell and Mitchell Scott	Random meander flora survey
21/06/18	Jennie Powell and Mike Lawrie	Targeted threatened flora survey
25/06/18	Belinda Failes and Mike Lawrie	Threatened flora survey, hollow-bearing tree survey, stagwatching, spotlighting, owl call playback, Anabat survey
2/07/18	Belinda Failes and Mike Lawrie	Stagwatching, spotlighting, owl call playback
4/07/18	Mike Lawrie and Griffin Taylor-Dalton	Stagwatching, spotlighting, owl call playback, Bush Stone-curlew and Black Bittern call playback, Red Crowned Toadlet call playback, Anabat Survey
09/07/18	Belinda Failes and Mike Lawrie	Stagwatching, spotlighting, owl call playback and Red Crowned Toadlet call playback
16/07/18	Mike Lawrie and Mitchell Scott	Stagwatching, spotlighting, owl call-playback and listening survey
25/03/19	Mike Lawrie and Frank Lemckert	Green and Golden Bell Frog survey, nocturnal bird and mammal survey, bat call survey.
26/03/19	Nicole McVicar and Frank Lemckert	Green and Golden Bell Frog survey, nocturnal bird and mammal survey, bat call survey.
27/03/19	Carolina Mora and Frank Lemckert	Green and Golden Bell Frog survey, nocturnal bird and mammal survey, bat call survey.
28/03/19	Mike Lawrie and Carolina Mora	Green and Golden Bell Frog survey, nocturnal bird and mammal survey, bat call survey.
24/07/19	Mike Lawrie and Stacey Wilson	Threatened flora survey, bird of prey nest survey, threatened flora survey
11/12/19	Mike Lawrie, Stacey Wilson, Carolina Mora, Claire Wheeler	Microbat emergence survey
12/12/19	Mike Lawrie, Stacey Wilson, Carolina Mora, Claire Wheeler	Microbat emergence survey Dusk Avifauna survey

Date	Surveyors	Survey type
18/12/19	Mike Lawrie, Stacey Wilson, Emily Messer, Alex Gorey	Microbat emergence survey Dusk Avifauna survey
19/12/19	Mike Lawrie, Stacey Wilson, Emily Messer, Alex Gorey	Microbat emergence survey
28/01/20	Frank Lemckert, Carolina Mora, Stacey Wilson	Harp trapping
29/01/20	Frank Lemckert, Carolina Mora, Stacey Wilson	Harp trapping
30/01/20	Mike Lawrie, Daniel Mackenzie, Frank Lemckert	Harp trapping Dawn Avifauna survey
31/01/20	Mike Lawrie, Daniel Mackenzie, Frank Lemckert	Harp trapping Afternoon Avifauna Survey
21/04/20	Mike Lawrie and Glenn Hoye	Diurnal Microbat Roost Search

Table 14: Weather conditions

Date	Rainfall (mm)	Minimum temperature (°C)	Maximum temperature (°C)	Max wind speed (km/h)
7/06/18	12	9.3	19.7	22
8/06/18	0	8.9	17.4	19
21/06/18	4.6	10.8	16.1	11
25/06/18	0	4.3	16.2	13
2/07/18	4	10.3	16.4	17
4/07/18	0	6.1	19.7	19
09/07/18	0	6.1	16.2	26
16/07/18	0	1.1	17.6	28
07/09/18	4.4	13.2	22.4	26
25/03/19	4.4	20.0	25.5	33
26/03/19	3.0	16.0	25.9	31
27/03/19	0	13.9	23.9	24
28/03/19	0	15.5	25.4	26
24/07/19	0	6.5	20.1	37

Table 15: Survey effort

Candidate species	Survey method	Dates	Survey effort	BAM survey period	Species present
<i>Burhinus grallarius</i> (Bush Stone-curlew)	Spotlighting, call playback	25/06/18	3 hours x 2 people	All year	No
		02/07/18	3 hours x 2 people		
		04/07/18	3 hours x 2 people		
		09/07/18	1.25 hours x 2 people		
		16/07/19	1 hour x 2 people		
		25/03/19	2 hours x 2 ecologists		
		26/03/19	2 hours x 2 ecologists		
		27/03/19	2 hours x 2 ecologists		
<i>Chalinolobus dwyeri</i> (Large-eared Pied-bat)	Acoustic detection, harp trapping, roost search	25/03/19-	13 nights ultrasonic detection (4 Anabats over 4 nights)	November - January	Yes - species identified during ultrasonic call survey.
		28/03/19	4 nights emergence and ultrasonic recording		
			13 nights harp trapping (4 traps x 3 nights, 1 trap x 1 night)		
<i>Haematopus fuliginosa</i> (Sooty Oystercatcher)	Avifauna survey	24/07/19	2 hours	All year	No
		12/12/19			
		18/12/19			
		30/01/20			
		31/01/20			
<i>Haematopus longirostris</i> (Pied Oystercatcher)	Avifauna survey	24/07/19	2 hours	All year	No
		12/12/19			
		18/12/19			
		30/01/20			
		31/01/20			
<i>Haliaeetus leucogaster</i> (White-bellied Sea-eagle)	Nest survey	24/07/19	2 hours	July - December	No
<i>Litoria aurea</i> and <i>Litoria biconvexa</i> (Green and Golden Bell Frog)	Habitat search, call playback	25/03/19	2 hours x 2 ecologists	November - March	No
		26/03/19	2 hours x 2 ecologists		
		27/03/19	2 hours x 2 ecologists		
		28/03/19	2 hours x 2 ecologist		
<i>Melaleuca biconvexa</i> (Biconvex Paperbark)	Random meander, targeted flora survey (parallel transects)	7/06/18	8 hours x 2 ecologists	All year	No
		8/06/18	8 hours x 2 ecologists		
		21/06/18	9 hours x 2 ecologists		
		25/06/18	7 hours x 2 ecologists		
		24/07/19	4 hours x 2 ecologists		

Candidate species	Survey method	Dates	Survey effort	BAM survey period	Species present
<i>Myotis macropus</i> (Southern Myotis)	Acoustic detection	25/03/19 28/03/19	– 13 nights (4 Anabats over 4 nights)	October March	- Yes – species identified during ultrasonic call survey.
<i>Ninox connivens</i> (Barking Owl)	Stagwatch, dusk listening survey, call playback	25/06/18 02/07/18 04/07/18 09/07/18 16/07/19	3 hours x 2 people 3 hours x 2 people 3 hours x 2 people 1.25 hours x 2 people 1 hour x 2 people	May December	- No
<i>Ninox strenua</i> (Powerful Owl)	Stagwatch, dusk listening survey, call playback	25/06/18 02/07/18 04/07/18 09/07/18 16/07/19	3 hours x 2 people 3 hours x 2 people 3 hours x 2 people 1.25 hours x 2 people 1 hour x 2 people	May - August	No
<i>Pandion cristatus</i> (Eastern Osprey)	Nest survey	24/07/19	2 hours	April November	- No
<i>Petaurus norfolcensis</i> (Squirrel Glider)	Stagwatch, spotlighting survey	25/06/18 02/07/18 04/07/18 09/07/18 16/07/19	3 hours x 2 people 3 hours x 2 people 3 hours x 2 people 1.25 hours x 2 people 1 hour x 2 people	All year	No
<i>Pseudophryne australis</i> (Red-crowned Toadlet)	Call playback	04/07/18 09/07/18 28/03/19	3 hours x 2 people 1.25 hours x 2 people 2 hours x 2 ecologist	All year	No
<i>Rhodamnia rubescens</i> (Scrub Turpentine)	Random meander flora survey, targeted flora survey (parallel transects)	7/06/18 8/06/18 21/06/18 25/06/18 24/07/19	8 hours x 2 ecologists 8 hours x 2 ecologists 9 hours x 2 ecologists 7 hours x 2 ecologists 4 hours x 2 ecologists	All year	No
<i>Tyto novaehollandiae</i> (Masked Owl)	Stagwatch, dusk listening survey, call playback	25/06/18 02/07/18 04/07/18 09/07/18 16/07/19 25/03/19 26/03/19 27/03/19 28/03/19	3 hours x 2 people 3 hours x 2 people 3 hours x 2 people 1.25 hours x 2 people 1 hour x 2 people 2 hours x 2 ecologists 2 hours x 2 ecologists 2 hours x 2 ecologists 2 hours x 2 ecologist	May - August	No

Candidate species	Survey method	Dates	Survey effort	BAM survey period	Species present
<i>Vespadelus troughtoni</i> (Little Cave Bat)	Little Cave Bat	25/03/19– 28/03/19	13 nights ultrasonic detection (4 Anabats over 4 nights) 16 nights emergence and ultrasonic recording (4 people x 4 nights) 13 nights harp trapping (4 traps x 3 nights, 1 trap x 1 night) 1 day roost search	November - January	Yes – species was positively identified during the harp trapping survey and roost search.

Following completion of targeted surveys, the species credit species included in the assessment are outlined in Table 16.

Table 16: Species credit species included in the assessment

Species	Common Name	Species presence	Number of individuals / Habitat (ha)	Biodiversity Risk Weighting	Species polygon description
<i>Cercartetus nanus</i>	Eastern Pygmy Possum	Yes (assumed present)	0.36	2.00	Habitat for this species within the biocertification area is confined to moderate condition vegetation within PCT 1557 with connectivity to large areas of intact vegetation. Poor condition vegetation or vegetation with limited connectivity has been excluded.
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	Yes (surveyed)	3.37	3.00	The entire biocertification area is within 2km of cliffs/caves. All PCTs within the biocertification area is included in the polygon.
<i>Myotis macropus</i>	Southern Myotis	Yes (surveyed)	2.89	2.00	All PCTs within the biocertification area and within 200 m of the Hawkesbury River have been included in the species polygon.
<i>Vespadelus troughtoni</i>	Little Cave Bat	Yes (surveyed)	3.37	3.00	The entire biocertification area is within 2km of cliffs/caves and known roost buildings. All PCTs within the biocertification area is included in the polygon.



Figure 22: Flora survey tracks



Figure 23: Targeted Fauna Survey

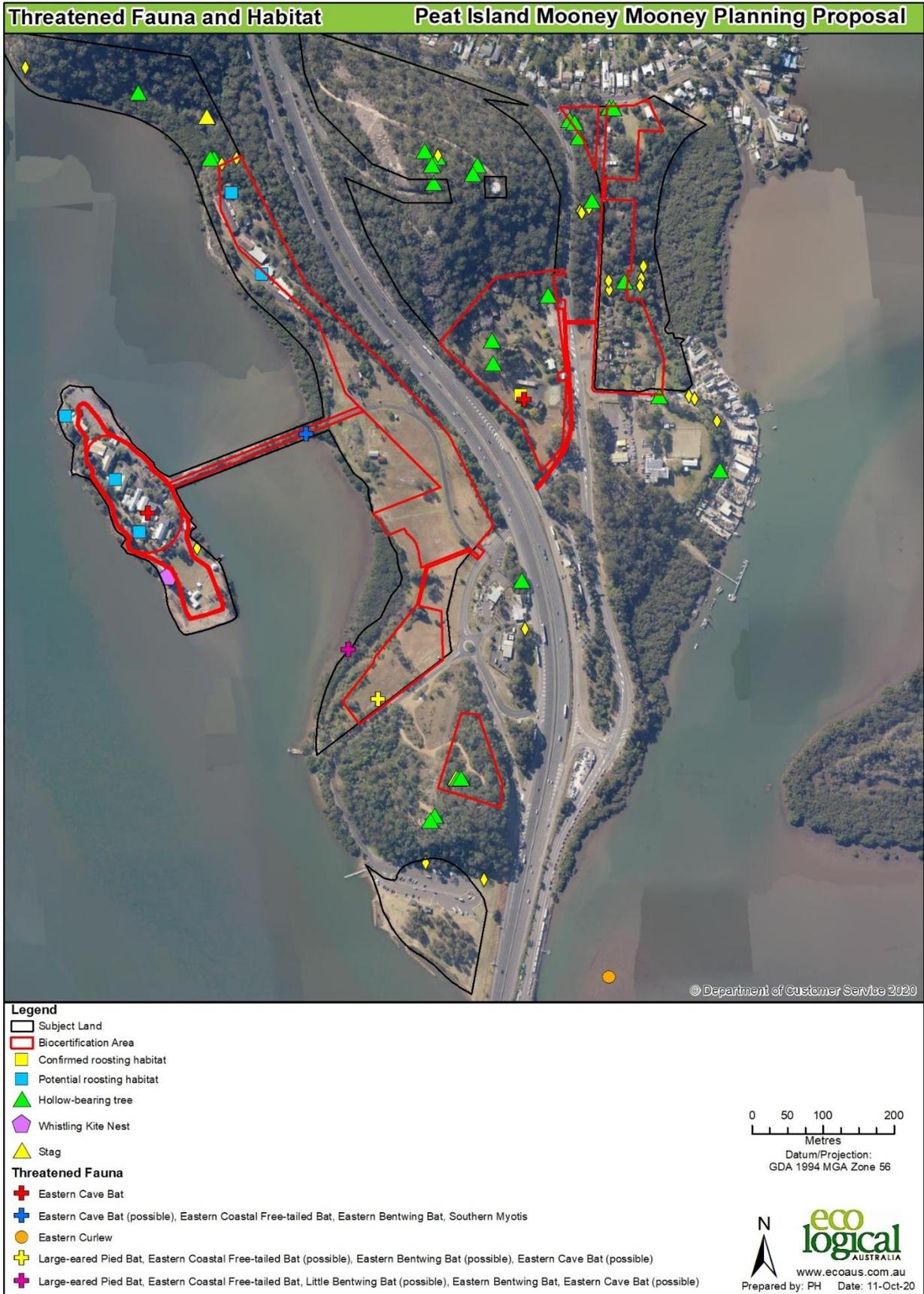
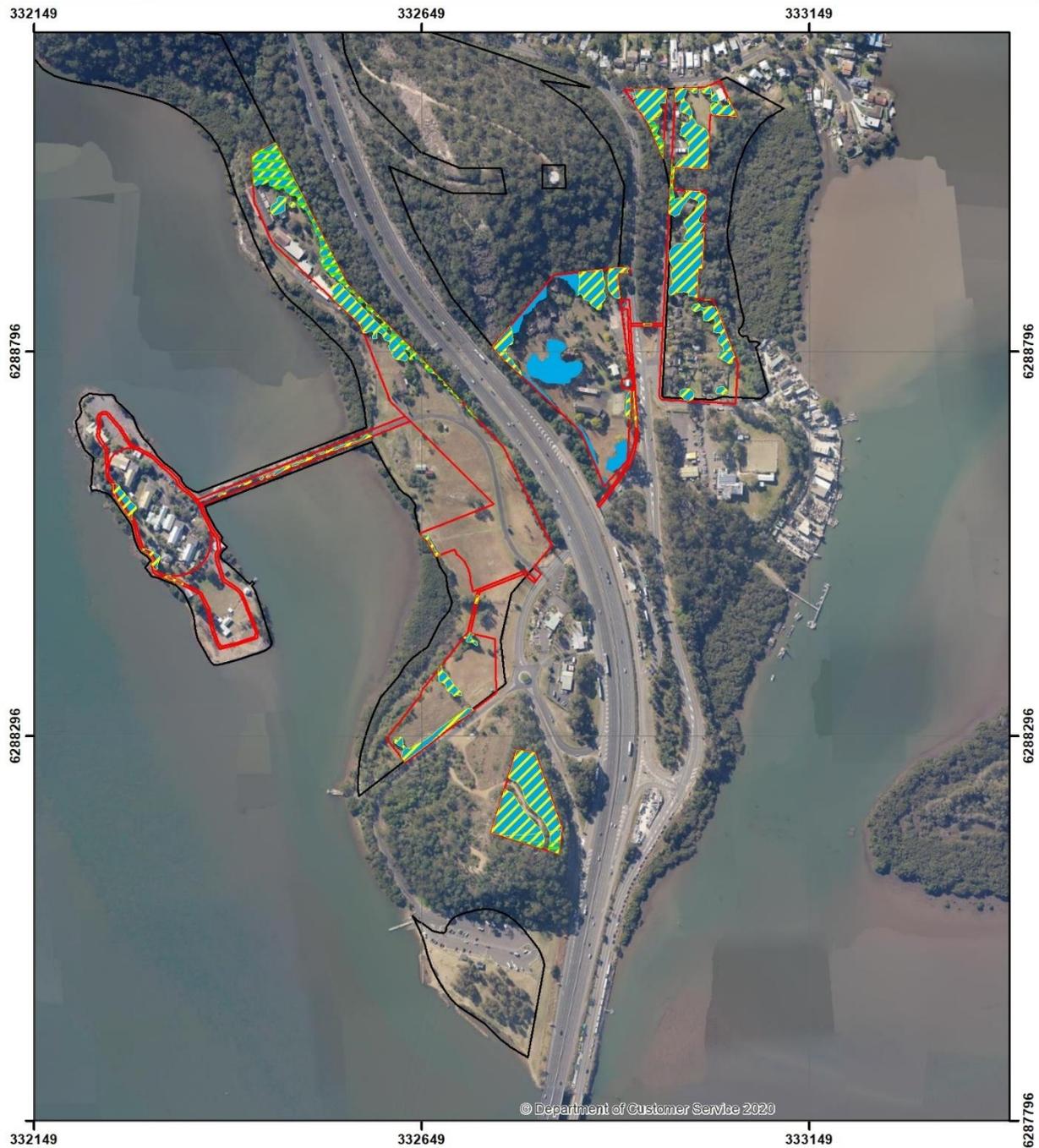


Figure 24: Location of threatened species and habitat features recorded during surveys (hollow-bearing trees recorded opportunistically)

Species Polygons **Peat Island Mooney Mooney Planning Proposal**



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Legend		0 55 110 220
	Subject Land	
	Biocertification Area	Metres
	<i>Cercartetus nanus</i> Species Polygon	Datum/Projection: GDA 1994 MGA Zone 56
	<i>Myotis macropus</i> Species Polygon	Location: Mooney Mooney, NSW Date Prepared: 26/07/2019
	<i>Chalinolobus dwyeri</i> and <i>Vespadelus troughtoni</i> Species Polygon	

Figure 25: Species polygons

1.6.2 Use of local data

Use of local data is not proposed.

1.6.3 Expert reports

Expert reports have not been used in this assessment.

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 development has been located in a way which avoids and minimises impacts as outlined in Table 17.

Table 17: 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	The biocertification area has utilised areas where there are no biodiversity values where possible.	<p>The majority of the biocertification area is located in areas where there are no biodiversity values, including areas of cleared/exotic grassland or where previous development currently exists. Where impacts to biodiversity is unavoidable, the majority of vegetation to be removed is in poor to moderate condition. The biocertification area has been redesigned to avoid impacting on the 20 m inner riparian zone and predominantly avoid impacting higher quality vegetation.</p> <p>Large areas of high quality vegetation will be retained within conservation areas in the north of the biocertification area. Vegetation will also be retained within public recreation areas throughout the subject land.</p> <p>A map showing the previously assessed footprint as submitted with the planning proposal in 2018 is shown in Figure 26. While some areas have increased impacts to account for construction buffers or community facilities, this figure demonstrates where several impacts, particularly in the eastern portion have been avoided, and that impacts to riparian areas have been reduced in several parts of the subject land.</p>
Locating the project in areas where the native vegetation or threatened species habitat is in the poorest condition	The biocertification area has been located to minimise impacts to vegetation and threatened species habitat which is in the poorest condition.	<p>The biocertification area is predominantly located in areas of cleared land, exotic grassland and previously disturbed or poor condition vegetation. Small areas of moderate or good condition vegetation will be impacted. Intact and good condition vegetation has predominantly been avoided.</p> <p>Native vegetation and threatened species habitat in good condition will be retained</p>

Approach	How addressed	Justification
		<p>in the conservation zones in the north of the biocertification area. A total of 3.37 ha of native vegetation in poor to good condition will be impacted. A total of 17.74 ha of native vegetation will be retained within the subject land, 10.15 ha of which is in good condition, 1.44 ha in moderate condition and 12.24 ha in poor, degraded or modified condition.</p>
<p>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</p>	<p>The biocertification area has been located in predominantly cleared or degraded areas that contain limited habitat for species in high threat categories or vegetation in high threat categories that are in poor condition.</p>	<p>The majority of the biocertification area (9.76 ha), is located in cleared areas which does not contain habitat or vegetation in high threat categories. The majority of native vegetation to be removed is in poor condition and provides only foraging habitat for species in high threat categories or roosting habitat within hollow-bearing trees and buildings. Only small areas of EECs will be impacted – including 0.16 ha of Swamp Oak Floodplain Forest and potential indirect impacts to Freshwater Wetland.</p>
<p>Locating the project such that connectivity enabling movement of species and genetic material between areas of adjacent or nearby habitat is maintained</p>	<p>The biocertification area is located at the southern end of Mooney Mooney. The areas to be impacted are generally located in cleared areas or at the edges of bushland and cleared land. Higher quality vegetation and areas of connectivity within the wider subject land will be retained.</p>	<p>The project has been located such that important vegetation corridors connecting large areas of habitat will be retained. Vegetation along the Hawkesbury River will predominantly be retained, providing a potential movement corridor from the south of the subject land to the north, connecting to large areas of vegetation in Popran National Park. Connectivity from Deerubbin Reserve in the south of the subject land will be impacted, with the removal of vegetation along the western side of the M1 which provided tenuous corridor to the north. This vegetation to be removed is degraded, and is unlikely to be a significant movement corridor for any species other than mobile birds and bats. A vegetated corridor will be retained in the north east of the site, connecting mangroves and native vegetation to Tank Hill to the north of the subject land.</p>

Impact Area Comparison Peat Island Mooney Mooney Planning Proposal

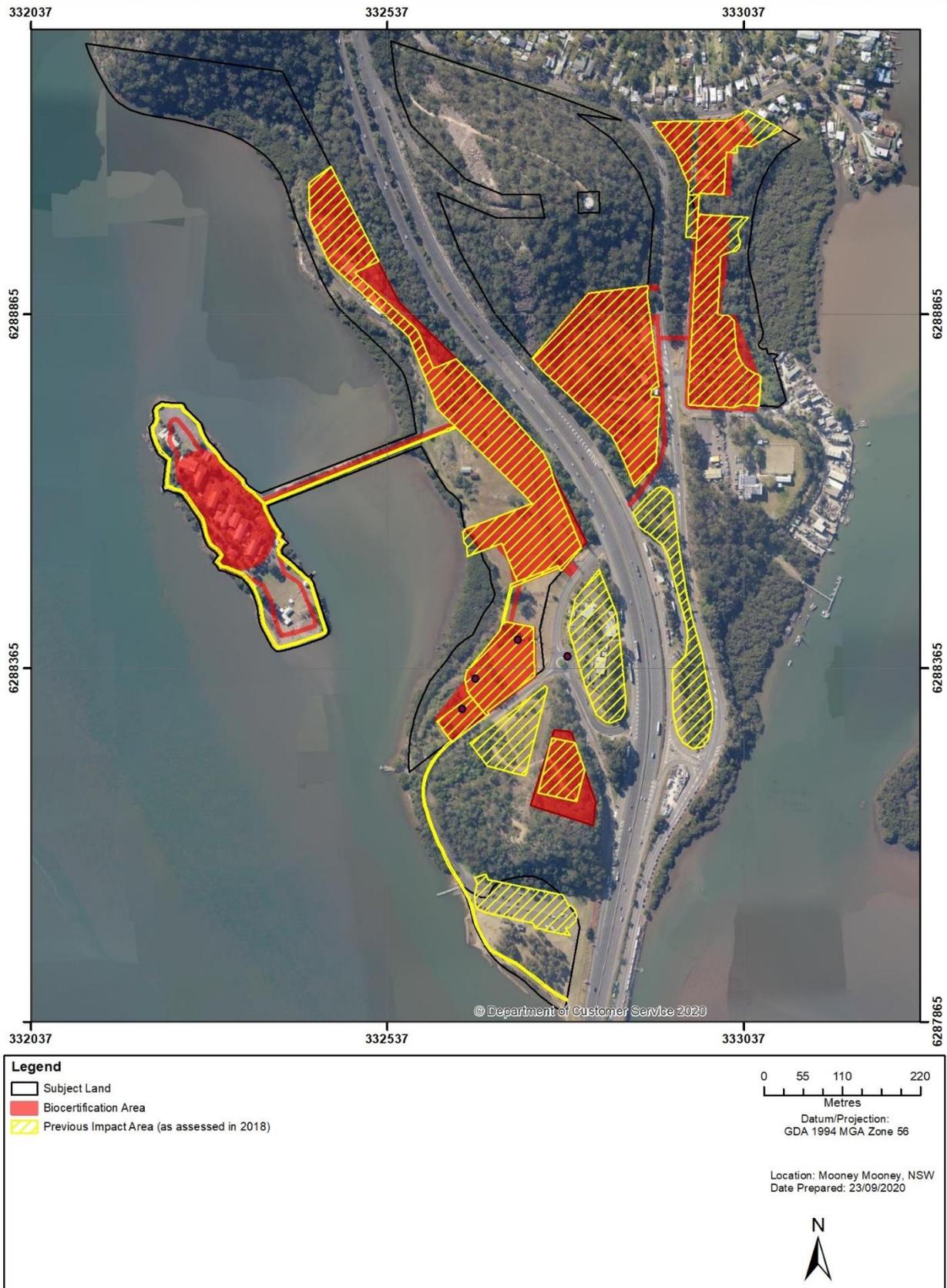


Figure 26: Impact area comparison

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 18.

Table 18: 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 of the project has been amended to avoid sensitive environmental features.	Efforts were made during the design phase to reduce the project footprint. This included reduction of the footprint to avoid impacts on the inner 20 m vegetation riparian zone. The clearing footprint has predominantly avoided good condition vegetation.
Locating ancillary facilities in areas where there are no biodiversity values	Ancillary features, where possible, will be located predominantly in areas where there are no biodiversity values.	Ancillary features and impacts associated with construction are to be located where possible within the biocertification area, minimising additional impacts on biodiversity values. A substation is required to be built to support the future development, which will result in impacts to biodiversity value with impacts to PCT 1557s. Additional construction ancillary features will not be located in areas containing biodiversity values.
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 features are primarily located in cleared areas, minimising impacts to native vegetation. Unavoidable impacts will occur as a result of unavoidable impacts.	Ancillary features and impacts associated with construction are to be located to minimise impacts on vegetation in good condition. A substation is required to be built to support the future development, which will result in impacts to PCT 1557 in poor condition.
Locating ancillary facilities in areas that avoid habitat for species and vegetation in high threat status categories (e.g. an EEC or CEEC)	Ancillary features have been located to avoid impacting vegetation in high threat categories. Impacts to foraging habitat for threatened species will occur as a result of ancillary features.	Ancillary features and impacts associated with construction or supporting infrastructure have been located to avoid impacting on vegetation in high threat categories, avoiding any additional impacts on habitat for species and vegetation in high threat status categories. Minor impacts to foraging habitat for threatened species will occur as a result of ancillary features, notably the substation impacting on PCT 1557.
Providing structures to enable species and genetic material to move across barriers or hostile gaps	The development will not create any barriers or hostile gaps that would impede the movement of genetic material.	The development is predominantly located in previously disturbed and cleared areas or at the interface of intact vegetation and cleared area, and will not sever any significant ecological

Approach	How addressed	Justification
		corridors that would impede the movement of species across the landscape. Therefore, no structures to assist movement of species and genetic material have been proposed.
<p>Making provision for the demarcation, ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on the subject land.</p>	<p>Recommendations pertaining to the demarcation and maintenance of retained native vegetation have been provided.</p>	<p>The boundaries of the biocertification area are to be clearly demarcated prior to commencement of construction to protect retained native vegetation. It is recommended that a Vegetation Management Plan (VMP) be prepared and implemented at the DA stage within the subject land to enhance retained native vegetation, in particular the Vegetated Riparian Zone.</p>

2.1.3 Prescribed biodiversity impacts

The biocertification area has the prescribed biodiversity impacts as outlined in Table 19.

Table 19: Prescribed biodiversity impacts

Prescribed biodiversity impact	Description in relation to the biocertification area	Threatened species or ecological communities effected
<p>Impacts of development on the habitat of threatened species or ecological communities associated with:</p> <ul style="list-style-type: none"> • human made structures, or • non-native vegetation 	<p>The proposed development will result in the refurbishment of several abandoned buildings on Peat Island and the nurses quarters in the east, and the refurbishment or removal of several buildings in the north-west of the subject land.</p> <p>Several areas of cliff and rock are present in the wider subject land and adjacent to the subject land along the Hawkesbury escarpment, however, no significant geological features which provide habitat will be directly or indirectly impacted by the development.</p> <p>The proposed development will result in impacts to cleared areas and exotic vegetation.</p>	<p>It was confirmed through targeted survey that Eastern Cave Bat is roosting within buildings.</p> <p>Roosting habitat is also available in abandoned buildings for several additional threatened microchiropteran bats which may utilise buildings as a temporary roost including:</p> <ul style="list-style-type: none"> • <i>Myotis macropus</i> (Southern Myotis) • <i>Saccolaimus flaviventris</i> (Yellow-bellied Sheath-tail Bat) • <i>Miniopterus australis</i> (Little Bentwing-bat) • <i>Miniopterus schreibersii oceanensis</i> (Eastern Bentwing-bat) <p>Threatened microchiropteran bats may also fly across or forage over cleared areas and within exotic vegetation, however, impacts to such habitat features are of low consequence to those threatened microbats likely to utilise the biocertification area.</p>

Prescribed biodiversity impact	Description in relation to the biocertification area	Threatened species or ecological communities effected
Impacts of development on movement of threatened species that maintains their lifecycle	The proposed development will have marginal impacts on connectivity of vegetation along the western side of the M1, which connects Deerubbin Reserve with larger areas in the north. The current connectivity of this area is tenuous and unlikely to be significantly reduced in a way that would impact the movement of threatened species that maintains their lifecycle.	N/A
Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining)	The development is located within proximity to the Hawkesbury River and has the potential to result in increased sedimentation and contaminated runoff into the waterway.	<p>Contaminated runoff has the potential to impact water dependent communities including Freshwater Wetland, Swamp Oak Floodplain Forest and Mangroves.</p> <p>Contaminated runoff would also have the potential to impact foraging habitat for wading birds which may forage on the mudflats and mangrove areas, including:</p> <ul style="list-style-type: none"> • Australasian Bittern • Curlew Sandpiper • Great Knot • Greater Sand-plover • Lesser Sand-plover • Beach-stone Curlew • Black Bittern • Broad-billed Sandpiper • Black-tailed Godwit • Australian Painted Snipe • Little Tern • Terek Sandpiper

2.1.3.1 Locating a project to avoid and minimise prescribed biodiversity impacts

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

Table 20: Locating a project to avoid and minimise prescribed biodiversity impacts

Approach	How addressed	Justification
Locating the envelope of surface works to avoid direct impacts on the habitat features	<p>The development has been located to avoid impacting on geological habitat features.</p> <p>Several man-made habitat features will require removal.</p>	<p>No caves or cliffs containing potential breeding habitat for cave dwelling microbats will be impacted by the development.</p> <p>Several buildings on Peat Island and the mainland will be refurbished, some buildings on the mainland will be demolished which will result in the</p>

Approach	How addressed	Justification
		<p>removal of known roosting and potential nesting habitat for Eastern Cave Bat. A Microbat Management Plan (MMP) has been prepared detailing the safe removal of Eastern Cave Bats and any other microbats from these habitat features.</p> <p>Surface works were located to utilise areas cleared areas or exotic vegetation, as this habitat type is of lower conservation value than native vegetation which has been retained where possible.</p>
<p>Locating the project to avoid severing or interfering with corridors connecting different areas of habitat, migratory flight paths to important habitat or preferred local movement pathways</p>	<p>The development will not significantly reduce the connectivity of different areas of habitat. Migratory flight paths will not be significantly disturbed by the development.</p>	<p>The development is located in predominantly cleared areas or at the edges of vegetated areas. The development is unlikely to significantly affect the connectivity of different areas of habitat. Connectivity in the north of the subject land to the adjacent Popran National Park will be maintained.</p> <p>Migratory birds may fly along the Hawkesbury River at times, however, this is not known to be a significant flight path and the potential flight path will not be significantly disturbed.</p>
<p>Optimising project layout to minimise interactions with threatened and protected species and ecological communities</p>	<p>The project has been located in a way that will minimise interactions with TECs.</p>	<p>The biocertification area is predominantly located in existing cleared areas containing exotic grassland. This layout minimises the potential of the development to interact and impact on TECs, and the majority of threatened species whereby most suitable habitat is located in higher quality vegetation.</p> <p>Impacts to buildings (and associated interaction with Eastern Cave Bat) is considered unavoidable in the scope of the proposal. Interactions with microbats roosting in buildings are to be minimised with the implementation of the MMP at the DA stage, prior to/during construction works.</p>
<p>Locating the project to avoid direct impacts on water bodies</p>	<p>The project has been located to minimise direct impacts on waterbodies.</p>	<p>The development has been designed to minimise direct and indirect impacts on waterbodies by minimising development outside of the 20 m inner vegetated riparian zone. There will be no direct impacts to waterbodies.</p>

2.1.3.2 Designing a project to avoid and minimise prescribed biodiversity impacts

The development has been designed in a way which avoids and minimises prescribed biodiversity impacts as outlined in Table 21.

Table 21: Designing a project to avoid and minimise prescribed biodiversity impacts

Approach	How addressed	Justification
Design of the project to maintain environmental processes critical to the formation and persistence of habitat features not associated with native vegetation	The project has been designed such that environmental processes critical to the formation and persistence of habitat features not associated with native vegetation will be maintained where possible.	Geological features including cliffs, caves and rock outcrops which provide potential roosting features will not be impacted by the proposal. Some habitat features including buildings and man-made features providing bat roosting habitat were unavoidable for the development.
Design of the project to maintain hydrological processes that sustain threatened species and TECs	The project will not significantly disrupt hydrological processes that sustain threatened species and TECs.	The project is located at the interface of the Hawkesbury River. The development will not impact the hydrological processes of the river. Strict controls on sediment and runoff must be implemented prior to construction to avoid indirect impacts on hydrology and waterbodies including sedimentation and contamination. It is recommended that a bio-filtration system be implemented to treat stormwater for the development.
Design of the project to avoid and minimise downstream impacts on rivers, wetlands and estuaries by control of the quality of water released from the site.	Controls must be implemented to prevent contaminated runoff and sediments impact the adjacent Hawkesbury River.	A biofiltration system should be installed to reduce the impacts of stormwater runoff during the operational stage of the development.

2.2 Assessment of Impacts

2.2.1 Direct impacts

The direct impacts of the development on:

- Table 22
- threatened ecological communities are outlined in Table 23
- threatened species and threatened species habitat is outlined in Table 24
- prescribed biodiversity impacts are outlined in Section 2.2.2

Table 22: Direct impacts to native vegetation

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)
1557	Rough-barked Apple - Forest Oak - Grey Gum grassy woodland	Northern Hinterland Wet Sclerophyll Forests	Wet Sclerophyll Forests (Grassy sub-formation)	3.17

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)
	on sandstone ranges of the Sydney Basin			
1232	Swamp floodplain forest, Sydney Basin Bioregion and South East Corner Bioregion (including planted vegetation within PCT 1232)	Oak Coastal Swamp Forests	Forested Wetlands	0.16
920	Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Mangrove Swamps	Saline Wetlands	0.03
Total				3.37

Table 23: Direct impacts on threatened ecological communities

PCT ID	BC Act			EPBC Act		
	Listing status	Name	Direct impact (ha)	Listing status	Name	Direct impact (ha)
1232	EEC	Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions	0.16	N/A	N/A	N/A

Table 24: Direct impacts on threatened species and threatened species habitat

Species	Common Name	Vegetation Zones / Description in Biocertification area	Direct impact area (ha)	NSW listing status	EPBC listing status
<i>Cercartetus nanus</i>	Eastern Pygmy Possum	All Zone 1 and 2	0.52	Vulnerable	Not Listed
<i>Chalinolobus dwyeri</i>	Large-eared pied Bat	All Zone 1, 2, 3, 4, 5, 6, 9, 10, 12	3.37	Vulnerable	Vulnerable
<i>Myotis macropus</i>	Southern Myotis	Zone 1, 2, 3, 4, 5, 6, 9, 10, 12 - within 200 m of Hawkesbury River	2.89	Vulnerable	Not Listed

Species	Common Name	Vegetation Zones / Description in Biocertification area	Direct impact area (ha)	NSW listing status	EPBC status	Listing
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	All Zone 1, 2, 3, 4, 5, 6, 9, 10, 12	3.37	Vulnerable	Not Listed	

2.2.2 Change in vegetation integrity

The change in vegetation integrity as a result of the development is outlined in Table 25.

Table 25: Change in vegetation integrity

Veg Zone	PCT ID	Condition	Area (ha)	Current vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity
2	1557	Moderate Condition	0.36	63.7	0	-63.7
3	1557	Gully Influence	0.21	38.2	0	-38.2
4	1557	Poor Condition	1.66	37.1	0	-37.1
5	1557	Acacia Regrowth	0.20	8.9	0	-8.9
6	1557	Planted	0.94	29.4	0	-29.4
9	1232	Degraded	0.06	25.6	0	-25.6
10	1232	Planted	0.46	18.2	0	-18.2
12	920	Good	<0.01	47.2	0	-47.2

2.2.3 Indirect impacts

The indirect impacts of the development are outlined in Table 26.

Table 26: Indirect impacts

Indirect impact	Project phase	Nature	Extent	Frequency	Duration	Timing
Sedimentation and contaminated and/or nutrient rich run-off	Construction / operation	Runoff during construction and operation	Potential sediment and contaminated runoff into adjacent Hawkesbury River	During heavy rainfall or storm events	Throughout construction and operation period	Potentially long-term impacts
Noise, dust or light spill	Construction	Noise and dust from machinery.	Adjacent vegetation and culverts	Daily, during construction works and operational phases	Throughout construction and operation period	Potentially long-term impacts

Indirect impact	Project phase	Nature	Extent	Frequency	Duration	Timing
Inadvertent impacts on adjacent habitat or vegetation	Construction	Damage to adjacent habitat or vegetation	Adjacent to vegetation and habitat features	Daily, during construction works and operational phases	Throughout construction and operation period	Long-term impacts.
Transport of weeds and pathogens from the site to adjacent vegetation	Construction	Spread of weed seed and pathogens from incoming machinery and equipment	Potential spread into nearby habitat	Daily, during construction and operational phases	Throughout construction and operation period	Potentially long-term impacts
Vehicle strike	Construction / operation	Potential for native fauna to be struck by working machinery and moving vehicles	Within biocertification area and adjacent land	Daily, during construction and operational phases	Throughout construction and operation period	Potentially long-term impacts
Trampling of threatened flora species	N/A	No threatened flora species detected during surveys	N/A	N/A	N/A	N/A
Rubbish dumping	Construction / operation	Illegal dumping by workers, residents, public	Potential for rubbish to spread into adjacent vegetation and outside development site	Daily, during construction and operational phases	Throughout life of project	Potentially long-term impacts
Wood collection	Construction / operation	Removal of wood in vegetation adjacent to development site	Throughout adjacent vegetation	Potential to occur at any time during construction or operational phases	Throughout life of project	Short-term impacts
Bush rock removal and disturbance	Construction / operation	Removal of rocks in vegetation adjacent to development site	Potential for disturbance in adjacent vegetation and area surrounding the development site	Potential to occur at any time during construction or operational phases	Throughout life of project	Short-term impacts

Indirect impact	Project phase	Nature	Extent	Frequency	Duration	Timing
Increase in predatory species populations	Construction / operation	Potential for an increase in predatory species in the locality through disturbance to vegetation	Throughout adjacent vegetation	Potential to occur gradually after disturbance to habitat and vegetation takes place	During construction and operation phase of project	Potentially long-term impacts
Increase in pest animal populations	Construction / operation	Potential to increase if food scraps/rubbish is left on site. Potential to increase +/- decrease due to disturbance to existing vegetation.	Throughout adjacent vegetation	Potential to occur gradually after disturbance to habitat and vegetation takes place	During operation and construction phase of project	Potentially long-term impacts
Increased risk of fire	Construction / operation	Potential for fire to spark during construction and operation from any machinery or electrical works	Throughout adjacent vegetation	Potential to occur at any time throughout the operational or construction phases	During operating/ construction hours	During operational /construction hours
Disturbance to specialist breeding and foraging habitat, e.g. beach nesting for shorebirds.	Construction / operation	Impact potential breeding habitat of <i>Vespadelus troughtoni</i> within buildings.	Within old buildings to be refurbished/ removed.	Loss of habitat with refurbishment /removal of buildings.	Throughout life of project	Long-term impacts.

2.2.4 Prescribed biodiversity impacts

An assessment of impacts of the development on prescribed biodiversity impacts is outlined in Table 27 in accordance with Section 9.2.1 of the BAM.

Table 27: Direct impacts on prescribed biodiversity impacts

BAM Criteria	Assessment
9.2.1.3 The assessment of the impacts of the development on the habitat of threatened species or ecological communities associated with human made structures	
a) identify the human made structures with potential to be habitat for threatened species of ecological communities	<p>Several abandoned buildings on Peat Island and around the old nurses' quarters on the mainland provide roosting habitat for Eastern Cave Bat, which was recorded roosting during targeted survey.</p> <p>A culvert is present on Peat Island however no bats or evidence of bats was observed in the culvert.</p>
b) identify the species and ecological communities likely to use the habitat	<p>Known roosting/nesting habitat is available in abandoned buildings for <i>Vespadelus troughtoni</i> (Eastern Cave Bat) which was determined to be present. Potential roosting habitat is also available for:</p> <ul style="list-style-type: none"> • <i>Myotis macropus</i> (Southern Myotis) • <i>Saccolaimus flaviventris</i> (Yellow-bellied Sheath-tail Bat) • <i>Miniopterus australis</i> (Little Bentwing-bat) • <i>Miniopterus schreibersii oceanensis</i> (Eastern Bentwing-bat) <p>However, these additional species were not recorded during survey.</p>
c) describe the nature, extent and duration of short and long-term impacts	<p>The development would result in the permanent removal of known roosting and potential breeding habitat for the above listed microbat species. This is a one-off event which would occur during construction, however, the removal of a potential breeding site is considered a long-term/permanent impact.</p>
d) describe, with reference to relevant literature the importance within the bioregion of the habitat of these species or ecological communities	<p>In general, very little information on the roosting and breeding requirements of the above listed species are known. Southern Myotis has been known to breed in culverts in the Sydney region. Little Bentwing-bat and Eastern Bentwing-bat may occasionally roost in culverts or buildings when caves are not available, they are only known to breed in caves in a small number of locations. Eastern Cave Bat has once been previously recorded breeding in a tin shed in northern NSW.</p> <p>Within the bioregion, similar buildings and culverts are not a rare occurrence. Within the local area there would be several similar culverts.</p> <p>It must be noted that preferred habitat for Eastern Cave Bat is abundant in the locality along the Hawkesbury River escarpment, however, this species was found to be roosting within buildings on multiple occasions, including during the breeding season.</p>
e) predict the consequences of the impacts for the local and bioregional persistence of the suite of threatened species and communities likely to use these areas as habitat, with reference to relevant literature and other published sources of information.	<p>Yellow-bellied Sheath-tail Bat, Eastern Bentwing-bat and Little Bentwing-bat would only use these habitat features on an occasional basis (if at all) for roosting and are unlikely to be breeding within these features in the development site. Eastern Cave Bat was recorded roosting within a building on the island and within</p> <p>Eastern Cave Bat primarily breeds in caves, however, has been found to have permanent maternity roosts within buildings. Targeted surveys found a maternal (lactating) female utilising a building on the island during the breeding season. While a permanent maternity roost was not detected during roost searches, the use of buildings by a maternal female indicates that the buildings are used as a roosting</p>

BAM Criteria	Assessment
	<p>site over the breeding season. The permanent loss of a breeding site may impact the persistence of this species in the locality. However, the preferred roosting habitat for Eastern Cave Bat is caves. The biocertification area is surrounded by the Hawkesbury escarpment which contains many caves and sandstone overhangs which may be used for roosting and breeding habitat. The removal of habitat from the buildings is unlikely to impact the persistence of this species within the Sydney Basin bioregion.</p>
<p>9.2.1.4 The assessment of the impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation</p>	
<p>a) identify the species and ecological communities likely to use the habitat</p>	<p>Low quality foraging habitat is available for mobile threatened species within exotic/cleared vegetation, including Grey-headed Flying Fox and microchiropteran bats.</p>
<p>(b) describe the nature, extent and duration of short and long-term impact</p>	<p>The proposed development will result in the permanent removal of 9.76 ha of exotic/cleared areas, part of which contains non-native vegetation.</p>
<p>(c) describe, with reference to relevant literature and other reliable published sources of information, the importance within the bioregion of the habitat to these species or ecological communities</p>	<p>The exotic vegetation provides only marginal, low quality foraging resources which would be secondary to the large areas of higher quality, native vegetation to be retained. This habitat is not considered important to the survival of any species in the locality.</p>
<p>(d) predict the consequences of the impacts for the local and bioregional persistence of the suite of threatened species and communities likely to use these areas as habitat, with reference to relevant literature and other published sources of information.</p>	<p>The removal of small areas of exotic vegetation is unlikely to impact the persistence of any threatened species in the locality or bioregion. Large areas of high quality native vegetation is available in adjacent areas which is more likely to be utilised than exotic vegetation or cleared areas.</p>
<p>9.2.1.7 The assessment of the impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including subsidence or upsidence resulting from underground mining or other development) must:</p>	
<p>(a) identify water bodies with potential to be habitat for threatened species or threatened ecological communities likely to use the habitat</p>	<p>The proposed development may impact on a small section of mangroves (0.03 ha) which occurs in the Hawkesbury River in the west of the development site.</p>
<p>(b) identify the threatened species and threatened ecological communities likely to use the habitat.</p>	<p>The waterbodies are utilised by Southern Myotis for foraging. Several water dependent birds also have potential foraging habitat within the mangroves and mudflats including:</p> <ul style="list-style-type: none"> • <i>Botaurus poiciloptilus</i> (Australasian Bittern) • <i>Calidris ferruginea</i> (Curlew Sandpiper) • <i>Calidris tenuirostris</i> (Great Knot) • <i>Charadrius mongolus</i> (Lesser Sand-plover) • <i>Esacus magnirostris</i> (Beach-stone Curlew) • <i>Haematopus fuliginosa</i> (Sooty Oystercatcher) • <i>Haematopus longirostris</i> (Pied Oystercatcher) • <i>Ixobrychus flavicollis</i> (Black Bittern)

BAM Criteria	Assessment
	<ul style="list-style-type: none"> • <i>Limicola falcinellus</i> (Broad-billed Sandpiper) • <i>Numenius madagascariensis</i> (Eastern Curlew) (observed near biocertification area) • <i>Rostratula australis</i> (Australian Painted Snipe) • <i>Xenus cinereus</i> (Terek Sandpiper) <p>It is also noted that Freshwater Wetlands and Swamp Oak Floodplain Forest EECs in the development site rely on the hydrology of the Hawkesbury River, however, the direct impact on a small area of the waterbody will not impact these communities.</p>
(c) identify the hydrological processes that sustain threatened species or ecological communities and the species and communities that are dependent on them	<p>Southern Myotis relies on waterbodies for foraging as they fly over water to catch insects.</p> <p>Those above listed wading birds rely on or occasionally utilise mangroves and mudflats for foraging.</p>
(d) describe, with reference to relevant literature and other reliable published sources of information, the importance within the bioregion of the waterbody or hydrological process to these species or ecological communities.	<p>Southern Myotis is known to utilise the water bodies within the site for foraging. The habitat to be impacted makes up only a very small portion of similar habitat available in the wider subject land and bioregion. Given the small area to be impacted (<0.01 ha) it is not considered important on a local or bioregional scale.</p> <p>For those above listed wading birds, the proposed development may result in the removal of 0.03 ha of potential foraging habitat on the mudflats. The area to be impacted (0.03 ha) is minimal, relative to the large areas of adjacent mudflats along the Hawkesbury River. Furthermore, considering the lack of records within or nearby for the majority of these birds, the development site is unlikely to be important habitat for any wading birds, but may be used on an occasional basis. Targeted bird surveys of the mudflats to be impacted did not detect any threatened or migratory species.</p>
(e) describe the nature, extent and duration of short-term impact and long-term impacts on water quality.	<p>Proposed development controls should be implemented during construction and operation to prevent runoff and sedimentation which could affect water quality in the short or long term.</p>
(g) predict the consequences of the impacts for the bioregional persistence of the suite of threatened species and communities likely to use these areas as habitat, with reference to relevant literature and other published sources of information.	<p>The proposed development may result in the loss of 0.03 ha of water foraging habitat for Southern Myotis. Given the small area, relative to the larger areas to be retained within the subject land and larger areas in the locality and bioregion, the proposed development would be unlikely to impact the persistence of Southern Myotis in the locality or bioregion.</p>
(h) predict the nature, extent and duration of short and long-term impacts on the habitat and life cycle of species using the natural features of any water dependent plant community	<p>Southern Myotis and those listed wading birds may use the water and mudflats within the mangrove water dependent community for foraging. The potential removal of 0.03 ha is an isolated event, however is a permanent loss of habitat.</p>
(i) justify predictions of impact on any water dependent plant communities, with appropriate modelling and with reference to relevant literature and other published sources of information	<p>The impacts to water dependent communities will be restricted to the direct construction area. The detailed design should be sensitive to minimise disturbance to the mudflat and substrate which provides foraging habitat for those wading birds.</p>
(j) predict the cumulative impacts of the project together with existing mining operations mining underneath the same water dependent plant communities	<p>N/A</p>

BAM Criteria	Assessment
(k) based on predictions of impacts on water dependant plant communities and the species they support, calculate the maximum predicted offset liability in accordance with the Upland Swamp Policy	N/A
(l) justify any prediction of 'nil' or 'negligible' environmental consequences for any impact on water dependent plant communities and the species they support.	N/A

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 28.

Table 28: Indicative measures proposed to mitigate and manage impacts

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
Displacement of resident fauna	High	Low	<ul style="list-style-type: none"> - Pre-clearance surveys for impacted hollow-bearing trees, nests, buildings and man-made structures. - A Microbat Management Plan (Appendix G) has been prepared to minimise impacts to bats roosting within buildings during construction. The plan proposes pre-construction/demolition roost searches and an exclusion process to ensure all bats have vacated the building before work commences to prevent injury or death of bats. 	Prevent injury to any resident fauna.	Prior to and during construction	Project Manager, Project Ecologist
Timing works to avoid critical life cycle events such as breeding or nursing	Medium	Low	<ul style="list-style-type: none"> - Abandoned buildings within the development site have been identified as containing potential breeding habitat for <i>Vespadelus troughtoni</i> (Eastern Cave Bat). Several hollow-bearing trees will also be removed which provide potential breeding habitat for several microbats, including <i>Myotis macropus</i> (Southern Myotis) which was recorded during the bat call survey. Timing of works to avoid construction during the microbat breeding season (December-March) and during winter when microbats are in torpor for long periods is to be undertaken. Detailed information on mitigation measures for microbats is provided in the MMP. 	Avoid impacts to breeding microbats and other fauna.	During construction	Project Manager
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	Medium	Low	<ul style="list-style-type: none"> - Pre-clearance survey for microbats in buildings / habitat features and any bird / other nests present. - Presence of qualified and vaccinated ecologist during removal/refurbishment of buildings and removal of habitat features. - Monitor response of bats to works/noise. - Detailed protocol is outlined in the MMP. 	Prevent injury to any microbats or other fauna.	During construction	Project Manager, Project Ecologist

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
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	High	Low	- Nest boxes should also be installed to replace hollows and buildings removed/refurbished at a minimum ratio of 1:1 (i.e. 1 nest box installed for each hollow removed).	Provide fauna with compensatory roosting/nesting habitat to replace removed hollow-bearing trees and man-made features.	Prior to construction	Ecologist, Project Manager
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	High	Low	- Boundaries of the impact area to be clearly delineated with fencing, retained areas marked with "No Go" signage, in particular for the riparian areas. - Soil disturbance must be minimised in proximity to the mangroves and mudflats.	Protection of vegetation outside biocertification area	Prior to/during construction	Project Manager
Sediment barriers or sedimentation ponds to control the quality of water released from the site into the receiving environment	Moderate	Low	- Install sediment barriers and erosion control during and post construction to prevent runoff into adjacent Hawkesbury River. Maintain controls throughout construction and undertake weekly inspections. Appropriate stormwater infrastructure is to be installed to manage long term impacts of the development. Consider installation of bio-filtration system for ongoing stormwater management.	Control of erosion, sedimentation and runoff of contaminated substances into adjacent waterways	Throughout life of project	Project Manager
Noise barriers or daily/seasonal timing of construction and operational activities to reduce impacts of noise	Low	Very Low	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	Noise impacts associated with the development will be managed in accordance with guidelines.	Low	Very Low

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
			No work on Sunday or public holidays Night-time works should be avoided to prevent indirect impacts to foraging microbats.			
Light shields or daily/seasonal timing of construction and operational activities to reduce impacts of light spill	Low	Very Low	Conduct works during daylight hours. Where possible, minimise bright lighting adjacent to the retained vegetation or consider use of warm spectrum lower brightness globes or lights with protective shields.	Avoid light disturbance to native fauna during construction and operation.	Low	Very Low
Adaptive dust monitoring programs to control air quality	Low	Very Low	Dust management controls to be implemented during construction.	Control dust and maintain air quality during construction.	During construction.	Project Manager, Contractor.
Temporary fencing to protect significant environmental features such as riparian zones	High	Low	Temporary fencing and signage to be installed at the edge of the development site to prevent entry into the adjacent riparian corridor to be retained and protected.	No unintended clearing or trampling of adjacent vegetation to be retained.	During construction.	Project Manager
Hygiene protocols to prevent the spread of weeds or pathogens between infected areas and uninfected areas	Moderate	Low	Vehicles should be washed down before entering and exiting the site to prevent the spread of weeds and pathogens to or from the development site and adjacent vegetation. Any weed outbreaks should be controlled during the project.	Spread of weeds and pathogens between unaffected areas prevented.	During construction.	Project Manager / Contractors
Staff training and site briefing to communicate environmental features to be protected and measures to be implemented	Low	Very Low	All staff working on the development will undertake an environmental induction as part of their site familiarisation. Site briefings should be updated based on phase of the work. This induction will include items such as: - Site environmental procedures (vegetation management, sediment and erosion control, exclusion fencing and weeds of national significance (WoNS) and priority weeds)	All staff entering the site are fully aware of all environmental aspects relating to the development and know what to do in case of any environmental emergencies	To occur for all staff entering / working at the site and when environmental issues become apparent	Project Manager, all staff

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
			<ul style="list-style-type: none"> - What to do in case of environmental emergency (chemical spills, fire, injured fauna) - Key contacts in case of environmental emergency - Contractors to be briefed on microbat protocol in accordance with the MMP. 			
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	Medium	Low	<p>The proposal includes development within 40 metres of the riparian corridor. As such, a Vegetation Management Plan (VMP) will be required at DA stage in accordance with the <i>Water Management Act 2000</i>. Several areas of native vegetation have been degraded by weed infestation. Particular weeds which are impacting native vegetation and habitat include <i>Lantana camara</i> (Lantana), <i>Asparagus aethiopicus</i> (Ground Asparagus), <i>Erythrina x sykesii</i> (Coral Tree) and <i>Ligustrum sinense</i> (Small-leaved Privet). Ongoing weed management should be undertaken in the subject land to improve the quality of native vegetation. The designated fauna corridor in the north-east of the subject land is severely infested with Lantana and must be managed in order to function as an effective wildlife corridor.</p> <p>The alignment of the lots in the north-east and south-west of the subject land would allow residents private access to the mangrove area. This could potentially result in damage and disturbance to the mangroves due to inappropriate activity from residents. To allow appropriate management of the mangroves the implementation of a community lot behind the residential lots, which would encompass the mangroves, should be considered. Alternatively,</p>	Protection of flora and fauna in adjacent vegetation. Management of retained vegetation and improved biodiversity values.	Approval stage	DA applicant, approval authority.

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
			controls should be implemented to prevent clearing or damage to the mangroves. Demolished buildings and debris are present in the north-west and north of the subject land within vegetation to be retained. This waste should be removed to improve the quality of vegetation.			
Making provision for the ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on or adjacent to the development site	Medium	Low	Preparation and implementation of a VMP is recommended to protect and enhance retained vegetation as described above, particularly with regard to riparian vegetation retained along the foreshore development, and areas of higher quality vegetation in the northern parts of the subject land.	Protection of flora and fauna outside of the biocertification area	Prior to the commencement of construction	DA applicant

2.2.6 Serious and Irreversible Impacts (SII)

Candidate species for Serious and Irreversible Impacts (SII) values are outlined in Table 29. All candidate species which are predicted to have the potential to occur based on the BAM Calculator have been addressed. No candidate SII ecological communities are present in the development site. Detailed consideration of whether impacts on candidate species are serious and irreversible is included in Table 29.

Table 29: SII Candidates

Species / Community	Common Name	Principle	Threshold	Direct impact / description in relation to development
<i>Anthochaera phrygia</i>	Regent Honeyeater	2 & 3	OEH mapped important areas.	The development site does not contain any OEH mapped important areas for this species. Further SII assessment not required for this species.
<i>Calidris ferruginea</i>	Curlew Sandpiper	3	OEH mapped important areas.	The development site does not contain any OEH mapped important areas for this species. Further SII assessment not required for this species.
<i>Calidris tenuirostris</i>	Great Knot	3	OEH mapped important areas.	The development site does not contain any OEH mapped important areas for this species. Further SII assessment not required for this species.
<i>Chalinolobus dwyeri</i>	Large-eared Pied-bat	4	Impacts to breeding habitat - PCTs within 100 m of rocky areas containing caves, overhangs, crevices, cliffs, escarpments or old mines, tunnels, culverts, derelict concrete buildings.	Potential breeding habitat is present within the vicinity of the development site with extensive large cliffs and overhangs along the Hawkesbury River escarpment. No suitable cliffs or caves were recorded within 100 m of the development site. It is noted that several derelict buildings are present which will be refurbished (Peat Island buildings, chapel, nurses quarters)/removed (buildings in north of subject land) as part of the development, however, this species is not known to breed in buildings and it is considered unlikely that a breeding colony will be impacted as a result of habitat within buildings being removed. No individuals were recorded within or adjacent to buildings during roost searches or harp trapping surveys. No maternity roosts are likely to be impacting by the proposed

Species / Community	Common Name	Principle	Threshold	Direct impact / description in relation to development
				biocertification and therefore no further assessment is required.
<i>Lathamus discolor</i>	Swift Parrot	1	OEH mapped important areas.	The development site does not contain any OEH mapped important areas for this species. Further SAIL assessment not required for this species.
<i>Miniopterus australis</i>	Little Bentwing-bat	4	Impacts to breeding habitat - PCTs within 100 m of rocky areas containing caves, overhangs, crevices, cliffs, escarpments or old mines, tunnels, culverts, derelict concrete buildings.	Very few breeding sites are known for this species. Those known site are limited to large maternity caves with <i>Miniopterus schreibersii oceanensis</i> (Eastern Bentwing-bat). No suitable caves or similar within 100 m of the development site. This species was recorded on ultrasonic detectors, however, was not detected near buildings during the harp-trapping survey or roost searches. Further SAIL assessment is not required for this species.
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	4	Impacts to breeding habitat - PCTs within 100 m of rocky areas containing caves, overhangs, crevices, cliffs, escarpments or old mines, tunnels, culverts, derelict concrete buildings.	Very few breeding sites are known for this species. Those known site are limited to large maternity caves with <i>Miniopterus australis</i> (Little Bentwing-bat). No suitable caves or similar within 100 m of the development site. This species was recorded on ultrasonic detectors, however, was not detected near buildings during the harp-trapping survey or roost searches. Further SAIL assessment is not required for this species.
<i>Vespadelus trouhntoni</i>	Eastern Cave Bat	4	Impacts to breeding habitat - PCTs within 100 m of rocky areas containing caves, overhangs, crevices, cliffs, escarpments or old mines, tunnels, culverts, derelict concrete buildings.	Potential breeding habitat is present within the vicinity of the development site with extensive large cliffs and overhangs along the Hawkesbury River escarpment. No suitable cliffs or caves were recorded within 100 m of the development site. It is noted that several buildings are present which will be repurposed/removed as part of the proposal. Targeted survey recorded this species utilising two buildings in the biocertification area. One female displayed signs of lactation, indicating that the buildings are being utilised by maternal individuals during the

Species / Community	Common Name	Principle	Threshold	Direct impact / description in relation to development
				breeding season. An SAI assessment has been undertaken in Table 30.

2.2.6.1 Assessment of SAI on Eastern Cave Bat

An assessment of SAI on Eastern Cave Bat is provided below in Table 30. Locations of roosting habitat relevant to the assessment is shown in

Table 30: Evaluation of potential SAI on *Vespadelus troughtoni* (Eastern Cave Bat).

Impact Assessment Provision (BAM Section 10.2.3.1)	Assessment
<p>(a) The action and measures taken to avoid the direct and indirect impact on the potential entity for an SAI</p>	<p>The proposed development has been located to avoid impacting any potential roosting/nesting habitat within caves, cliffs or rock overhangs. Impacts to buildings containing known roosting habitat within the biocertification area considered unavoidable within the scope of the proposal.</p> <p>Indirect impacts to Eastern Cave Bat will be avoided and mitigated with the implementation of the MMP (Appendix G). The MMP details the methodology for safely removing bats from buildings through a process of exclusion, which is to be undertaken outside of the breeding season and winter roosting season.</p>
<p>(b) The size of the local population directly and indirectly impacted by the development, clearing or biodiversity certification</p>	<p>There is limited information available on a local population of this species. This species has not been previously recorded within 5 km of the development site. Sparse records are present within 20 km of the development site. Several records are located approximately 6.7 km to the east at Patonga, however, considering this species typically travels within 1.5 km and up to 3.75 km between roost sites (Law et. al 2005), these records are likely to form part of a separate population.</p>
<p>(c) The extent to which the impact exceeds any threshold for the potential entity that is specified in the <i>Guidance to assist a decision-maker to determine a serious and irreversible impact</i></p>	<p>The threshold for SAI is outlined as impacts to confirmed breeding habitat. Several individuals were recorded within proximity to the buildings during the harp trapping survey, including two individuals caught exiting the building through a broken window. Multiple female captures, including from the building, had everted, pink nipples indicating lactation (summer of 2019/2020), it is therefore considered that the buildings are being used as a maternity roost.</p> <p>Roost searches were undertaken in April 2020 of buildings proposed to be refurbished/removed, including roof cavities where accessible. Three individuals were recorded in buildings, two in the nurses quarters (one male and one female) and one in a building on Peat Island. While these buildings will be refurbished, not removed, the works will result in the loss of the roosting habitat. There was no evidence of permanent maternity roosts within accessible parts of buildings, these would have been indicated by a build-up of guano and deceased bats. However, it must be noted that the buildings contain many potential entry/exit points, including to cavities between layers of bricks through narrow holes. These cavities were not possible to access and there is potential for permanent roosts to be established in such locations.</p>

Impact Assessment Provision (BAM Section 10.2.3.1)	Assessment
<p>(d) The likely impact (including direct and indirect impacts) that the development, clearing or biodiversity certification will have on the habitat of the local population, including but not limited to:</p>	
<p>(i) An estimate of the change in habitat available to the local population as a result of the proposed development</p>	<p>The biocertification would result in the loss of two known roosts and an additional five potential roost sites within buildings. There are few known breeding sites for this species, however, this species has a preference for breeding and roosting in caves and sandstone cliffs. There is abundant potential habitat in the form of cliffs and sandstone overhangs within the locality along the Hawkesbury escarpment.</p> <p>The overall change to foraging habitat for this species is considered small, with 3.37 ha of foraging habitat to be removed. Substantial areas of suitable foraging habitat will be retained in the locality. 13.82 ha of foraging habitat will be retained within conservation areas in the north of the subject land.</p>
<p>(ii) The proposed loss, modification, destruction or isolation of the available habitat used by the local population, and</p>	<p>Two buildings were confirmed as being used for roosting by the Eastern Cave Bat, one located on Peat Island and the Nurses Quarters on the eastern side of the M1. An additional five buildings were identified as providing potential roosting habitat. While the Peat Island buildings and nurses quarters will be refurbished, not removed, the works will result in the loss of the roosting habitat. Therefore, two known roost sites (one containing maternal females), and five potential roost sites will be lost to the local population.</p> <p>Preferred habitat is considered abundant in proximity to the development site with the presence of cliffs and potential caves along the Hawkesbury escarpment. Only minor impacts to foraging habitat will occur. No habitat for this species will be isolated from other areas of habitat as a result of the development.</p>
<p>(iii) Modification of habitat required for the maintenance of processes important to the species' life cycle (such as in the case of a plant – pollination, seed set, seed dispersal, germination), genetic diversity and long-term evolutionary development</p>	<p>Assuming presence of a breeding site within a building to be refurbished/removed, the loss of a breeding site would impact a critical process for the species lifecycle. Preferred potential roosting habitat is abundant in the adjacent areas due to the presence of cliffs overhangs and caves along the Hawkesbury escarpment.</p>
<p>(e) The likely impact on the ecology of the local population. At a minimum address the following:</p>	
<p>(i) For fauna:</p> <ul style="list-style-type: none"> - breeding - foraging - roosting, and - dispersal or movement pathways 	<p>The proposed development may result in the removal of potential breeding habitat in the form of derelict buildings. While this species typically breeds in caves, it has been previously recorded breeding in a derelict shed and therefore buildings must be considered potential breeding habitat. Multiple individuals were recorded adjacent to buildings during the breeding season, one maternal female (as indicated by lactating or post-lactating nipple) was</p>

Impact Assessment Provision (BAM Section 10.2.3.1)

Assessment

recorded flying out of a building during the breeding season. Therefore, buildings are being used by breeding individuals. It must be noted that no permanent maternity roost sites were recorded during the diurnal roost searches (as would be evident with a build-up of guano and deceased bats). However, it is also to be noted that several parts of buildings (such as between double layers of bricks) have potential entry/exit points that cannot be searched. The biocertification would result in the loss of roosting habitat used by maternal bats, however, in the context of the local landscape there are abundant cliffs and caves in the locality along the Hawkesbury escarpment, which has high potential to contain alternative roosting habitat and may form part of the network of roosts within the locality.

The species typically forages in wet sclerophyll forest within the vicinity of sandstone cliff lines and caves. The proposed development would result in the removal of 3.37 ha of foraging habitat, however, an abundance of foraging habitat would be retained within the wider development site and adjacent vegetation.

Confirmed roosting habitat has been identified within buildings to be refurbished/removed from the development site. Eastern Cave Bats have been previously found to switch roosts frequently (Law et. al 2005), typically within 1.5 km and up to 3.75 km apart. It is considered that the buildings are likely to form part of a local network of roosts, which is likely to include cliffs and caves along the Hawkesbury escarpment, considering caves are the preferred roosting habitat of this species. The proposed biocertification would result in the loss of two roost sites within buildings and five additional buildings which have been identified as potential roosting habitat.

Eastern Cave Bat is a highly mobile species and the proposed development is unlikely to impact the potential for this species to disperse from the development site to areas of adjacent habitat to forage, roost or breed.

(f) A description of the extent to which the local population will become fragmented or isolated as a result of the proposed development

The Eastern Cave Bat is a highly mobile species. The removal of this roosting habitat as well as the removal of foraging habitat will not result in the fragmentation or isolation of a local population of this species.

(g) The relationship of the local population to other population/populations of the species. This must include consideration of the interaction and importance of the local population to other population/populations for factors such as breeding, dispersal and genetic viability/diversity, and whether the local population is at the limit of the species' range

Limited information is available on any local populations. The development site is towards the southern end of the species range, as mapped on the NSW threatened species profile. Sporadic records of this species are located throughout Sydney, however the majority of these (excluding one record at Avalon) are ultrasonic recordings and may potentially be *Vespadelus pumilus* or *Vespadelus vulturnus*. There are a number of confirmed records approximately 6.7 km to the east at Patonga, along the Hawkesbury River. There is potential for dispersal between

Impact Assessment Provision (BAM Section 10.2.3.1)	Assessment
	these locations for as habitat is contiguous for this highly mobile species.
(h) The extent to which the proposed development will lead to an increase in threats and indirect impacts, including impacts from invasive flora and fauna, that may in turn lead to a decrease in the viability of the local population	The proposed development would result in increased human activity around the roosting habitat. This may deter this species from roosting or nesting in similar adjacent habitat in retained or new buildings. This has the potential to decrease the viability of the population within and directly adjacent to the biocertification area, however, within the wider subject land and adjacent areas, the abundance of potential roosting and breeding habitat (within cliffs, caves and sandstone overhangs along the Hawkesbury River) will be maintained.
(i) An estimate of the area, or number of populations and size of populations that is in the reserve system in NSW, the IBRA region and the IBRA subregion	There is limited information on this species to provide an accurate estimate of the number and size of populations of this species in NSW, the IBRA region or the IBRA subregion.
(j) The measure/s proposed to contribute to the recovery of the species in the Interim Biogeographic Regionalisation for Australia (IBRA) subregion.	If credits are available, species credits for Eastern Cave Bat should be sourced from within the Pittwater subregion. A MMP has been prepared to mitigate impacts to this species during works, however, no additional measures have been proposed to contribute to the recovery of this species.

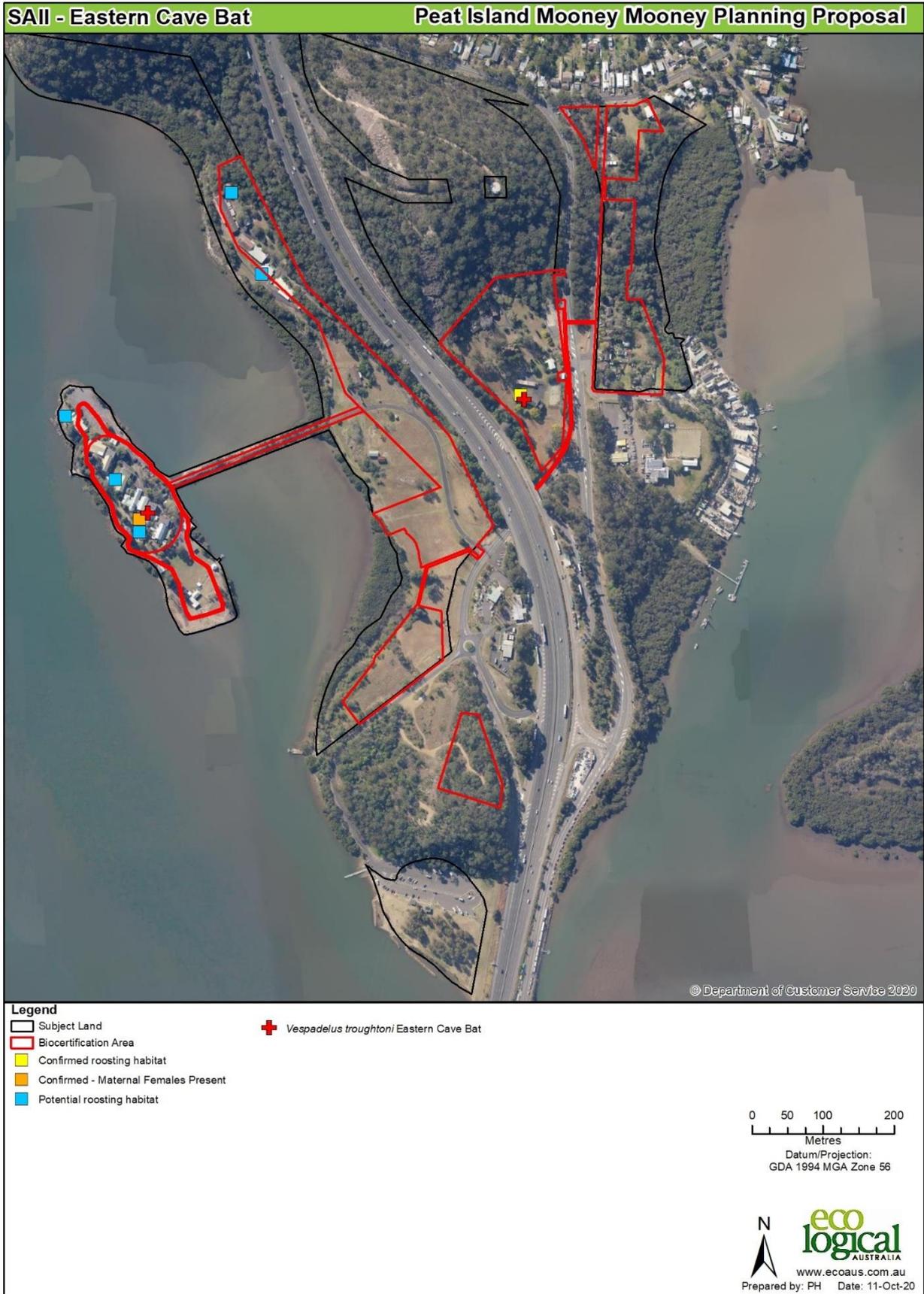


Figure 27: Roosting locations of Eastern Cave Bat

2.3 Risk assessment

A risk assessment has been undertaken for any residual impacts likely to remain after the mitigation measures (Section 2.2.5) have been applied. Likelihood criteria, consequence criteria and the risk matrix are provided in Table 31, Table 32 and Table 33 respectively.

Table 31: 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 32: 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.
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 33: 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 34: Risk assessment

Potential impact	Project phase	Risk (pre-mitigation)	Risk (post mitigation)
Vegetation clearing	Construction / operation	High	Low
Sedimentation and contaminated and/or nutrient rich run-off	Construction	High	Low
Noise, dust or light spill	Construction	Medium	Low
Inadvertent impacts on adjacent habitat or vegetation	Construction	High	Low
Transport of weeds and pathogens from the site to adjacent vegetation	Construction	Medium	Low
Rubbish dumping	Construction / operation	Low	Very Low
Wood collection	Construction / operation	Medium	Low
Bush rock removal and disturbance	Construction / operation	Medium	Low
Disturbance to specialist breeding and foraging habitat, e.g. abandoned buildings providing habitat for microbats	Construction / operation	High	High

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 potential candidate Serious and Irreversible Impacts (SII) values as outlined above in Table 29. Detailed consideration of whether impacts on candidate species are serious and irreversible is included above in Table 29 and Table 30.

Assessment of SAIL on Eastern Cave Bat

2.4.1.1 An assessment of SAIL on Eastern Cave Bat is provided below in Table 30. Locations of roosting habitat relevant to the assessment is shown in

Table 30.

Table 35: Serious and Irreversible Impacts Summary

Species / Community	Common Name	Principle	Direct impact individuals / area (ha)
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	4	Impact to known roosting habitat used by maternal females during the breeding season.

2.4.2 Impacts requiring offsets

The impacts of the development requiring offset for native vegetation are outlined in Table 36 and shown on Figure 28. The impacts of the development requiring offset for threatened species and threatened species habitat are outlined in Table 37 and on Figure 28.

Table 36: Impacts to native vegetation that require offsets

Zone	PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)
2	1557	Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	Northern Hinterland Wet Sclerophyll Forests	Wet Sclerophyll Forests (Grassy sub-formation)	0.53
3	1557	Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	Northern Hinterland Wet Sclerophyll Forests	Wet Sclerophyll Forests (Grassy sub-formation)	0.26
4	1557	Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	Northern Hinterland Wet Sclerophyll Forests	Wet Sclerophyll Forests (Grassy sub-formation)	1.84
6	1557	Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	Northern Hinterland Wet Sclerophyll Forests	Wet Sclerophyll Forests (Grassy sub-formation)	0.38
9	1232	Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion	Coastal Swamp Forests	Forested Wetlands	0.16
12	920	Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Mangrove Swamps	Saline Wetlands	0.03*
Total					3.19

*Although it is intended to not require removal of PCT 920 – Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion, for the purposes of the BCAR, an impact area of 0.03 ha has been included as a precautionary measure

Table 37: Impacts on threatened species and threatened species habitat that require offsets

Species	Common Name	Direct impact number of individuals / habitat (ha)	NSW listing status	EPBC Listing status
<i>Cercartetus nanus</i>	Eastern Pygmy Possum	0.52	Vulnerable	Not Listed
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	3.37	Vulnerable	Vulnerable
<i>Myotis macropus</i>	Southern Myotis	2.89	Vulnerable	Not Listed
<i>Vespadelus troughtoni</i>	Little Cave Bat	3.37	Vulnerable	Not Listed

2.4.3 Impacts not requiring offsets

The impacts of the development not requiring offset for native vegetation are outlined in Table 38 and shown on Figure 30.

Table 38: Impacts to native vegetation that do not require offsets

Zone	PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)	Rationale
5	1557	Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	Northern Hinterland Wet Sclerophyll Forests	Wet Sclerophyll Forests (Grassy sub-formation)	0.17	Vegetation integrity score (8.9) lower than threshold

2.4.4 Areas not requiring assessment

Areas not requiring assessment are shown on Figure 31. These areas consist of roads, hard urban surfaces, exotic grassland and planted exotic vegetation.

2.4.5 Credit summary

The number of ecosystem credits required for the development are outlined in Table 39. The number of species credits required for the development are outlined in Table 40. A biodiversity credit report is included in Appendix I.

Table 39: Ecosystem credits required

Zone	PCT ID	PCT Name	Vegetation Formation	Direct impact (ha)	impact	Credits required
2	1557	Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	Wet Sclerophyll Forests (Grassy sub-formation)	0.53		13

Zone	PCT ID	PCT Name	Vegetation Formation	Direct impact (ha)	Credits required
3	1557	Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	Wet Sclerophyll Forests (Grassy sub-formation)	0.26	4
4	1557	Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	Wet Sclerophyll Forests (Grassy sub-formation)	1.84	26
6	1557	Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	Wet Sclerophyll Forests (Grassy sub-formation)	0.38	1
9	1232	Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion	Forested Wetlands	0.16	2
12	920	Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Saline Wetlands	0.03	1
Total				3.37	50

Table 40: Species credit summary

Species	Common Name	Direct impact number of individuals / habitat (ha)	Credits required
<i>Cercartetus nanus</i>	Eastern Pygmy Possum	0.52	17
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	3.37	96
<i>Myotis macropus</i>	Southern Myotis	2.89	59
<i>Vespadelus troughtoni</i>	Little Cave Bat	3.37	96
Total			268

2.5 Offset Plan and Conservation Measures

No formal conservation measures in the form of stewardship sites have been proposed as part of this biocertification application. However, large areas of good condition intact vegetation have been proposed for protection within an E2 – Environmental Conservation zoning in the north of the biocertification area on Tank Hill and in the north-west, adjoining Popran National Park. This rezoning will ensure long-term protection of these areas of native vegetation and threatened species habitat. The vegetation proposed for conservation under the E2 zoning is outlined in Table 41. A total of 13.82 ha of native vegetation is proposed for retention.

Table 41: Vegetation proposed for retention under E2 Environmental Conservation Zoning

PCT ID	PCT Name	Condition	Area of native vegetation within conservation area (ha)
1557	Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	Good	4.17
1557	Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	Moderate	0.07
1557	Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin	Poor	2.94
1083	Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	Good	4.60
1183	Smooth-barked Apple - Sydney Peppermint - Turpentine heathy open forest on plateaux areas of the Sydney Basin Bioregion	Good	1.41
1232	Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion	Degraded	0.08
920	Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Moderate	0.55
Total			13.82

As outlined in Section 2.4.5, the proposed development will require the offset of 50 ecosystem credits and 268 species credits. The delivery of these credits will fulfil the conservation measures requirement of the biocertification. The conservation measures requirement to fulfil the credit offset obligation is outlined in

Table 42: Conservation measures implementation plan

Conservation measure requirement	Implementation
Mechanism for delivery of conservation measures	The conservation measures (i.e. meeting the offset obligation) will be achieved through purchasing credits from the market to retire (where possible), or payment into the Biodiversity Conservation Fund (BCF). Where available, and at the request of Central Coast Council, credits should be secured within the LGA.

Conservation measure requirement	Implementation
Responsibility for delivery, including details of biodiversity certification agreements entered or proposed to be entered into	It is the responsibility of Property & Development NSW to fulfil the offset obligation of this biocertification agreement.
Timing of implementation of conservation measures	Detailed timing of meeting credit obligations for the proposed biocertification has not yet been determined by Property & Development NSW. The offset obligation should be met prior to issue of the first construction certificate.
Funding sources for delivery of conservation measures	The funding sources for delivery of conservation measures (offset obligation) is the responsibility of Property & Development NSW.
Framework for monitoring, reporting or auditing of the implementation of proposed conservation measures	No stewardship site or similar conservation measures will be implemented for the proposed biocertification. Conservation measures (offset obligation) will be met through purchase of credits from the marked or payment into the BCF. As such, no monitoring or reporting component is proposed.

Ecosystem Impacts Requiring Offset **Peats Island Mooney Mooney Planning Proposal**

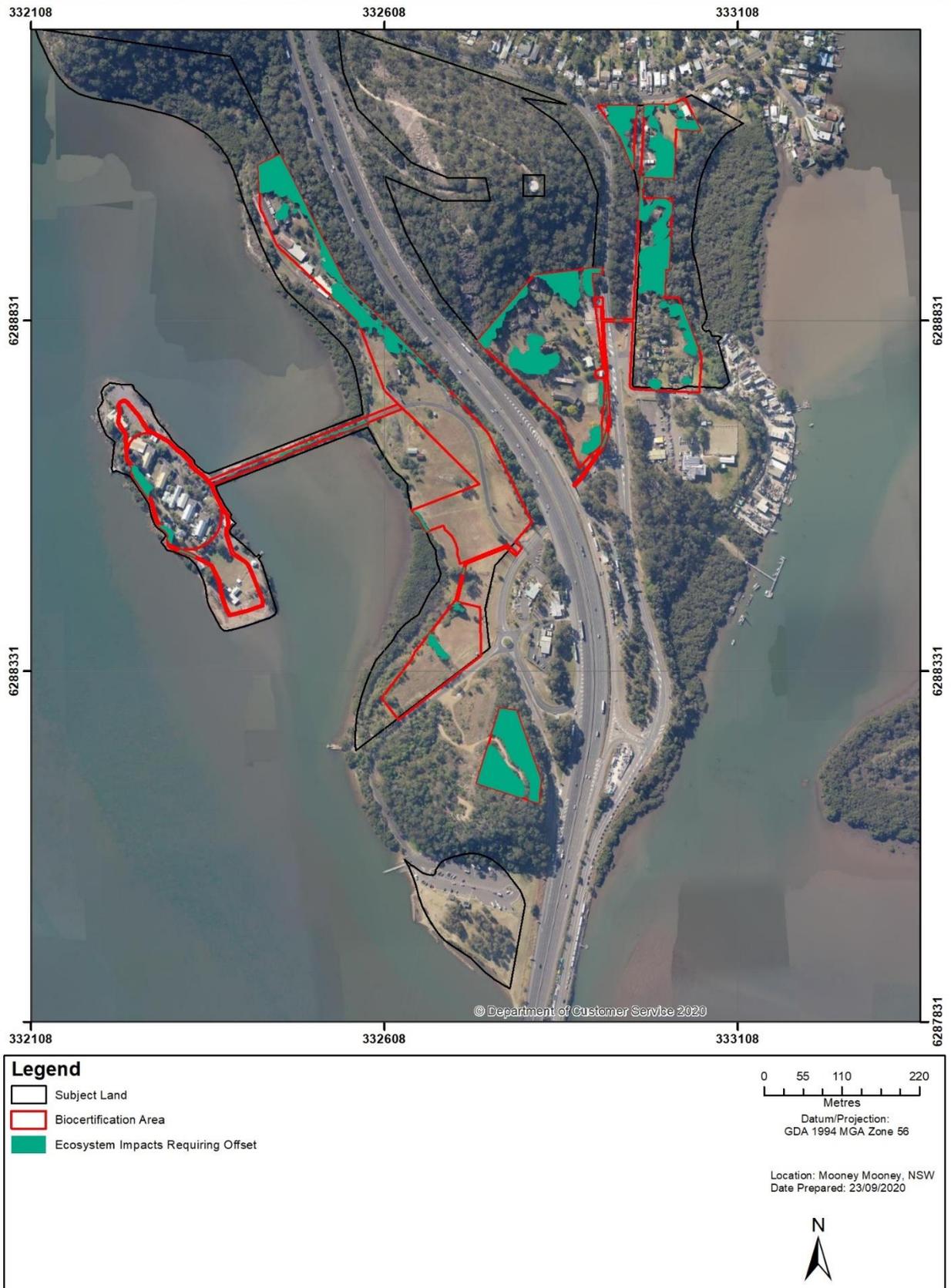


Figure 28: Ecosystem Impacts requiring offset

Species Impacts Requiring Offset **Peat Island Mooney Mooney Planning Proposal**



Figure 29: Species Impacts requiring offset

Ecosystem Impacts Not Requiring Offset **Peats Island Mooney Mooney Planning Proposal**

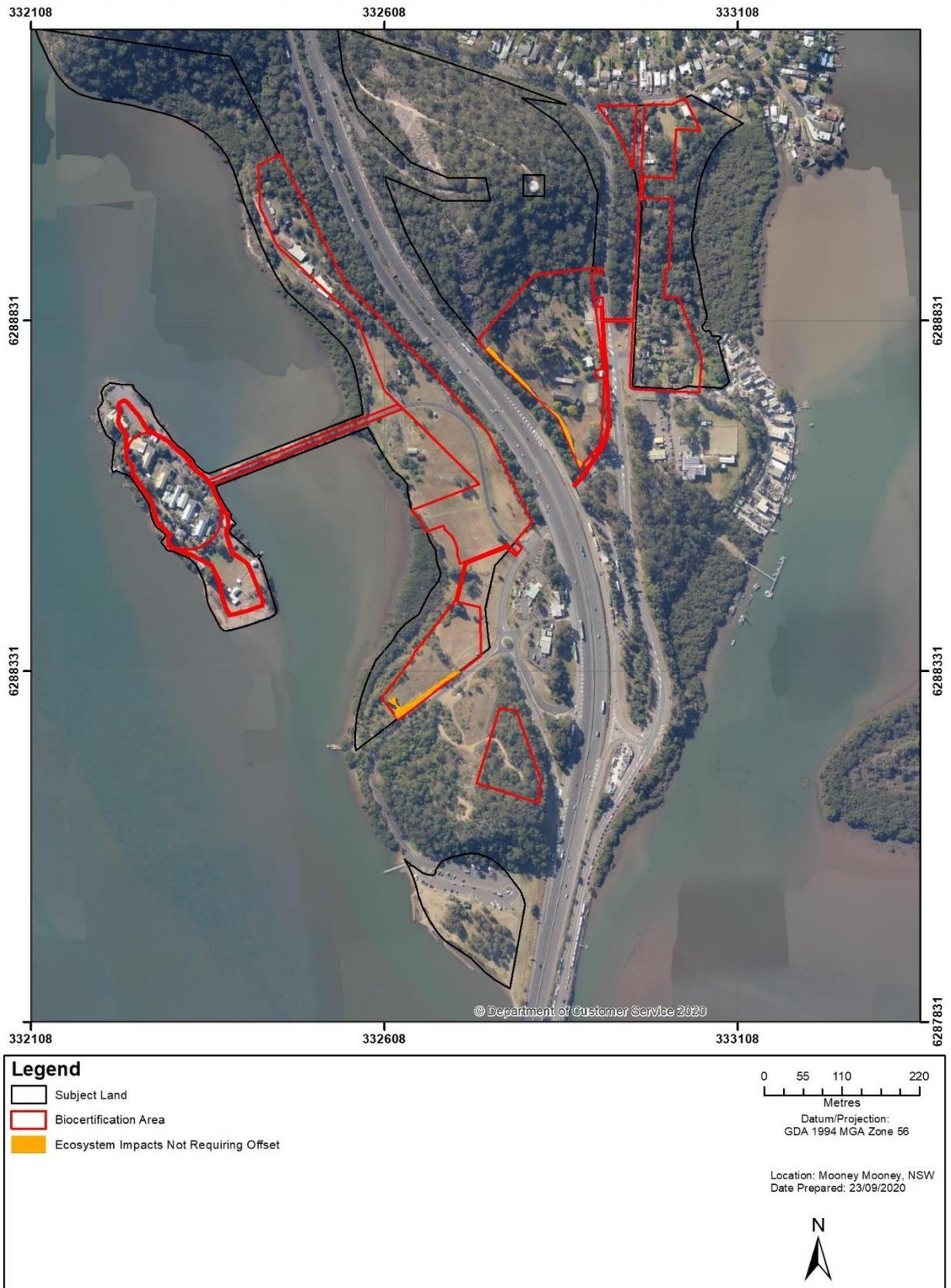


Figure 30: Impacts not requiring offset

Ecosystem Impacts Not Requiring Assessment Peats Island Mooney Mooney Planning Proposal

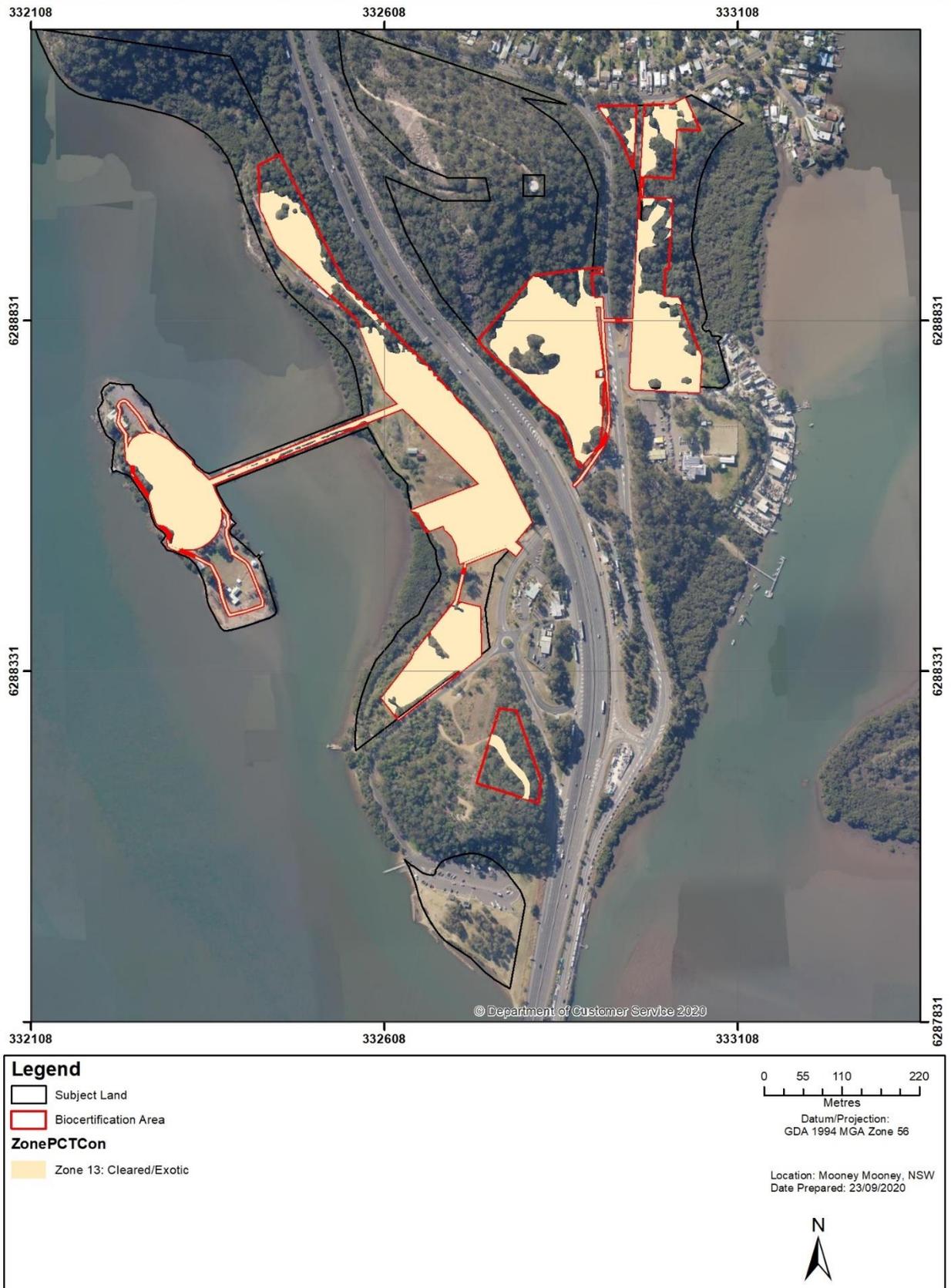


Figure 31: Areas not requiring assessment

Proposed Conservation Zone Peat Island Mooney Mooney Planning Proposal

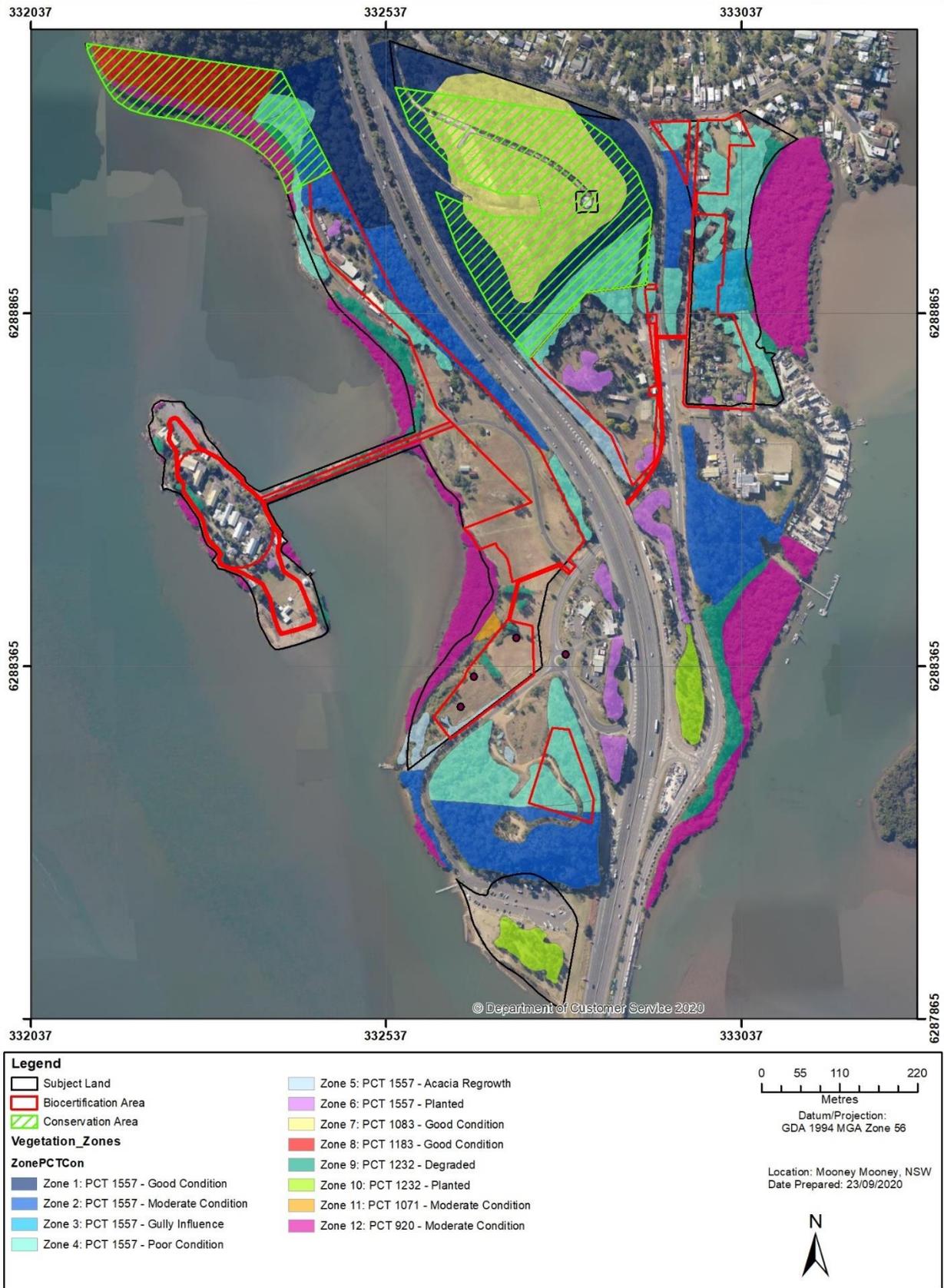


Figure 32: Area proposed for conservation under E2 Zoning

3. Consistency with legislation and policy

3.1 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

Several threatened and migratory fauna species listed under the EPBC Act have potential habitat within the development site:

- *Anthochaera phrygia* (Regent Honeyeater) – Critically Endangered
- *Calidris ferruginea* (Curlew Sandpiper) – Critically Endangered
- *Lathamus discolor* (Swift Parrot) – Critically Endangered
- *Numenius madagascariensis* (Eastern Curlew) – Critically Endangered and Migratory
- *Rostratula australis* (Australian Painted Snipe) - Endangered
- *Chalinolobus dwyeri* (Large-eared Pied Bat) – Vulnerable
- *Pteropus poliocephalus* (Grey-headed Flying-fox) – Vulnerable
- *Actitis hypoleucos* (Common Sandpiper) – Migratory
- *Calidris acuminata* (Sharp-tailed Sandpiper) – Migratory
- *Calidris melanotos* (Pectoral Sandpiper) – Migratory
- *Gallinago hardwickii* (Latham’s Snipe) – Migratory
- *Tringa nebularia* (Common Greenshank) – Migratory

Regent Honeyeater and Swift Parrot have only marginal foraging habitat available and would be unlikely to frequently use these resources in the development site. The development site has not been mapped as an “important area” by DPIE for these species. Large-eared Pied Bat was recorded within the development site and Grey-headed Flying-fox has abundant foraging habitat available in the development site. Eastern Curlew was recorded to the east of the development site. Significance Assessments have been undertaken for those species listed above (Appendix E). It was determined that the proposed development would be unlikely to have a significant impact on these species.

The development site has not been mapped as an Important Bird Area (IBA) by Birds Australia (2009), however under the EPBC Policy Statement 3.21 Industry Guidelines for assessing and mitigating impacts on EPBC Act listed migratory shorebird species, impacts to migratory shorebird habitat needs to consider whether the habitat is internationally significant or nationally significant, based on the number of birds and the percentage of the Australasian Flyway population that regularly visit the site. As the site is relatively small compared to the extent of similar habitat in the Hawkesbury estuary and there are limited records of migratory shorebirds in proximity to the site, it is unlikely that the site is considered nationally or internationally important. Figure 33 demonstrates that records of threatened and migratory waterbirds (BioNet) in proximity to the development site are sparse. Within the region, waterbird records are concentrated around Brisbane Water and coastal areas, with records relatively sparse moving upstream in the Hawkesbury River. It is noted, however, that Hornsby Shire Council undertook an extensive estuarine bird survey in 2011-2012, which noted the highest numbers of waterbird species have been recorded at Brooklyn/Dangar Island and Laughtondale. Dangar Island was identified as one of the most important sites in the Hornsby Shire for migratory shorebirds, who briefly stopover during migrations. The study concluded that the numbers of shorebirds have been declining in recent years.

Impacts of the proposed development on migratory shorebirds are unlikely to be significant. Assessment of the marina, which is subject to a future planning proposal, will need to consider potential mitigation measures and the impact assessment criteria in EPBC Policy Statement 3.21 Industry Guidelines for assessing and mitigating impacts on EPBC Act listed migratory shorebird species.

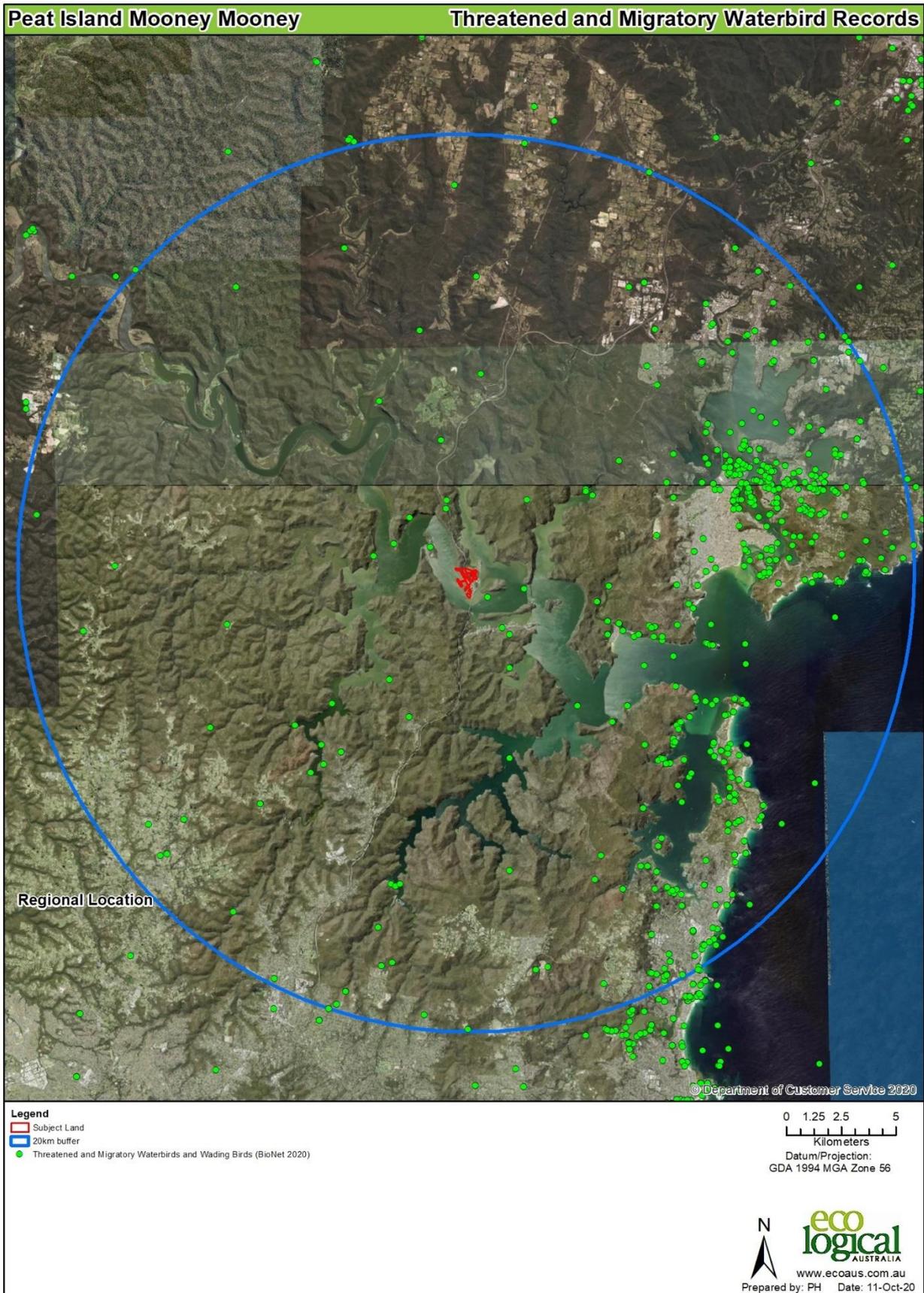


Figure 33: Records for threatened/migratory water birds within 20km of the development site.

3.2 State Environmental Planning Policy (Coastal Management) 2018

SEPP (Coastal Management) 2016 replaces SEPP 14 – Coastal Wetlands, SEPP 26 – Littoral Rainforests and SEPP 71 – Coastal Protection. The development site contains land mapped under the Coastal Management SEPP as Coastal Wetlands and Coastal Wetlands Proximity Area. The proposal will involve damage to native vegetation, marine vegetation and carrying out of earthworks within land mapped as Coastal Wetlands. Therefore, development within these areas will be declared to be designated development. Removal of terrestrial native vegetation will be addressed through assessment and offsetting under the BC Act. The removal of marine vegetation should be assessed in accordance with the *Fisheries Management Act 1994* (FM Act) and has been addressed in further detail in the Riparian and Aquatic Constraints Assessment. It is noted that the development is currently at the Gateway Determination stage, and will not result in any direct impacts until after the DA stage. However, assessment has been undertaken for terrestrial biodiversity related impacts on the SEPP Coastal Wetland Proximity Area in Table 44. Although it is intended to not require removal of 0.03 ha of mangroves (*PCT 920 – Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion*), for the purposes of this report, this impact area has been included as a precautionary measure

Table 43: Coastal Wetland assessment

SEPP Coastal Management (2018) Clause	Assessment
<i>Clause 10 (4)</i>	
<i>A consent authority must not grant consent for development referred to in subclause (1) unless the consent authority is satisfied that sufficient measures have been, or will be, taken to protect, and where possible enhance, the biophysical, hydrological and ecological integrity of the coastal wetland or littoral rainforest.</i>	The proposal has been located to minimise, where possible, impacts to the Coastal Wetland. Small areas may be impacted for infrastructure related to the marina, and minor encroachment in the north-west will occur due to the residential development (note that detailed impacts relating to the marina will be subject to a separate planning proposal). This assessment has been undertaken at the planning proposal stage, therefore, detailed design and engineering controls have not yet been determined. Stormwater controls and stringent construction mitigation measures are required to be implemented to ensure the quality and quantity of water discharged from future development would not result in degradation and damage to the Coastal Wetland.

Table 44: Coastal Wetland Proximity Area assessment

SEPP Coastal Management (2018) Clause	Assessment
<i>Clause 11 (1) Development consent must not be granted to development on land identified as “proximity area for coastal wetlands” or “proximity area for littoral rainforest” on the Coastal Wetlands and Littoral Rainforests Area Map unless the consent authority is satisfied that the proposed development will not significantly impact on—</i>	
<i>(a) the biophysical, hydrological or ecological integrity of the adjacent coastal wetland or littoral rainforest, or</i>	The proposed works will impact on 0.87 ha of coastal wetland proximity area (including 0.03 ha of mangroves). The impacts within the proximity area involves vegetation removal for the residential development and APZs, infrastructure relating to the future marina and recreational facilities (note that detailed impacts relating to the marina will be subject to a separate planning proposal, however,

SEPP Coastal Management (2018) Clause	Assessment
	<p>land based impacts resulting from supporting infrastructure have been assessed in this report). The adjacent wetland is considered to be in degraded to good condition with regards to ecological integrity. Where mangroves are present, the wetland is generally in good condition. Parts of the wetland containing Swamp Oak Forest are degraded by weed incursion and past land clearing. The majority of areas to be impacted within the Coastal Wetland Proximity Area are cleared, exotic or degraded. The proposal will, however, impact native vegetation within the Coastal Wetlands Proximity Area. Overall, impacts to vegetation within the Coastal Wetland have been minimised through locating the development in suitable area.</p> <p>Detailed stormwater controls should be implemented to ensure discharge from the development does not have significant impacts and result in degradation to the Coastal Wetland.</p>
<p><i>(b) the quantity and quality of surface and ground water flows to and from the adjacent coastal wetland or littoral rainforest.</i></p>	<p>Impacts to the quantity and quality of surface and groundwater flows to and from the adjacent coastal wetland have not been assessed as part of this report. The impacted area is proposed to be used for residential and recreational development. As this assessment is being undertaken at the planning proposal stage, detailed design and engineering controls have not yet been determined with regards to the development design and stormwater management. Issues relating to water quality and quantity discharging into the wetland will need to be addressed in detail during the design phase to ensure the biophysical, hydrological and ecological integrity of the wetlands are maintained.</p>



Figure 34: SEPP (Coastal Management) 2018

3.3 Sydney Regional Environmental Plan (SREP) No 20—Hawkesbury-Nepean River

DPIE requested that policies relating to flora and fauna in the SREP be further considered. Part 1 Clause 6 (6) of the policy relates to flora and fauna and has been addressed below:

Policy: Manage flora and fauna communities so that the diversity of species and genetics within the catchment is conserved and enhanced.

Strategies, generally:

(a) Conserve and, where appropriate, enhance flora and fauna communities, particularly threatened species, populations and ecological communities, aquatic habitats, wetland flora, rare flora and fauna, riverine flora, flora with heritage value, habitats for indigenous and migratory species of fauna, and existing or potential fauna corridors.

The proposed development will conserve large areas of suitable flora and fauna habitat with bushland adjacent to the biocertification area. In the north-west of the development site, a fauna corridor will be maintained in a strip of vegetation adjacent to the M1 which connects to Popran National Park. Existing connectivity in the south-west of the development site is tenuous. The waterfront vegetation will be retained which will provide continued connectivity to the north, however, the development will reduce the quality of this connectivity. A designated fauna corridor will be retained within the proposed residential area in the north-east of the development site, linking vegetation in the east to Tank Hill.

It is recommended that management of degraded vegetation, particularly riparian areas, be undertaken to enhance habitat for flora and fauna communities. Controls should be implemented to minimise disturbance to wetland flora and fauna within private and public lands.

(b) Locate structures where possible in areas which are already cleared or disturbed instead of clearing or disturbing further land.

Biocertification areas have been predominantly located in cleared areas or where native vegetation is generally in poor condition. The residential area in the north-east of the site will be located in an area of moderate quality native vegetation. Areas of highest quality vegetation at Tank Hill and adjacent to Popran National Park will not be disturbed. A total of 10.96 ha of native vegetation will be retained within conservation areas, 3.37 ha of native vegetation will be removed.

(c) Minimise adverse environmental impacts, protect existing habitat and, where appropriate, restore habitat values by the use of management practices.

The development has been designed to minimise the removal of native vegetation by locating footprints in cleared or disturbed areas. Some areas of moderate quality native vegetation will be impacted by the proposal and several hollow-bearing trees will be removed. A Vegetation Management Plan should be prepared at the DA stage and implemented to ensure restoration of habitat values and improve the quality of native vegetation to be retained.

(d) Consider the impact on ecological processes, such as waste assimilation and nutrient cycling.

Footprints have been located predominantly in cleared/exotic and disturbed areas. Impacts on waste assimilation and nutrient cycling have not been determined at this stage.

(e) Consider the range of flora and fauna inhabiting the site of the development concerned and the surrounding land, including threatened species and migratory species, and the impact of the proposal on the survival of threatened species, populations and ecological communities, both in the short and longer terms.

The proposal will result in the removal of 0.16 ha of degraded EEC Swamp Oak Floodplain Forest. This EEC does not have high conservation value in the development site.

The proposal will impact on 3.37 ha of habitat of native vegetation which provides potential habitat for several threatened species. Impact areas have been predominantly located in cleared areas or degraded vegetation. Areas of highest quality vegetation and habitat, in particular the north-east of the development site adjacent to Popran National Park and Tank Hill in the north of the development site, will be retained. Offsetting in accordance with the NSW BAM will be undertaken to compensate lost habitat for threatened flora, fauna and ecological communities.

(f) Consider the need to provide and manage buffers, adequate fire radiation zones and building setbacks from significant flora and fauna habitat areas.

Impacts on native vegetation associated with Asset Protection Zones (APZs) have been included in impact area calculations. APZs have been located primarily within poor quality vegetation, and in moderate vegetation in the north-west of the site. Setbacks from the foreshore have been established in the concept plan for residential properties which back on to the waterfront to minimise impacts to mangroves and the riparian corridor. The proposed marina, however, will result in the removal of a small area of mangroves. note that detailed impacts relating to the marina will be subject to a separate planning proposal, however, land based impacts resulting from supporting infrastructure have been assessed in this report.

(g) Consider the need to control access to flora and fauna habitat areas.

Several private properties extend into the foreshore area where mangroves are present. Building footprints for residential development will not be located within mangroves. The plan should consider making a community lot where mangroves are present to reduce private use of the vegetation which may result in degradation.

A pedestrian path is proposed to be built throughout public areas. This should limit foot traffic off the pedestrian path into adjacent vegetation.

It is proposed that the north-west of the development site and north of the development site (Tank Hill) be rezoned to public recreation E2 – Environmental Conservation. This would increase foot traffic through these areas of high quality vegetation. It is considered that these areas are suitable for access provided that pathways be aligned to minimise impacts on adjacent vegetation

(h) Consider the need to maintain corridors for fish passage, and protect spawning grounds and gravel beds.

The proposed development is unlikely to prevent fish passage. Impacts on fish habitat have been outlined in more detail in the Riparian and Aquatic Constraints Assessment.

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Appendix A Definitions

Terminology	Definition
Biocertification area	The area of land proposed for biodiversity certification that is directly impacted on by a proposed development, including access roads, and areas used to store construction materials.
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 biocertification area, 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 DPIE 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 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 biocertification area 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 biocertification area. In cases where multiple populations occur in the biocertification area or a population occupies part of the biocertification 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 DPIE, which is a guide to assist assessors when using the BAM
Patch size	An area of intact native vegetation that: a) occurs on the biocertification area 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 biocertification area 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 DPIE 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 biocertification area, 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 Vegetation Plot Data

Table 45: Species matrix (species recorded by plot)

Species name	Exotic (*)	Form	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5	Cover (%) Plot 6	Cover (%) Plot 7	Cover (%) Plot 8	Cover (%) Plot 9	Cover (%) Plot 10	Cover (%) Plot 11	Cover (%) Plot 12	Cover (%) Plot 13	Cover (%) Plot 14	Cover (%) Plot 15	Cover (%) Plot 16	Cover (%) Plot 17
<i>Acacia brownii</i>		Shrub (SG)	0		0.1															
<i>Acacia falcata</i>		Shrub (SG)	0							5		0.1								
<i>Acacia implexa</i>		Shrub (SG)	0			3							75		0.1				1	
<i>Acacia longissima</i>		Shrub (SG)	0		2							3								
<i>Acacia oxycedrus</i>		Shrub (SG)	0									0.1								
<i>Acacia saligna</i>	*	0	0												20					
<i>Acacia spp.</i>		Shrub (SG)	0															0.2	0.1	
<i>Acacia ulicifolia</i>		Shrub (SG)	0								0.1		0.1							
<i>Acianthus spp.</i>		Forb (FG)	0	0.1																
<i>Actinotus helianthi</i>		Forb (FG)	0											0.1						

Species name	Exotic (*)	Form	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5	Cover (%) Plot 6	Cover (%) Plot 7	Cover (%) Plot 8	Cover (%) Plot 9	Cover (%) Plot 10	Cover (%) Plot 11	Cover (%) Plot 12	Cover (%) Plot 13	Cover (%) Plot 14	Cover (%) Plot 15	Cover (%) Plot 16	Cover (%) Plot 17
<i>Adiantum aethiopicum</i>		Fern (EG)	0								0.1			0.1		0.1				
<i>Ageratina adenophora</i>	*	0	1							0.4										
<i>Allocasuarina littoralis</i>		Tree (TG)	0		3						3		1		0.2				0.1	
<i>Allocasuarina torulosa</i>		Tree (TG)	0		0.2	0.5													0.5	
<i>Alphitonia excelsa</i>		Tree (TG)	0		0.1	10					0.1									
<i>Alternanthera denticulata</i>		Forb (FG)	0						3											
<i>Amyema spp.</i>		Other (OG)	0										0.2							
<i>Angophora bakeri</i>		Tree (TG)	0								1									
<i>Angophora costata</i>		Tree (TG)	0	3									3		0.1					
<i>Angophora floribunda</i>		Tree (TG)	0		5	10					2								5	
<i>Araujia sericifera</i>	*	0	1					0.1												
<i>Aristida vagans</i>		Grass & grasslike (GG)	0								3									

Species name	Exotic (*)	Form	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5	Cover (%) Plot 6	Cover (%) Plot 7	Cover (%) Plot 8	Cover (%) Plot 9	Cover (%) Plot 10	Cover (%) Plot 11	Cover (%) Plot 12	Cover (%) Plot 13	Cover (%) Plot 14	Cover (%) Plot 15	Cover (%) Plot 16	Cover (%) Plot 17
<i>Asparagus aethiopicus</i>	*		1		5	2	0.1	0.5						0.1		0.1				
<i>Asparagus asparagoides</i>	*		1																0.1	
<i>Astrotricha floccosa</i>		Shrub (SG)	0	0.1																
<i>Avicennia marina var. australasica</i>			0				75													
<i>Banksia integrifolia</i>		Tree (TG)	0																3	
<i>Banksia serrata</i>		Tree (TG)	0										3							
<i>Bidens pilosa</i>	*		1					0.5	0.1	1									0.5	0.1
<i>Billardiera scandens</i>		Other (OG)	0		0.1	0.1					0.1		0.1							
<i>Blechnum cartilagineum</i>		Fern (EG)	0	10																
<i>Bossiaea obcordata</i>		Shrub (SG)	0										0.1							
<i>Breynia oblongifolia</i>		Shrub (SG)	0	0.5		0.5										0.1	0.5	0.1	0.1	0
<i>Bursaria spinosa</i>		Shrub (SG)	0			0.5														

Species name	Exotic (*)	Form	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5	Cover (%) Plot 6	Cover (%) Plot 7	Cover (%) Plot 8	Cover (%) Plot 9	Cover (%) Plot 10	Cover (%) Plot 11	Cover (%) Plot 12	Cover (%) Plot 13	Cover (%) Plot 14	Cover (%) Plot 15	Cover (%) Plot 16	Cover (%) Plot 17
<i>Calochlaena dubia</i>		Other (OG)	0	1																
<i>Camellia spp.</i>	*	0	0											0.1						
<i>Cassytha glabella</i>		Other (OG)	0										0.1							
<i>Cassytha pubescens</i>		Other (OG)	0	0.1																
<i>Casuarina glauca</i>		Tree (TG)	0					70	0.5					0.5	5				0.1	
<i>Cayratia clematidea</i>		Other (OG)	0					0.5												
<i>Cenchrus clandestinus</i>	*																		4	30
<i>Ceratopetalum gummiferum</i>		Tree (TG)	0	3																
<i>Chloris gayana</i>	*	0	1				0.1	0.5		35					30		0.5			
<i>Chloris gayana</i>	*																		20	0.2
<i>Cinnamomum camphora</i>	*	0	1						0.1	0.1					0.5					
<i>Cissus hypoglauca</i>		Other (OG)	0	5																
<i>Citrus limonia</i>	*	0	0											0.1						

Species name	Exotic (*)	Form	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5	Cover (%) Plot 6	Cover (%) Plot 7	Cover (%) Plot 8	Cover (%) Plot 9	Cover (%) Plot 10	Cover (%) Plot 11	Cover (%) Plot 12	Cover (%) Plot 13	Cover (%) Plot 14	Cover (%) Plot 15	Cover (%) Plot 16	Cover (%) Plot 17
<i>Commelina cyanea</i>		Forb (FG)	0					5	0.1											
<i>Conyza spp.</i>	*	0	0						0.1	0.5						0.1			0.2	0.2
<i>Coreopsis lanceolata</i>	*	0	0		2															
<i>Correa reflexa</i>		Shrub (SG)	0	0.1																
<i>Corymbia gummifera</i>		Tree (TG)	0	3	20								5							
<i>Corymbia maculata</i>		Tree (TG)	0														45			
<i>Cryptostylis subulata</i>		Forb (FG)	0		0.1															
<i>Cymbopogon refractus</i>		Grass & grasslike (GG)	0									5								
<i>Cynodon dactylon</i>		Grass & grasslike (GG)	0					5	0.5							1			65	60
<i>Cyperus brevifolius</i>	*																		0.1	0.1
<i>Cyperus eragrostis</i>	*																		0.2	0
<i>Desmodium varians</i>		Other (OG)	0									0.1								

Species name	Exotic (*)	Form	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5	Cover (%) Plot 6	Cover (%) Plot 7	Cover (%) Plot 8	Cover (%) Plot 9	Cover (%) Plot 10	Cover (%) Plot 11	Cover (%) Plot 12	Cover (%) Plot 13	Cover (%) Plot 14	Cover (%) Plot 15	Cover (%) Plot 16	Cover (%) Plot 17
<i>Dianella caerulea</i>		Forb (FG)	0	0.1	0.1	0.1					0.2							0.1		
<i>Dianella longifolia</i>		Forb (FG)	0		0.1	0.1														
<i>Dillwynia retorta</i>		Shrub (SG)	0										0.1							
<i>Dodonaea triquetra</i>		Shrub (SG)	0		5	1			0.1											
<i>Ehrharta erecta</i>	*		0	1	1		5									0.5	1			
<i>Elaeocarpus reticulatus</i>		Shrub (SG)	0										0.1							
<i>Entolasia marginata</i>		Grass & grasslike (GG)	0	0.1	0.1	0.1					2		1			0.1				
<i>Entolasia marginata</i>		Grass & grasslike (GG)	0	0.1	0.1	0.1					2		1			0.1				
<i>Entolasia stricta</i>		Grass & grasslike (GG)	0	0.1	0.1	0.1					2		10							
<i>Entolasia stricta</i>		Grass & grasslike (GG)	0	0.1	0.1	0.1					2		10							

Species name	Exotic (*)	Form	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5	Cover (%) Plot 6	Cover (%) Plot 7	Cover (%) Plot 8	Cover (%) Plot 9	Cover (%) Plot 10	Cover (%) Plot 11	Cover (%) Plot 12	Cover (%) Plot 13	Cover (%) Plot 14	Cover (%) Plot 15	Cover (%) Plot 16	Cover (%) Plot 17
<i>Eragrostis brownii</i>		Grass & grasslike (GG)	0								1									
<i>Eragrostis brownii</i>		Grass & grasslike (GG)	0								1									
<i>Eragrostis curvula</i>	*	0	1									1			1		20	10		
<i>Eragrostis curvula</i>	*	0	1									1			1		20	10		
<i>Eragrostis curvula</i>	*																		1	0
<i>Erythranthera spp.</i>		0	0																	
<i>Erythranthera spp.</i>		0	0																	
<i>Erythrina x sykesii</i>	*	0	0													15				
<i>Eucalyptus crebra</i>		Tree (TG)	0													1				
<i>Eucalyptus crebra</i>		Tree (TG)	0													1				
<i>Eucalyptus piperita</i>		Tree (TG)	0	10																

Species name	Exotic (*)	Form	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5	Cover (%) Plot 6	Cover (%) Plot 7	Cover (%) Plot 8	Cover (%) Plot 9	Cover (%) Plot 10	Cover (%) Plot 11	Cover (%) Plot 12	Cover (%) Plot 13	Cover (%) Plot 14	Cover (%) Plot 15	Cover (%) Plot 16	Cover (%) Plot 17
<i>Eucalyptus punctata</i>		Tree (TG)	0		20	5					10			1		20				
<i>Eucalyptus spp.</i>		Tree (TG)	0	10											3					
<i>Eustrephus latifolius</i>		Other (OG)	0	0.1	3	0.1					0.1		0.1	2						
<i>Exocarpos strictus</i>		Shrub (SG)	0			5														
<i>Ficus rubiginosa</i>		Tree (TG)	0	0.1		1					0.5		0.1							
<i>Gahnia aspera</i>		Grass & grasslike (GG)	0								0.2									
<i>Galium aparine</i>	*																		0.2	0
<i>Geitonoplesium cymosum</i>		Other (OG)	0			0.1								0.1					0.1	
<i>Glochidion ferdinandi</i>		Tree (TG)	0		1	0.3		0.1	0.1	0.1		0.2	0.1	75		30		10		
<i>Glycine clandestina</i>		Other (OG)	0			0.1					0.1									
<i>Glycine tabacina</i>		Other (OG)	0		0.1															
<i>Gomphocarpus fruticosus</i>	*		0	0						0.1										

Species name	Exotic (*)	Form	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5	Cover (%) Plot 6	Cover (%) Plot 7	Cover (%) Plot 8	Cover (%) Plot 9	Cover (%) Plot 10	Cover (%) Plot 11	Cover (%) Plot 12	Cover (%) Plot 13	Cover (%) Plot 14	Cover (%) Plot 15	Cover (%) Plot 16	Cover (%) Plot 17
<i>Gomphocarpus fruticosus</i>	*																		0	0.1
<i>Gonocarpus teucroides</i>		Forb (FG)	0								0.1									
<i>Goodenia hederacea</i>		Forb (FG)	0								0.1									
<i>Grevillea sericea</i>		Shrub (SG)	0		0.1									0.2						
<i>Hakea salicifolia</i>		Shrub (SG)	0		0.1															
<i>Hakea sericea</i>		Shrub (SG)	0						7									2		
<i>Hedychium gardnerianum</i>	*	0	0											5						
<i>Hibbertia aspera</i>		Shrub (SG)	0		0.1															
<i>Hibbertia dentata</i>		Other (OG)	0	0.1																
<i>Hibbertia monogyna</i>		Shrub (SG)	0		0.5	0.1														
<i>Homalanthus populifolius</i>		Shrub (SG)	0						0.5		0.1									
<i>Homalanthus populifolius</i>		Shrub (SG)																	0	0.5

Species name	Exotic (*)	Form	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5	Cover (%) Plot 6	Cover (%) Plot 7	Cover (%) Plot 8	Cover (%) Plot 9	Cover (%) Plot 10	Cover (%) Plot 11	Cover (%) Plot 12	Cover (%) Plot 13	Cover (%) Plot 14	Cover (%) Plot 15	Cover (%) Plot 16	Cover (%) Plot 17
<i>Hydrocotyle pedicellosa</i>		Forb (FG)	0					0.5												
<i>Hydrocotyle sibthorpioides</i>		Forb (FG)																	0.1	0
<i>Hyparrhenia hirta</i>	*	0	1												10					
<i>Hypochaeris radicata</i>	*																		0.1	0
<i>Imperata cylindrica</i>		Grass & grasslike (GG)	0	25	0.1					2						1			30	
<i>Ipomoea indica</i>	*	0	1												0.2					
<i>Isopogon anemonifolius</i>		Shrub (SG)	0																0.2	
<i>Jacksonia scoparia</i>		Shrub (SG)	0	0.1																
<i>Jasminum polyanthum</i>	*	0	0											2						
<i>Juncus kraussii subsp. australiensis</i>		Grass & grasslike (GG)	0						1											
<i>Juncus usitatus</i>		Grass & grasslike (GG)	0						5											

Species name	Exotic (*)	Form	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5	Cover (%) Plot 6	Cover (%) Plot 7	Cover (%) Plot 8	Cover (%) Plot 9	Cover (%) Plot 10	Cover (%) Plot 11	Cover (%) Plot 12	Cover (%) Plot 13	Cover (%) Plot 14	Cover (%) Plot 15	Cover (%) Plot 16	Cover (%) Plot 17
<i>Juncus usitatus</i>		Grass & grasslike (GG)																	0.1	0.1
<i>Kennedia rubicunda</i>		Other (OG)	0		0.3							0.1								
<i>Kunzea ambigua</i>		Shrub (SG)	0						1		40								5	
<i>Lambertia formosa</i>		Shrub (SG)	0											1						
<i>Lantana camara</i>	*		0	1		10	5	0.1	0.5	3	0.3	2	85		3	0.2	25	40	15	
<i>Lantana camara</i>	*																		0	4
<i>Lepidosperma laterale</i>		Grass & grasslike (GG)	0	0.1	0.1							0.1								
<i>Leptospermum polyanthum</i>		Shrub (SG)	0	0.2	0.1										0.2					
<i>Leucopogon muticus</i>		Shrub (SG)	0		0.1															
<i>Ligustrum sinense</i>	*		0	1											50		0.2			
<i>Lilium formosanum</i>	*		0	0						0.1										
<i>Lilium spp.</i>	*																		0.1	0

Species name	Exotic (*)	Form	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5	Cover (%) Plot 6	Cover (%) Plot 7	Cover (%) Plot 8	Cover (%) Plot 9	Cover (%) Plot 10	Cover (%) Plot 11	Cover (%) Plot 12	Cover (%) Plot 13	Cover (%) Plot 14	Cover (%) Plot 15	Cover (%) Plot 16	Cover (%) Plot 17
<i>Lomandra brevis</i>		Grass & grasslike (GG)	0	0.1																
<i>Lomandra filiformis</i>		Grass & grasslike (GG)	0		0.1	0.1							3							
<i>Lomandra glauca</i>		Grass & grasslike (GG)	0										5							
<i>Lomandra longifolia</i>		Grass & grasslike (GG)	0	0.2	0.5	35			0.1					0.1				0.1		
<i>Lomandra multiflora subsp. multiflora</i>		Grass & grasslike (GG)	0		0.1				0.1				0.1							
<i>Lomandra obliqua</i>		Grass & grasslike (GG)	0		0.1															
<i>Macfadyena spp.</i>	*		0	0								2		0.1						
<i>Medicago sativa</i>	*																		0.5	0
<i>Melinis repens</i>	*		0	0					0.2								0.1			
<i>Microlaena stipoides</i>		Grass & grasslike (GG)	0		0.5	0.1						3							0.1	

Species name	Exotic (*)	Form	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5	Cover (%) Plot 6	Cover (%) Plot 7	Cover (%) Plot 8	Cover (%) Plot 9	Cover (%) Plot 10	Cover (%) Plot 11	Cover (%) Plot 12	Cover (%) Plot 13	Cover (%) Plot 14	Cover (%) Plot 15	Cover (%) Plot 16	Cover (%) Plot 17
<i>Monotoca elliptica</i>		Shrub (SG)	0	3		3														
<i>Morinda jasminoides</i>		Other (OG)	0								1			7		0.1				
<i>Myrsine variabilis</i>		Shrub (SG)	0	0.3		0.1							0.1	0.1						
<i>Notelaea longifolia</i>		Tree (TG)	0	0.1		3					0.1					0.1		0.1		
<i>Ochna serrulata</i>	*	0	1		0.1									5		0.2		0.1		
<i>Olea europaea</i>	*	0	1			5		0.1			0.1	0.1							0.1	
<i>Opercularia aspera</i>		Forb (FG)	0								3									
<i>Oplismenus aemulus</i>		Grass & grasslike (GG)	0		0.5							0.1								
<i>Oxalis spp.</i>		Forb (FG)	0	0.1						0.1			0.1							
<i>Pandorea pandorana</i>		Other (OG)	0	1	0.5	0.1					0.1				0.1				0.1	
<i>Panicum simile</i>		Grass & grasslike (GG)	0									0.1								
<i>Parsonsia straminea</i>		Other (OG)	0											0.1						

Species name	Exotic (*)	Form	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5	Cover (%) Plot 6	Cover (%) Plot 7	Cover (%) Plot 8	Cover (%) Plot 9	Cover (%) Plot 10	Cover (%) Plot 11	Cover (%) Plot 12	Cover (%) Plot 13	Cover (%) Plot 14	Cover (%) Plot 15	Cover (%) Plot 16	Cover (%) Plot 17
<i>Paspalidium distans</i>		Grass & grasslike (GG)	0										0.1							
<i>Paspalum dilatatum</i>	*		1					0.1					0.1							
<i>Paspalum dilatatum</i>	*																		1	1
<i>Paspalum spp.</i>	*	Grass & grasslike (GG)	0									0.1								
<i>Paspalum urvillei</i>	*		0	0												5				
<i>Pellaea falcata</i>		Fern (EG)	0							0.1						0.1				
<i>Pennisetum clandestinum</i>	*		0	1				0.5	5							1	0.1	1		
<i>Persicaria decipiens</i>		Forb (FG)	0					0.1	0.1											
<i>Persoonia linearis</i>		Shrub (SG)	0	0.3								0.5		1						
<i>Phragmites australis</i>		Grass & grasslike (GG)	0						65											
<i>Pimelea linifolia</i>		Shrub (SG)	0											0.1						

Species name	Exotic (*)	Form	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5	Cover (%) Plot 6	Cover (%) Plot 7	Cover (%) Plot 8	Cover (%) Plot 9	Cover (%) Plot 10	Cover (%) Plot 11	Cover (%) Plot 12	Cover (%) Plot 13	Cover (%) Plot 14	Cover (%) Plot 15	Cover (%) Plot 16	Cover (%) Plot 17
<i>Pittosporum multiflorum</i>		Shrub (SG)	0	0.1	0.1						1									
<i>Pittosporum undulatum</i>		Shrub (SG)	0		20	0.2					0.1			5		0.1				
<i>Plantago lanceolata</i>	*	0	0					0.1	0.1	0.1									0.2	0.2
<i>Platanus acerifolia</i>	x																		0.1	2
<i>Platylobium formosum</i>		Shrub (SG)	0	0.2																
<i>Platysace linearifolia</i>		Shrub (SG)	0											0.1						
<i>Pomaderris elliptica</i>		0	0								0.1									
<i>Pomax umbellata</i>		Forb (FG)	0		0.1															
<i>Pratia purpurascens</i>		Forb (FG)	0		0.1						0.1									
<i>Prostanthera incisa</i>		Shrub (SG)	0	0.1																
<i>Pseuderanthemum variabile</i>		Forb (FG)	0	0.1																
<i>Pteridium esculentum</i>		Fern (EG)	0	10	0.5									1						

Species name	Exotic (*)	Form	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5	Cover (%) Plot 6	Cover (%) Plot 7	Cover (%) Plot 8	Cover (%) Plot 9	Cover (%) Plot 10	Cover (%) Plot 11	Cover (%) Plot 12	Cover (%) Plot 13	Cover (%) Plot 14	Cover (%) Plot 15	Cover (%) Plot 16	Cover (%) Plot 17
<i>Pultenaea ferruginea</i>		Shrub (SG)	0										0.2							
<i>Pultenaea flexilis</i>		Shrub (SG)	0		0.3	0.1					0.1									
<i>Rumex crispus</i>	*																		0.1	0
<i>Salix spp.</i>	*	0	0						1											
<i>Senecio madagascariensis</i>	*	0	1						0.1	0.1										
<i>Senecio madagascariensis</i>	*																		1	0.1
<i>Senna pendula</i>	*	0	1		0.1			1	0.5					0.1			0.1			
<i>Setaria parviflora</i>	*																		1	0
<i>Setaria spp.</i>	*	Grass & grasslike (GG)	0		0.1			0.1												
<i>Sida rhombifolia</i>	*	0	0		0.1			0.5							0.1		0.1			
<i>Smilax glycyphylla</i>		Other (OG)	0	0.1	0.1	1							0.1	1		0.2				
<i>Solanum nigrum</i>	*	0	0						0.5			0.1			0.1					

Species name	Exotic (*)	Form	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5	Cover (%) Plot 6	Cover (%) Plot 7	Cover (%) Plot 8	Cover (%) Plot 9	Cover (%) Plot 10	Cover (%) Plot 11	Cover (%) Plot 12	Cover (%) Plot 13	Cover (%) Plot 14	Cover (%) Plot 15	Cover (%) Plot 16	Cover (%) Plot 17
<i>Sonchus oleraceus</i>	*	0	0																0.1	
<i>Sonchus oleraceus</i>	*																		0	0.1
<i>Sporobolus africanus</i>	*																		0	0.1
<i>Stephania japonica</i> var. <i>discolor</i>		Other (OG)																	0	0.1
<i>Syncarpia glomulifera</i>		Tree (TG)	0																0.1	
<i>Synoum glandulosum</i> subsp. <i>glandulosum</i>		Shrub (SG)	0	0.2																
<i>Tagetes minuta</i>	*	0	0												0.2					
<i>Tetragonia tetragonioides</i>		Forb (FG)	0				1	0.5												
<i>Themeda triandra</i>		Grass & grasslike (GG)	0	0.1	5						2									
<i>Thunbergia spp.</i>	*	0	0		0.1															
<i>Tradescantia fluminensis</i>	*	0	1													5				

Species name	Exotic (*)	Form	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5	Cover (%) Plot 6	Cover (%) Plot 7	Cover (%) Plot 8	Cover (%) Plot 9	Cover (%) Plot 10	Cover (%) Plot 11	Cover (%) Plot 12	Cover (%) Plot 13	Cover (%) Plot 14	Cover (%) Plot 15	Cover (%) Plot 16	Cover (%) Plot 17
<i>Trifolium repens</i>	*																		0.1	0
<i>Urtica incisa</i>		Forb (FG)	0						0.1											
<i>Verbena bonariensis</i>	*	0	0						0.1	1		2			1	0.1	0.2	0.1	0.1	0.2
<i>Verbena bonariensis</i>	*																			
<i>Vicia sativa</i>	*	0	0									0.1							0.4	0.2
<i>Xanthorrhoea arborea</i>		Other (OG)	0	1									10							
<i>Zieria smithii</i>		Shrub (SG)	0			0.1					0.1									

Composition (number of species)							
Plot no.	Plot name	Tree	Shrub	Grass	Forb	Fern	Other
1	Z8P1	7	11	6	4	2	8
2	Z2P1	7	13	12	5	1	6
3	Z2P3	7	11	6	2	0	6
4	Z12P1	0	0	0	1	0	0
5	Z9P1	2	0	2	4	0	1
6	Z11P1	2	1	4	4	0	0

Composition (number of species)							
7	Z13P1	1	4	0	1	1	0
8	Z2P2	6	11	15	5	1	7
9	Z5P1	1	1	0	1	0	1
10	Z7P1	6	12	6	1	1	6
11	Z3P1	3	3	1	0	1	5
12	Z910P1	5	0	1	0	1	0
13	Z4P1	3	2	2	0	1	2
14	Z6P1	3	3	0	1	0	0
15	Z4P2	5	5	3	0	0	2
16	Z13P2	1	0	2	1	0	0
17	Z13P3	0	1	2	0	0	1

Structure (Total cover)							
Plot no.	Tree	Shrub	Grass	Forb	Fern	Other	
1	29.2	5.1	0.7	0.4	20.0	8.4	
2	49.3	28.6	32.2	0.5	0.5	4.1	
3	29.8	13.6	35.5	0.2	0.0	1.5	
4	0.0	0.0	0.0	1.0	0.0	0.0	
5	70.1	0.0	5.1	6.1	0.0	0.5	
6	0.6	0.5	71.5	3.3	0.0	0.0	
7	0.1	13.1	0.0	0.1	0.1	0.0	
8	16.6	45.2	20.8	3.5	0.1	1.6	
9	0.2	75.0	0.0	0.1	0.0	0.2	

Structure (Total cover)						
10	12.2	3.3	19.2	0.1	1.0	10.5
11	76.5	5.2	0.1	0.0	0.1	10.2
12	9.3	0.0	1.0	0.0	0.1	0.0
13	50.1	0.2	1.1	0.0	0.1	0.3
14	45.6	1.7	0.0	0.1	0.0	0.0
15	18.2	7.4	30.2	0.0	0.0	0.2
16	0.1	0.0	65.1	0.1	0.0	0.0
17	0.0	0.5	60.1	0.0	0.0	0.1

Function											
Plot no.	Large Trees	Hollow trees	Litter Cover	Length Fallen Logs	Tree Stem 5- 9 cm	Tree Stem 10-19 cm	Tree Stem 20-29 cm	Tree Stem 30-49 cm	Tree Stem 50-79 cm	Tree Regen	High Threat Weed Cover
1	1	1	46	0	0	0	1	1	1	1	20
2	2	0	41	9	1	1	1	1	1	1	1
3	1	0	36	1	1	1	1	1	1	1	2
4	3	0	29	4	1	0	1	1	1	1	29
5	4	0	29	0	0	1	1	1	1	1	23
6	4	0	40	0	0	1	1	1	1	1	1
7	0	0	0	0	0	0	0	0	0	0	24
8	0	0	54	0	0	0	0	0	0	1	9
9	0	0	83	0	0	1	0	0	0	1	16
10	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1
11	0	0	82	42	1	1	1	1	1	1	0

Function												
12	0	1	68	0	1	1	1	1	1	1	1	16
13	0	0	46	11	1	1	1	1	0	1	1	12
14	0	0	0.4	2.5	1	1	1	1	0	1	1	0
15	0	0	24	3	1	1	1	1	0	0	0	9
16	0	0	20	13	1	1	0	0	0	0	0	9
17	0	0	6	0.5	1	1	0	0	0	0	0	37

Appendix C Species lists

Table 46: Flora species recorded during the survey

Family	Species Name	Common Name	Exotic (*)	Priority Weed/WoNS
Acanthaceae	<i>Avicennia marina</i> var. <i>australasica</i>	Grey Mangrove		
Acanthaceae	<i>Pseuderanthemum variabile</i>	Pastel Flower		
Acanthaceae	<i>Thunbergia alata</i>	Black-eyed Susan	*	
Aizoaceae	<i>Tetragonia tetragonioides</i>	New Zealand Spinach	*	
Altingiaceae	<i>Liquidambar styraciflua</i>	American Sweetgum	*	
Amaranthaceae	<i>Alternanthera denticulata</i>	Lesser Joyweed		
Anthericaceae	<i>Chlorophytum comosum</i>	Spider Plant	*	
Apiaceae	<i>Actinotus helianthi</i>	Flannel Flower		
Apiaceae	<i>Platysace linearifolia</i>			
Apocynaceae	<i>Araujia sericifera</i>	Moth Vine	*	PW
Apocynaceae	<i>Gomphocarpus fruticosus</i>	Narrow-leaf Cotton Bush	*	
Apocynaceae	<i>Nerium oleander</i>	Oleander	*	
Apocynaceae	<i>Parsonsia straminea</i>	Common Silkpod		
Araliaceae	<i>Astrotricha floccosa</i>			
Araliaceae	<i>Hydrocotyle pedicellosa</i>	Pennywort		
Araucariaceae	<i>Araucaria bidwillii</i>	Bunya Pine		
Araucariaceae	<i>Araucaria heterophylla</i>	Norfolk Island Pine	*	
Asparagaceae	<i>Asparagus aethiopicus</i>	Ground Asparagus	*	PW, WoNS
Asteraceae	<i>Ageratina adenophora</i>	Crofton Weed	*	OWRC
Asteraceae	<i>Bidens pilosa</i>	Cobbler's Pegs	*	
Asteraceae	<i>Cirsium vulgare</i>	Spear-thistle	*	
Asteraceae	<i>Conyza bonariensis</i>	Flax-leaf Fleabane	*	
Asteraceae	<i>Coreopsis lanceolata</i>	Coreopsis	*	
Asteraceae	<i>Hypochaeris radicata</i>	Flatweed	*	
Asteraceae	<i>Senecio madagascariensis</i>	Fireweed	*	PW, WoNS
Asteraceae	<i>Tagetes minuta</i>	Stinking Roger	*	
Asteraceae	<i>Taraxacum officinale</i>	Dandelion	*	
Basellaceae	<i>Anredera cordifolia</i>	Madeira Vine	*	PW, WoNS
Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Wonga Vine		
Bignoniaceae	<i>Dolichandra unguis-cati</i>	Cat's Claw Creeper	*	PW, WoNS
Bignoniaceae	<i>Jacaranda mimosifolia</i>	Jacaranda	*	
Blechnaceae	<i>Blechnum cartilagineum</i>	Gristle Fern		

Family	Species Name	Common Name	Exotic (*)	Priority Weed/WoNS
Campanulaceae	<i>Pratia purpurascens</i>	White Root		
Caryophyllaceae	<i>Stellaria media</i>	Chickweed	*	
Casuarinaceae	<i>Allocasuarina littoralis</i>	Black She-oak		
Casuarinaceae	<i>Allocasuarina torulosa</i>	Forest Oak		
Casuarinaceae	<i>Casuarina glauca</i>	Swamp Oak		
Commelinaceae	<i>Commelina cyanea</i>	Scurvy Weed		
Commelinaceae	<i>Tradescantia fluminensis</i>	Trad	*	OWRC
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed		
Convolvulaceae	<i>Ipomoea indica</i>	Morning Glory	*	OWRC
Crassulaceae	<i>Bryophyllum delagoense</i>	Mother-of-millions	*	OWRC
Cunoniaceae	<i>Ceratopetalum gummiferum</i>	Christmas Bush		
Cupressaceae	<i>Cupressus sp.</i>		*	
Cyperaceae	<i>Baumea juncea</i>			
Cyperaceae	<i>Cyperus eragrostis</i>	Umbrella Sedge	*	
Cyperaceae	<i>Gahnia aspera</i>	Rough Saw-sedge		
Cyperaceae	<i>Lepidosperma laterale</i>			
Dennstaedtiaceae	<i>Pteridium esculentum</i>	Bracken		
Dicksoniaceae	<i>Calochlaena dubia</i>	Rainbow Fern		
Dilleniaceae	<i>Hibbertia aspera</i>	Rough Guinea Flower		
Dilleniaceae	<i>Hibbertia dentata</i>			
Dilleniaceae	<i>Hibbertia monogyna</i>			
Elaeocarpaceae	<i>Elaeocarpus reticulatus</i>	Blueberry Ash		
Ericaceae (Epacridaceae)	<i>Leucopogon muticus</i>	Blunt Beard-heath		
Ericaceae (Epacridaceae)	<i>Monotoca elliptica</i>	Tree Broom Heath		
Ericaceae (Epacridaceae)	<i>Styphelia triflora</i>	Pink Five-corners		
Euphorbiaceae	<i>Homalanthus populifolius</i>	Bleeding Heart		
Fabaceae (Faboideae)	<i>Acacia falcata</i>	Hickory Wattle		
Fabaceae (Faboideae)	<i>Acacia implexa</i>	Hickory Wattle		
Fabaceae (Faboideae)	<i>Bossiaea obcordata</i>	Spiny Bossiaea		
Fabaceae (Faboideae)	<i>Bossiaea heterophylla</i>	Variable Bossiaea		
Fabaceae (Faboideae)	<i>Desmodium varians</i>	Slender Tick-trefoil		
Fabaceae (Faboideae)	<i>Dillwynia retorta</i>			
Fabaceae (Faboideae)	<i>Erythrina x sykesii</i>	Coral Tree	*	OWRC
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	Love Creeper		
Fabaceae (Faboideae)	<i>Glycine tabacina</i>			
Fabaceae (Faboideae)	<i>Jacksonia scoparia</i>	Dogwood		

Family	Species Name	Common Name	Exotic (*)	Priority Weed/WoNS
Fabaceae (Faboideae)	<i>Kennedia rubicuna</i>	Dusky Coral Pea		
Fabaceae (Faboideae)	<i>Platylobium formosum</i>	Handsome Flat Pea		
Fabaceae (Faboideae)	<i>Pultenaea ferruginea</i>	Large Bronze Bush-pea		
Fabaceae (Faboideae)	<i>Pultenaea flexilis</i>	Graceful Bush-pea		
Fabaceae (Faboideae)	<i>Senna pendula</i>	Senna	*	OWRC
Fabaceae (Faboideae)	<i>Vicia sativa</i>	Vetch	*	
Fabaceae (Mimosoideae)	<i>Acacia brownii</i>	Heath Wattle		
Fabaceae (Mimosoideae)	<i>Acacia floribunda</i>	White Sally Wattle		
Fabaceae (Mimosoideae)	<i>Acacia longissima</i>			
Fabaceae (Mimosoideae)	<i>Acacia oxycedrus</i>	Spiked Wattle		
Fabaceae (Mimosoideae)	<i>Acacia parramattensis</i>	Parramatta Wattle		
Fabaceae (Mimosoideae)	<i>Acacia podylriifolia</i>	Queensland Silver Wattle	*	
Fabaceae (Mimosoideae)	<i>Acacia saligna</i>	Golden Wreath Wattle	*	
Fabaceae (Mimosoideae)	<i>Acacia spp.</i>			
Fabaceae (Mimosoideae)	<i>Acacia ulicifolia</i>	Prickly Moses		
Haloragaceae	<i>Gonocarpus teucrioides</i>			
Juncaceae	<i>Juncus kraussii</i> subsp. <i>australiensis</i>	Sea Rush		
Juncaceae	<i>Juncus usitatus</i>			
Lauraceae	<i>Cassytha glabella</i>			
Lauraceae	<i>Cassytha pubescens</i>			
Lauraceae	<i>Cinnamomum camphora</i>	Camphor Laurel	*	
Liliaceae	<i>Lilium formosanum</i>	Formosan Lily	*	
Lomandraceae	<i>Lomandra brevis</i>	Tufted Mat-rush		
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>rubiginosa</i>			
Lomandraceae	<i>Lomandra glauca</i>	Pale Mat-rush		
Lomandraceae	<i>Lomandra gracilis</i>			
Lomandraceae	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush		
Lomandraceae	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	Many-flowered Mat-rush		
Lomandraceae	<i>Lomandra obliqua</i>	Fish Bones		
Loranthaceae	<i>Amyema spp.</i>			
Luzuriagaceae	<i>Eustrephus latifolius</i>	Wombat Berry		
Luzuriagaceae	<i>Geitonoplesium cymosum</i>	Scrambling Lily		
Malvaceae	<i>Sida rhombifolia</i>	Paddy's Lucerne	*	
Meliaceae	<i>Synoum glandulosum</i>	Scentless Rosewood	*	

Family	Species Name	Common Name	Exotic (*)	Priority Weed/WoNS
Menispermaceae	<i>Stephania japonica</i>	Snake Vine		
Moraceae	<i>Ficus rubiginosa</i>	Port Jackson Fig		
Myrtaceae	<i>Angophora bakeri</i>	Narrow-leaved Apple		
Myrtaceae	<i>Angophora costata</i>	Smooth-barked Apple		
Myrtaceae	<i>Angophora floribunda</i>	Rough-barked Apple		
Myrtaceae	<i>Corymbia citriodora</i>	Lemon-scented Gum		
Myrtaceae	<i>Corymbia gummifera</i>	Red Bloodwood		
Myrtaceae	<i>Corymbia maculata</i>	Spotted Gum		
Myrtaceae	<i>Eucalyptus botryoides x saligna</i>			
Myrtaceae	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark		
Myrtaceae	<i>Eucalyptus microcorys</i>	Tallowwood		
Myrtaceae	<i>Eucalyptus pilularis</i>	Blackbutt		
Myrtaceae	<i>Eucalyptus piperita</i>	Sydney Peppermint		
Myrtaceae	<i>Eucalyptus punctata</i>	Grey Gum		
Myrtaceae	<i>Eucalyptus saligna</i>	Sydney Blue Gum		
Myrtaceae	<i>Kunzea ambigua</i>	Tick Bush		
Myrtaceae	<i>Leptospermum polygalifolium</i> subsp. <i>polygalifolium</i>	Tantoon		
Myrtaceae	<i>Syncarpia glomulifera</i>	Turpentine		
Ochnaceae	<i>Ochna serrulata</i>	Mickey Mouse Plant	*	
Oleaceae	<i>Jasminum polyanthum</i>	White Jasmine	*	
Oleaceae	<i>Ligustrum lucidum</i>	Broad-leaf Privet	*	
Oleaceae	<i>Ligustrum sinense</i>	Small-leaf Privet	*	
Oleaceae	<i>Notelaea longifolia</i>	Large Mock-olive		
Oleaceae	<i>Olea europaea</i> subsp. <i>cuspidata</i>	African Olive	*	
Orchidaceae	<i>Acianthus</i> sp.	Pixie Caps		
Orchidaceae	<i>Cryptostylis subulata</i>	Large Tongue Orchid		
Oxalidaceae	<i>Oxalis</i> spp.		*	
Phormiaceae	<i>Dianella caerulea</i>	Blue Flax-lily		
Phormiaceae	<i>Dianella longifolia</i>	Blue Flax-lily		
Phyllanthaceae	<i>Breynia oblongifolia</i>	Coffee Bush		
Phyllanthaceae	<i>Glochidion ferdinandi</i>	Cheese Tree		
Pinaceae	<i>Pinus patula</i>	Mexican Weeping Pine	*	
Pinaceae	<i>Pinus radiata</i>	Radiata Pine	*	OWRC
Pittosporaceae	<i>Billardiera scandens</i>	Apple Dumpling		
Pittosporaceae	<i>Bursaria spinosa</i> subsp. <i>spinosa</i>	Blackthorn		

Family	Species Name	Common Name	Exotic (*)	Priority Weed/WoNS
Pittosporaceae	<i>Pittosporum multiflorum</i>	Orange Thorn		
Pittosporaceae	<i>Pittosporum undulatum</i>	Sweet Pittosporum		
Plantaginaceae	<i>Plantago lanceolata</i>	Plantain	*	
Poaceae	<i>Aristida vagans</i>	Threeawn Speargrass		
Poaceae	<i>Chloris gayana</i>	Rhodes Grass	*	OWRC
Poaceae	<i>Cymbopogon refractus</i>	Barbed-wire Grass		
Poaceae	<i>Cynodon dactylon</i>	Common Couch		
Poaceae	<i>Ehrharta erecta</i>	Vasey Grass	*	
Poaceae	<i>Entolasia marginata</i>	Bordered Panic		
Poaceae	<i>Entolasia stricta</i>	Wiry Panic		
Poaceae	<i>Eragrostis brownii</i>	Brown's Love Grass		
Poaceae	<i>Eragrostis curvula</i>	African Lovegrass	*	
Poaceae	<i>Hyparrhenia hirta</i>	Coolatai Grass	*	OWRC
Poaceae	<i>Imperata cylindrica var. major</i>	Blady Grass	*	
Poaceae	<i>Melinis repens</i>	Red Natal Grass	*	
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Grass		
Poaceae	<i>Oplismenus aemulus</i>	Australian Basket Grass		
Poaceae	<i>Panicum simile</i>	Two-colour Panic		
Poaceae	<i>Paspalidium distans</i>			
Poaceae	<i>Paspalum dilatatum</i>		*	
Poaceae	<i>Paspalum urvillei</i>	Vasey Grass	*	
Poaceae	<i>Pennisetum clandestinum</i>	Kikuyu	*	
Poaceae	<i>Phragmites australis</i>	Common Reed		
Poaceae	<i>Setaria parviflora</i>	Slender Pigeon Grass	*	
Poaceae	<i>Setaria</i> spp.		*	
Poaceae	<i>Themeda triandra</i>	Kangaroo Grass		
Polygonaceae	<i>Persicaria decipiens</i>	Slender Knotweed		
Polygonaceae	<i>Rumex crispus</i>	Curled Dock	*	
Portulacaceae	<i>Portulaca oleracea</i>	Pigweed		
Primulaceae	<i>Myrsine variabilis</i>			
Proteaceae	<i>Banksia serrata</i>	Old Man Banksia		
Proteaceae	<i>Grevillea robusta</i>	Silky Oak		
Proteaceae	<i>Grevillea sericea</i>	Pink Spider Flower		
Proteaceae	<i>Hakea salicifolia</i>			
Proteaceae	<i>Hakea sericea</i>	Needle Hakea		

Family	Species Name	Common Name	Exotic (*)	Priority Weed/WoNS
Proteaceae	<i>Isopogon anemonifolius</i>	Broad-leaf Drumsticks		
Proteaceae	<i>Lambertia formosa</i>	Mountain Devils		
Proteaceae	<i>Persoonia linearis</i>	Narrow-leaved Geebung		
Proteaceae	<i>Xylomelum pyriforme</i>	Woody Pear		
Pteridaceae	<i>Adiantum aethiopicum</i>	Common Maidenhair Fern		
Pteridaceae	<i>Pellaea falcata</i>	Sickle Fern		
Ranunculaceae	<i>Clematis aristata</i>	Old Man's Beard		
Rhamnaceae	<i>Alphitonia excelsa</i>	Red Ash		
Rhamnaceae	<i>Pomaderris elliptica</i>			
Rosaceae	<i>Rubus fruticosus</i>	Blackberry	*	PW, WoNS
Rubiaceae	<i>Gynochthodes jasminoides</i>	Sweet Morinda		
Rubiaceae	<i>Opercularia aspera</i>	Coarse Stinkweed		
Rubiaceae	<i>Pomax umbellata</i>			
Rubiaceae	<i>Richardia humistrata</i>		*	
Rutaceae	<i>Citrus limonia</i>	Lemon	*	
Rutaceae	<i>Correa reflexa</i>	Common Correra		
Rutaceae	<i>Zieria smithii</i>	Sandfly Zieria		
Salicaceae	<i>Populus sp.</i>	Poplar	*	
Salicaceae	<i>Salix spp.</i>	Willow	*	PW, WoNS
Santalaceae	<i>Exocarpos strictus</i>	Pale-fruit Ballart		
Sapindaceae	<i>Acer negundo</i>		*	
Sapindaceae	<i>Dodonaea pinnata</i>			
Sapindaceae	<i>Dodonaea triquetra</i>	Large-leaf Hop Bush		
Smilacaceae	<i>Smilax glycyphylla</i>	Sweet Sarsaparilla		
Solanaceae	<i>Solanum nigrum</i>	Black-berry Nightshade	*	
Theaceae	<i>Camellia sp.</i>		*	
Thymelaeaceae	<i>Pimelea linifolia</i>	Rice Flower		
Urticaceae	<i>Urtica incisa</i>	Stinging Nettle		
Verbenaceae	<i>Lantana camara</i>	Lantana	*	PW, WoNS
Verbenaceae	<i>Verbena bonariensis</i>	Purple Tops	*	
Vitaceae	<i>Cayratia clematidea</i>	Native Grape		
Vitaceae	<i>Cissus hypoglauca</i>	Water Vine		
Zingiberaceae	<i>Hedychium gardnerianum</i>	Ginger Lily	*	

WoNS = Weed of National Significance, PW = Priority Weed, OWRC = Other Weeds of Regional Concern (Greater Sydney Local Land Services 2017).

Table 47: Fauna species recorded during the survey

Family	Species Name	Common Name	Threatened	Observation Type	Exotic (*)
Amphibians					
<i>Myobatrachidae</i>	<i>Crinia signifera</i>	Common Eastern Froglet		Heard	
Avifauna					
<i>Acanthizidae</i>	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill		Observed and heard	
<i>Acanthizidae</i>	<i>Acanthiza pusilla</i>	Brown Thornbill		Observed and heard	
<i>Acanthizidae</i>	<i>Sericornis frontalis</i>	White-browed Scrub-wren		Observed and heard	
Accipitridae	<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	V – BC Act	Observed and heard	
<i>Accipitridae</i>	<i>Haliastur sphenurus</i>	Whistling Kite		Observed	
<i>Anatidae</i>	<i>Chenonetta jubata</i>	Australian Wood Duck		Observed	
<i>Ardeidae</i>	<i>Ardea modesta</i>	Easter Great Egret		Observed	
<i>Ardeidae</i>	<i>Egretta novaehollandiae</i>	White-faced Heron		Observed	
<i>Artamidae</i>	<i>Cracticus tibicen</i>	Australian Magpie		Observed	
<i>Artamidae</i>	<i>Cracticus torquatus</i>	Grey Butcherbird		Observed	
<i>Cacatuidae</i>	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo		Heard	
<i>Cacatuidae</i>	<i>Cacatua sanguinea</i>	Little Corella		Observed and heard	
<i>Charadriidae</i>	<i>Vanellus miles</i>	Masked Lapwing		Observed	
<i>Columbidae</i>	<i>Ocyphaps lophotes</i>	Crested Pigeon		Observed and heard	
<i>Corvidae</i>	<i>Corvus coronoides</i>	Australian Raven		Observed and heard	
<i>Cuculidae</i>	<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo		Observed and heard	
<i>Eupetidae</i>	<i>Psophodes olivaceus</i>	Eastern Whipbird		Heard	
<i>Halcyonidae</i>	<i>Dacelo novaeguineae</i>	Laughing Kookaburra		Observed	
<i>Hirundinidae</i>	<i>Hirundo neoxena</i>	Welcome Swallow		Observed	
<i>Maluridae</i>	<i>Malurus cyaneus</i>	Superb Fairy-wren		Observed and heard	
<i>Megapodiidae</i>	<i>Alectura lathami</i>	Australian Brush-turkey		Observed	
<i>Meliphagidae</i>	<i>Anthochaera chrysoptera</i>	Little Wattlebird		Observed and heard	
<i>Meliphagidae</i>	<i>Manorina melanocephala</i>	Noisy Miner		Observed and heard	
<i>Meliphagidae</i>	<i>Meliphaga lewinii</i>	Lewin's Honeyeater		Heard	

Family	Species Name	Common Name	Threatened	Observation Type	Exotic (*)
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark		Observed and heard	
Pachycephalidae	<i>Pachycephala pectoralis</i>	Golden Whistler		Heard	
Pardalotidae	<i>Pardalotus punctatus</i>	Spotted Pardalote		Heard	
Pelicanidae	<i>Pelecanus conspicillatus</i>	Australian Pelican		Observed	
Petroicidae	<i>Eopsaltria australis</i>	Eastern Yellow Robin		Observed	
Psittacidae	<i>Glossopsitta concinna</i>	Musk Lorikeet		Heard	
Psittaculidae	<i>Alisterus scapularis</i>	Australian King Parrot		Observed	
Psittaculidae	<i>Platycercus eximius</i>	Eastern Rosella		Observed	
Psittaculidae	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet		Observed and heard	
Ptilonorhynchidae	<i>Ptilonorhynchus violaceus</i>	Satin Bowerbird		Heard	
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie Wagtail		Observed and heard	
Scolopacidae	<i>Numenius madagascariensis</i>	Eastern Curlew	EPBC Act - CE	Observed	
Sturnidae	<i>Sturnus tristis</i>	Common Myna		Observed and heard	
Threskiornithidae	<i>Threskiornis molucca</i>	Australian White Ibis		Observed	
Timaliidae	<i>Zosterops lateralis</i>	Silvereeye		Observed and heard	
Mammals					
Leporidae	<i>Oryctolagus cuniculus</i>	European Rabbit		Observed	*
Miniopteridae	<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing Bat	BC Act - V	Ultrasonic recording	
Miniopteridae	<i>Miniopterus australis</i>	Little Bentwing Bat	BC Act - V	Ultrasonic recording	
Molossidae	<i>Austronomus australis</i>	White-striped Freetail Bat		Ultrasonic recording	
Molossidae	<i>Micronomus (Mormopterus) norfolkensis</i>	Eastern Freetail Bat	BC Act - V	Ultrasonic recording	
Molossidae	<i>Ozimops ridei</i>	Ride's Free-tailed Bat		Ultrasonic recording	
Petauridae	<i>Petaurus breviceps</i>	Sugar Glider		Observed	
Phalangeridae	<i>Trichosurus vulpecula</i>	Common Brushtail Possum		Observed	
Pseudocheirinae	<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum		Observed	
Rhinolophidae	<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe Bat		Ultrasonic recording, harp capture	

Family	Species Name	Common Name	Threatened	Observation Type	Exotic (*)
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	BC Act – V EPBC Act - V	Ultrasonic recording	
Vespertilionidae	<i>Chalinolobus morio</i>	Chocolate Wattled Bat		Ultrasonic recording	
Vespertilionidae	<i>Myotis macropus</i>	Southern Myotis	BC Act – V	Ultrasonic recording	
Vespertilionidae	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat		Harp capture	
Vespertilionidae	<i>Nyctophilus gouldii</i>	Gould's Long-eared Bat		Harp capture	
Vespertilionidae	<i>Nyctophilus sp.</i>	Long-eared Bat		Ultrasonic recording	
Vespertilionidae	<i>Vespadelus pumilus</i>	Eastern Forest Bat		Ultrasonic recording	
Vespertilionidae	<i>Vespadelus (Potential)</i>	<i>regulus</i> Southern Forest Bat		Ultrasonic recording	
Vespertilionidae	<i>Vespadelus troughtoni</i>	Eastern Cave Bat	BC Act - V	Ultrasonic recording, harp capture, roost search	
Vespertilionidae	<i>Vespadelus (Potential)</i>	<i>vulturinus</i> Little Forest Bat		Ultrasonic recording	

Appendix D Ultrasonic Bat Report

D1 Introduction

Eco Logical Australia Pty Ltd (ELA) was engaged by Property & Development NSW to prepare a Biodiversity Certification Assessment Report (BCAR) for a Planning Proposal at Mooney Mooney and Peat Island (the subject land). The subject land is bounded by the Hawksbury River to the south, west and east, and by the Old Pacific Highway and Point Road to the north.

This results of this ultrasonic microchiropteran bat call survey and subsequent data analysis will contribute to the outcomes of a BCAR.

This report outlines the methodology used and results of the data analysis.

D2 Methods

Two Anabat Swift (AS) recorders (AS 01 and AS 02), a SD1 (COF02 SN3698) and SD2 Anabat (COF04 SN82076) recorders were set to passively record microbat calls at four survey sites located within the Mooney Mooney subject land. The four recorders were set in the following configurations:

- Anabat Swift 01 was set among mangroves near to the Hawksbury River.
- Anabat Swift 02 was set in a tree facing an open non-vegetated area.
- COF02 was set near next to an abandoned building and vegetated area that is located near to the Hawksbury River.
- COF04 was set near to a rocky wall pointing out over the Hawksbury River.

Data was collected passively over four consecutive nights between 25 and 28 March 2019. The total survey effort undertaken was equivalent to 13 detector nights.

A further and more detailed description of the vegetation community and structure at the subject site will be presented in the BCAR.

Data Analysis

Bat calls were analysed by Dr Rodney Armistead from Eco Logical Australia (ELA) using the program AnalookW (Version 4.24a 17 September 2018, written by Chris Corben, www.hoarybat.com). Call identifications were 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>). Dr Armistead 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, who has over eleven years of experience in the identification of ultrasonic call recordings.

Bat calls were 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) were followed:

Search phase calls were used in the analysis, rather than cruise phase calls or feeding buzzes (McKenzie et al 2002). Cruise phase or feeding calls cannot be used for identification purposes and were labelled as being unidentifiable.

Recorded calls containing less than three pulses were not analysed and these sequences were labelled as unidentifiable as they are too short to confidently determine the identity of the species making the call (Law et al 1999).

For those calls that were useful to identify the species making the call, two categories of confidence were 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

Sequences produced by bats but of inferior quality were also labelled as unidentifiable.

All calls labelled as unidentifiable were retained in the data as they can be used as an indicator of microbat activity at the site.

Nyctophilus spp. (Long-eared bats) are difficult to identify or separate confidently to species level based upon their recorded calls. Therefore, we have made no attempt to identify any recorded *Nyctophilus* spp. calls to species level (Pennay et al 2004). There are two potential *Nyctophilus* species that could occur in the subject land. Two species, *N. geoffroyi* (Lesser Long-eared Bat) and *N. gouldii* (Gould's Long-eared Bat) are relatively common and widely distributed across NSW, including the subject land. These species are not threatened under the BC Act or EPBC Act.

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 48 below.

Sequences not attributed to microbat echolocation calls (e.g. insect buzzes, wind, train and vehicle movement) were dismissed from the analysis.

Table 48: 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	

Jackson and Groves 2015	Previously known as	Common Name	BC Act
<i>Setirostris eleryi</i>	<i>Mormopterus</i> species 6	Bristle-faced Free-tailed Bat	Endangered

D3 Results

There were 1,244 call sequences recorded during this survey. Of these, 1,009 (81.11%) were deemed to be useful because the call profiles were of sufficient quality or length to enable positive identification of a bat to genus or species. The remaining 235 (18.89%) call sequences were either too short (three or less pulses) or of low quality, thus preventing positive identification of bat species.

There were at least 10 and up to 15 species recorded during this survey (Table 49). Up to six species listed as vulnerable under the NSW *Biodiversity Conservation Act 2016* (BC Act) were recorded among this data (Table 49). The five vulnerable species that were confidently identified as being present within the subject land include;

- ***Chalinolobus dwyeri* (Large-eared Pied Bat)**
- ***Micronomus norfolkensis* (Eastern Coastal Free-tailed Bat)**
- ***Miniopterus australis* (Little Bentwing Bat)**
- ***Miniopterus orianae oceanensis* (Eastern Bentwing Bat)**
- ***Myotis macropus* (Southern Myotis)**

One other threatened species was recorded as being potentially present within the subject land;

- ***Vespadelus troughtoni* (Eastern Cave Bat)**

The quality, shape and characteristic frequency (defining features) of calls assigned to the threatened species listed above were such that we cannot be certain of this species presence within the subject site. This is because features of the call profile of this threatened species overlap with certain features of the call profiles of other more common and non-threatened species. Eastern Cave Bats are known to occur in the Sydney Basin and consequently, may be present within the subject land. See the Survey Limitations section provided below for further information on call identification and separation of species with overlapping call profiles.

The Large-eared Pied Bat is also listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Activity and foraging

The most commonly recorded species within the subject land included the non-threatened *Rhinolophus megaphyllus* (Eastern Horseshoe Bat) and the *Vespadelus* spp. combination (*Vespadelus pumilus* (Eastern Forest Bat), ***Vespadelus troughtoni* (Eastern Cave Bat)** and *Vespadelus vulturnus* (Little Forest Bat). Collectively, 889 calls were attributed to Eastern Horseshoe Bat and the *Vespadelus* spp. combination, which accounted for 71.46% of the calls that were recorded during this survey. Of these, 522 calls were attributed to the Eastern Horseshoe Bat. These calls were recorded on COF02 and over a single survey night only. It is important to note that the 522 calls were evenly spread across the survey period, thus suggesting the area in which this COF02 was set, may form an important foraging site for this species. In contrast, the calls attributed to the remaining species accounted for between one to 10 calls per species per survey site.

General microbat activity moderate across the four survey sites (e.g. a call was recorded less often than every two minutes and more often than every ten minutes of recording time). Activity was highest at COF02, followed by Anabat Swift 01, COF 04 and Anabat Swift 02 recorded moderate microbat activity levels.

Very few long sequences and feeding buzzes were observed in this data set. Some infrequent feeding buzzes were observed among the *Vespadelus* spp. combination calls recorded on Anabat Swift 02.

The low rates of feeding buzzes recorded suggest that either

- little foraging activity was occurring at these sites,
- the weather conditions were not favourable for the recording of the lower intensity feeding calls, or
- bats were predominantly commuting through these areas.

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.

The 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 at the end of March during a period of warm humid climatic conditions. High humidity can also impact on how sound travels through the air and can consequently impact upon how these microbat calls were recorded.

Interpretation of Survey Results

Calls attributed to the BC Act and EPBC Act listed Large-eared Pied Bat were recorded on two of the four recorders, Anabat Swift 01 and 02. These sites were located within mangroves and near to an open non-vegetated area.

Large-eared Pied Bats are known to roost in in the twilight areas of caves, crevices in cliffs, mines and disused *Hirundo ariel* (Fairy Martin) nests; in colonies of three to 40 (Churchill, 2008). They forage within a range of high fertility forest and woodland communities (dry and wet sclerophyll, grassy woodland, Callitris forest, sub-alpine woodland, tall open eucalypt forest with a rainforest sub-canopy and sandstone outcrop country) within several kilometres of cliff lines and rocky terrain (Churchill, 2008).

It is noted that this is a species credit species in accordance with the BAM. Impact to vegetation within 2 km of sandstone cliffs and caves requires offset. Therefore, all vegetation within the site is considered habitat and requires species credit offsets for Large-eared Pied Bat. It is also noted that this species is listed as a candidate for Serious and Irreversible Impacts (SAIL) under the BAM where breeding habitat is impacted (i.e. impacts to habitat within 100 m of breeding sites). This species breeds in sandstone caves, disused mines or cliff lines. Small cliffs and rock faces are present within 100 m of the subject land. The potential for the development to cause an SAIL will need to be addressed in the BCAR.

Furthermore, it is important to note that individuals of this species have been found roosting in Fairy Martin nests in culverts and under bridges, but these roosts represent habitat for small numbers of bats only (Churchill, 2008). There are several bridges located within and near to the subject land. This includes the bridge that connects Peat Island to the northern bank of Hawksbury River, as well as the Hawksbury River road and rail bridges.

Eastern Coastal Free-tailed Bats are primarily a tree roosting species, but will at times roost in buildings (Churchill, 2008). This species prefers dry sclerophyll forest and woodland and forages over open spaces. It is known from this region, particularly from the rural residential and agricultural areas surrounding the Hawksbury River. This species will forage over the subject land and could form maternity roosts within hollow bearing trees or disused buildings that are present within the subject land. This species will be offset using ecosystem credits.

Southern Myotis is known from this locality. 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 ≥ 3 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 it forages exclusively over water, trawling the surface for small insects and aquatic species such as fish and crustaceans (Anderson et al. 2006). Suitable foraging within and near to the subject land includes the open waters of the nearby Hawksbury River. Species credits are required to offset impacts to habitat for this species, which includes all native vegetation within 200 m of waterbodies.

Eastern Bentwing Bats and Little Bentwing Bats are known to occur in this region. These species are both subterranean roosting species that are only known to breed in a small number of caves and shared caves in NSW (Churchill, 2008). Little Bent-winged Bats have also been known to roost in tree hollows, though not in any great numbers (Churchill, 2008). Caves provide the perfect microclimatic conditions for rearing of young. 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). It is likely that Eastern Bentwing Bats and Little Bentwing Bats will forage over the Mooney Mooney subject land. It is also possible that these two species could roost in hollow bearing trees, nearby subterranean habitats and disused buildings that are present adjacent to or within the subject site. Breeding habitat for these species was not recorded with the subject land. Ecosystem credits are required to offset impacts to foraging habitat for these species. While SAI and species credits can apply to these species, they are not required for the development, as breeding habitat will not be impacted.

The Eastern Cave Bat is known to occur in this region (Pennay et al. 2011). Eastern Cave Bats are a subterranean roosting species known to roost in caves, disused mines, boulder piles and buildings (Churchill, 2008). The presence of Eastern Cave Bat is unlikely to be a significant issue for the project provided that the proposed works will not be impacting upon any significant habitat features such as sandstone caves, boulder piles, disused mines or buildings where this species is known to roost and breed (Churchill, 2008). However, if these features do occur within 100 m of the subject land then a test of significance test under s7.3 of the BC Act will be required. Impact to vegetation within 2 km of sandstone cliffs and caves requires offset. Therefore, all vegetation within the site is considered habitat and requires species credit offsets for Large-eared Pied Bat. It is also noted that this species is listed as

a candidate for Serious and Irreversible Impacts (SAII) under the BAM where breeding habitat is impacted (i.e. impacts to habitat within 100 m of breeding sites). This species breeds in sandstone caves, disused mines or cliff lines as well as old buildings. Small cliffs and rock faces are present within 100 m of the development site, however, suitable roosting habitat was not identified in these features. Several abandoned buildings were also present which provide potential breeding habitat which are being utilised by Eastern Cave Bat.

Further desk top and field validation surveys may be required to determine the location of any potential roost habitat that is located in and within a 100 m radius of the subject land.

Survey Limitations

The species recorded in this survey with overlapping call profiles include Eastern Coastal Free-tailed Bat and Ride's Free-tailed Bat. The calls of these three species overlap in the range 30 kHz to 32 kHz. Eastern Coastal Free-tailed Bat calls were identified by alternation in call frequency between pulses, a flat shape (initial slope S1 of less than 100 octaves per second) and a characteristic frequency of between 31 – 36 kHz. Calls were identified as Ride's Freetail 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.

Eastern Bentwing Bats have call profiles that overlap with other species in the Sydney Basin, including *V. darlingtoni* (Large Forest Bat) and *V. regulus* (Southern Forest Bat). Eastern Bentwing Bat calls can be identified by a characteristic frequency of 43.5 – 47.5 kHz, a down-sweeping tail, uneven time between call pulses and uneven pulse shape within a sequence and a drop of more than 2 kHz between the knee and characteristic section of the call. Large Forest Bat calls have a characteristic frequency of 40 - 44 kHz, have no tail or up-sweeping tails. Large Forest Bats often have a long characteristic section which can aid in separating this species from the Southern Forest Bat. Southern Forest Bat calls fall between 43.5 – 46 kHz, are curved and generally have up-sweeping tails but can have down-sweeping tails. Some of the calls recorded during this survey displayed a drop of more than 2 kHz, downward sweeping tails and variability between the pulses leading to an identification of Eastern Bentwing Bat.

The calls of Little Bentwing Bats are generally easily separated from those of *Chalinolobus morio* (Chocolate Wattled Bat) by higher frequency falling between 54.5 and 64.5kHz, however both have down-sweeping tails. Chocolate Wattled Bats generally call between 49.5 and 52 kHz in the Sydney Basin but call at frequencies up to 54.5 kHz in other regions of NSW. Calls falling between 54 and 55.5 kHz can be difficult to separate. Little Bentwing Bat calls often display variable shape and time between pulses and rarely call below 58 kHz. When calls with down sweeping tails were recorded at 54 to 55.5 kHz they were assigned mixed species labels.

In this region, calls of Eastern Forest Bat, Eastern Cave Bat) Little Forest Bat and Chocolate Wattled Bat can overlap in the range 47 – 53 kHz. Chocolate Wattled Bat calls have a down-sweeping tail whereas Eastern Forest Bat, Eastern Cave Bat and Little Forest Bat calls have an up-sweeping tail. At frequencies between 49 and 53 kHz it is impossible to separate Eastern Cave Bat from Little Forest Bat. Calls with an upsweeping tail and characteristic frequency between 54 and 58 kHz can be attributed Eastern Forest Bat. Calls with an end frequency below 51 kHz can be identified as either Eastern Cave Bat or Little Forest Bat. Calls with an end frequency above 54.5 kHz can be identified as Eastern Forest Bat. When no distinguishing characteristics were present calls were assigned to multi-species groups or characterized as unidentifiable.

The calls of Southern Myotis and the *Nyctophilus* group of species are difficult to separate. Calls can sometimes 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 sometimes be identified as Southern Myotis when the time between calls (TBC) is lower than 75ms and the initial slope S1 is greater than 400 (OPS). Southern Myotis calls are often louder and more distinct, recorded in longer sequences and more variable in shape and TBC than *Nyctophilus* calls. In addition, there is often two kinks in the slope of *Nyctophilus spp.* calls. Where the TBC is between 75 and 95ms and the OPS is between 300 and 400 calls are assigned a mixed species label of Southern Myotis / Long-eared Bats (Pennay, Law and Reinhold 2004).

Results tables

Table 49. Microbat species diversity recorded ultrasonically over 16 survey nights from four survey sites at Mooney Mooney between 25 and 28 March 2019.

Species Name	Common Name	Result	Offsets Required	SAII Candidate
<i>Austronomus australis</i>	White-striped Free-tailed Bat	X	No	No
<i>Chalinolobus dwyeri</i> * ¹	Large-eared Pied Bat	X	Species credits	Yes – suitable breeding habitat (caves) not present in biocertification area
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	X	No	No
<i>Micronomus norfolkensis</i> *	Eastern Coastal Free-tailed Bat	X	Ecosystem credits	No
<i>Miniopterus australis</i> *	Little Bentwing Bat	X	Ecosystem credits	Yes – suitable breeding habitat (caves) not present in biocertification area
<i>Miniopterus orianae oceanensis</i> *	Eastern Bentwing Bat	X	Ecosystem credits	Yes – suitable breeding habitat (caves) not present in biocertification area
<i>Myotis macropus</i> *	Southern Myotis	X	Species credits	No
<i>Nyctophilus spp.</i> In this region the non-threatened <i>N. geoffroyi</i> and <i>N. gouldii</i> are likely to be present.	In this region the non-threatened Lesser and Gould's Long-eared Bats are likely to be present.	P	No	No
<i>Ozimops ridei</i>	Ride's Free-tailed Bat	X	No	No
<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe Bat	X	No	No
<i>Vespadelus pumilus</i>	Eastern Forest Bat	X	No	No

Species Name	Common Name	Result	Offsets Required	SAIL Candidate
<i>Vespadelus regulus</i>	Southern Forest Bat	P	No	No
<i>Vespadelus troughtoni</i> *	Eastern Cave Bat	P	Species credits	Yes – potential breeding habitat present in abandoned buildings
<i>Vespadelus vulturnus</i>	Little Forest Bat	P	No	No

X = Definitely recorded, P = Potentially recorded. *listed as threatened under the BC Act and ¹ listed as threatened under the EPBC Act

Table 50. Number of calls recorded per microbat species on Anabat Swift 01, Mooney Mooney, 25 to 28 March 2019.

Species Name	Common name	Definitely present	Potentially present	Total present
<i>Austronomus australis</i>	White-striped Free-tailed Bat	6	1	7
<i>Chalinolobus dwyeri</i> * ¹	Large-eared Pied Bat	3	0	3
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	0	1	1
<i>Micronomus norfolkensis</i> *	Eastern Coastal Free-tailed Bat	1	1	2
<i>Miniopterus australis</i> * / <i>Vespadelus pumilus</i>	Little Bentwing Bat / Eastern Forest Bat	0	3	3
<i>Miniopterus orianae oceanensis</i> *	Eastern Bentwing Bat	5	2	7
<i>Ozimops ridei</i>	Ride's Free-tailed Bat	3	4	7
<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe Bat	124	0	124
<i>Vespadelus pumilus</i>	Eastern Forest Bat	3	0	3
<i>Vespadelus pumilus</i> / <i>Vespadelus troughtoni</i> * / <i>Vespadelus vulturnus</i>	Eastern Forest Bat / Eastern Cave Bat / Little Forest Bat	0	140	140
Unidentifiable calls				70
Identifiable calls				297
Total Calls				367
Percentage usable calls				80.93

* listed as vulnerable under the BC Act and ¹listed as vulnerable EPBC Act

Table 51. Number of calls recorded per microbat species on Anabat Swift 02, Mooney Mooney, 25 to 28 March 2019.

Species Name	Common name	Definitely present	Potentially present	Total present
<i>Austronomus australis</i>	White-striped Free-tailed Bat	1	2	3
<i>Chalinolobus dwyeri</i> * ¹	Large-eared Pied Bat	2	1	3
<i>Chalinolobus morio</i> / <i>Vespadelus pumilus</i> / <i>Vespadelus troughtoni</i> * / <i>Vespadelus vulturnus</i>	Chocolate Wattled Bat / Eastern Forest Bat / Eastern Cave Bat / Little Forest Bat	0	1	1
<i>Micronomus norfolkensis</i> *	Eastern Coastal Free-tailed Bat	4	1	5

Species Name	Common name	Definitely present	Potentially present	Total
<i>Micronomus norfolkensis*</i> / <i>Ozimops ridei</i>	Eastern Coastal Free-tailed Bat / Ride's Free-tailed Bat	0	3	3
<i>Miniopterus oriana oceanensis*</i>	Eastern Bentwing Bat	4	6	10
<i>Miniopterus oriana oceanensis*</i> <i>Vespadelus darlingtoni</i> / <i>Vespadelus regulus</i>	Eastern Bentwing Bat / Large Forest Bat / Southern Forest Bat	0	1	1
<i>Ozimops ridei</i>	Ride's Free-tailed Bat	1	0	1
<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe Bat	3	0	3
<i>Vespadelus pumilus</i>	Eastern Forest Bat	4	4	8
<i>Vespadelus pumilus</i> / <i>Vespadelus troughtoni*</i> / <i>Vespadelus vulturnus</i>	Eastern Forest Bat / Eastern Cave Bat / Little Forest Bat		83	83
Unidentifiable calls				31
Identifiable calls				121
Total Calls				152
Percentage usable calls				79.61

* listed as vulnerable under the BC Act and ¹listed as vulnerable EPBC Act

Table 52. Number of calls recorded per microbat species on COF02 (3998), Mooney Mooney, 25 to 28 March.

Species Name	Common name	Definitely present	Potentially present	Total
<i>Austronomus australis</i>	White-striped Free-tailed Bat	0	1	1
<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe Bat	456	21	477
Unidentifiable calls				44
Identifiable calls				478
Total Calls				522
Percentage usable calls				91.57

Table 53. Number of calls recorded per microbat species on COF04 Mooney Mooney, 25 and 28 March 2019.

Species Name	Common name	Definitely present	Potentially present	Total
<i>Austronomus australis</i>	White-striped Free-tailed Bat	6	1	7
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	4	3	7
<i>Chalinolobus morio</i> / <i>Vespadelus pumilus</i> / <i>Vespadelus troughtoni*</i> / <i>Vespadelus vulturnus</i>	Chocolate Wattled Bat / Eastern Forest Bat / Eastern Cave Bat / Little Forest Bat	0	8	8
<i>Micronomus norfolkensis*</i>	Eastern Coastal Free-tailed Bat	3	0	3
<i>Micronomus norfolkensis*</i> / <i>Ozimops ridei</i>	Eastern Coastal Free-tailed Bat / Rides Free-tailed Bat	0	1	1
<i>Miniopterus australis*</i> / <i>Vespadelus pumilus</i>	Little Bentwing Bat / Eastern Forest Bat	0	1	1
<i>Miniopterus oriana oceanensis*</i>	Eastern Bentwing Bat	3	1	4

Species Name	Common name	Definitely present	Potentially present	Total
<i>Miniopterus orianae oceanensis*</i> / <i>Vespadelus regulus</i>	Eastern Bentwing Bat / Southern Forest Bat	0	3	3
<i>Myotis macropus*</i>	Southern Myotis	3	0	3
<i>Myotis macropus*</i> / <i>Nyctophilus sp</i>	Southern Myotis / Long-eared Bat	0	5	5
<i>Ozimops ridei</i>	Ride's Free-tailed Bat	8	0	8
<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe Bat	20	0	20
<i>Vespadelus pumilus</i>	Eastern Forest Bat	1	0	1
<i>Vespadelus pumilus</i> / <i>Vespadelus trouhtoni*</i> / <i>Vespadelus vulturnus</i>	Eastern Forest Bat / Eastern Cave Bat / Little Forest Bat	42	0	42
Unidentifiable calls				90
Identifiable calls				113
Total Calls				203
Percentage usable calls				55.67

* listed as vulnerable under the BC Act

Example Call Profiles

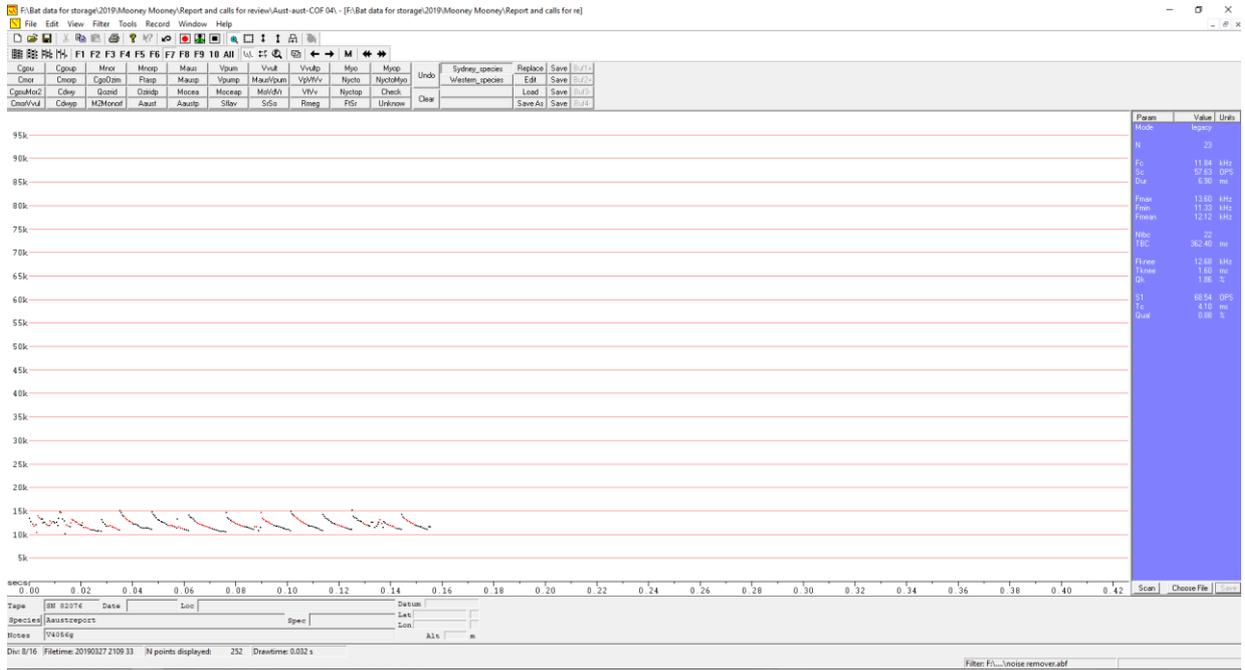


Figure 35. Call profile for *Austronomus australis* (White-striped Free-tailed Bat) recorded on COF04 at 2109 (9.09 pm) on 27 March 2019.

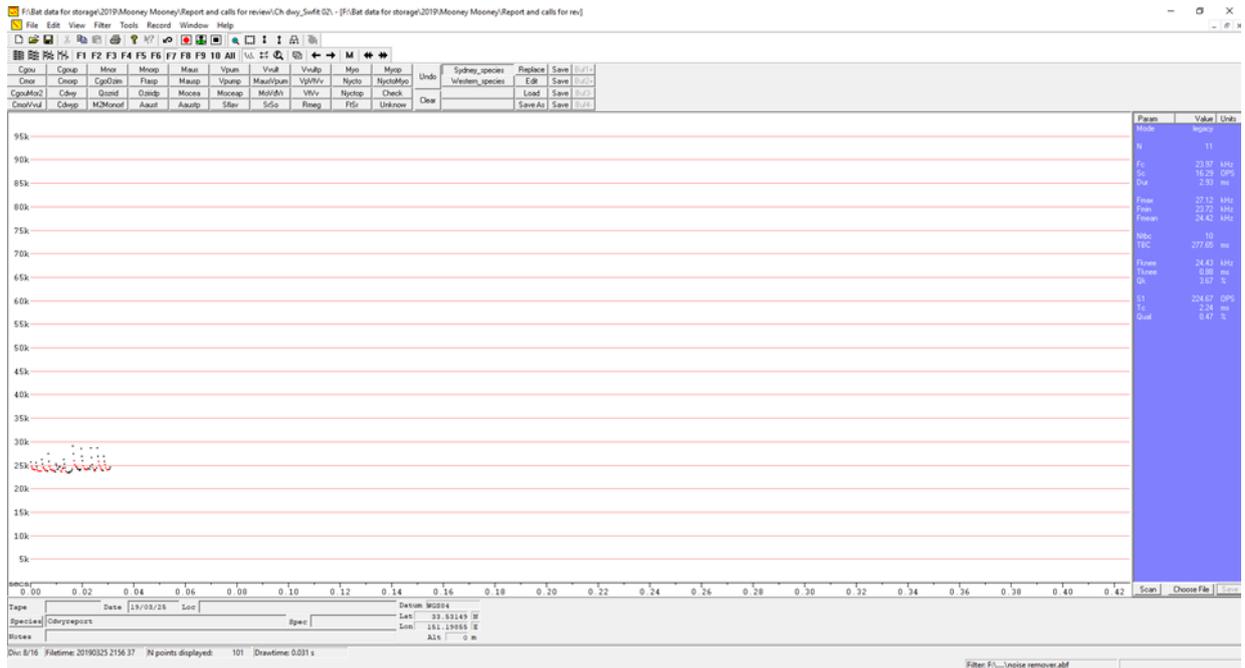


Figure 36: Call profile for *Chalinolobus dwyeri* (Large-eared Pied Bat) recorded on Anabat Swift 02 at 2156 (9.56 pm) on 25 March 2019.

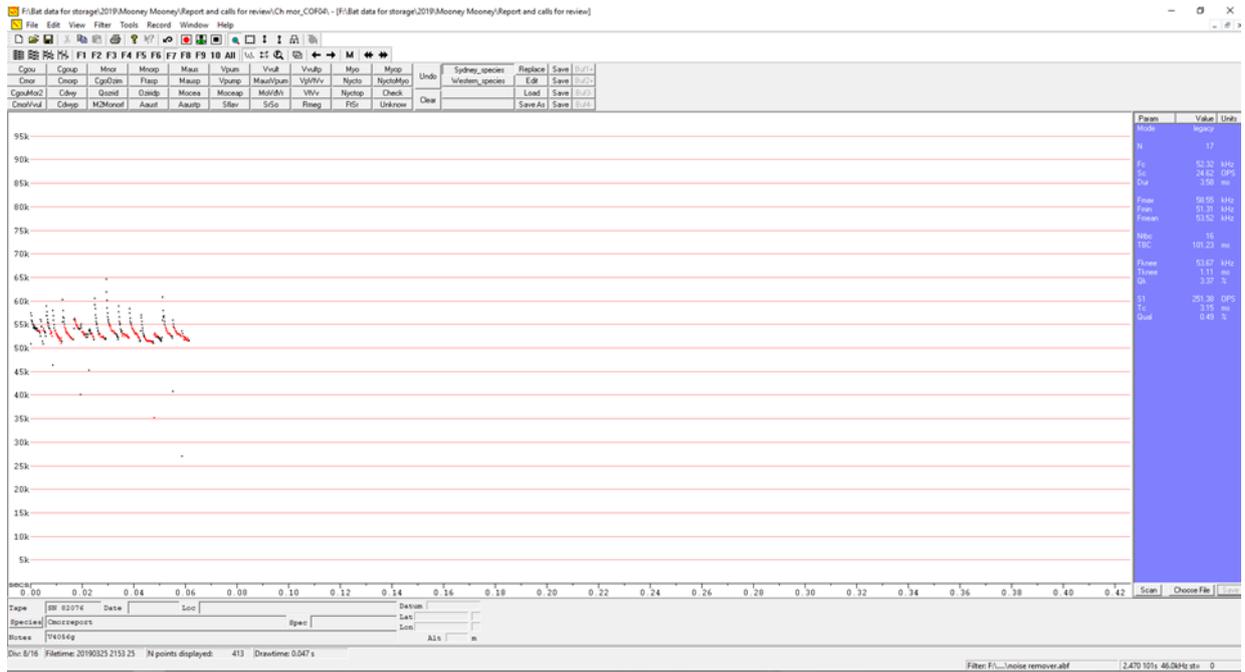


Figure 37: Call profile for *Chalinolobus morio* (Chocolate Wattled Bat) recorded on COF04 2153 (9.53 pm) on 25 March 2019.

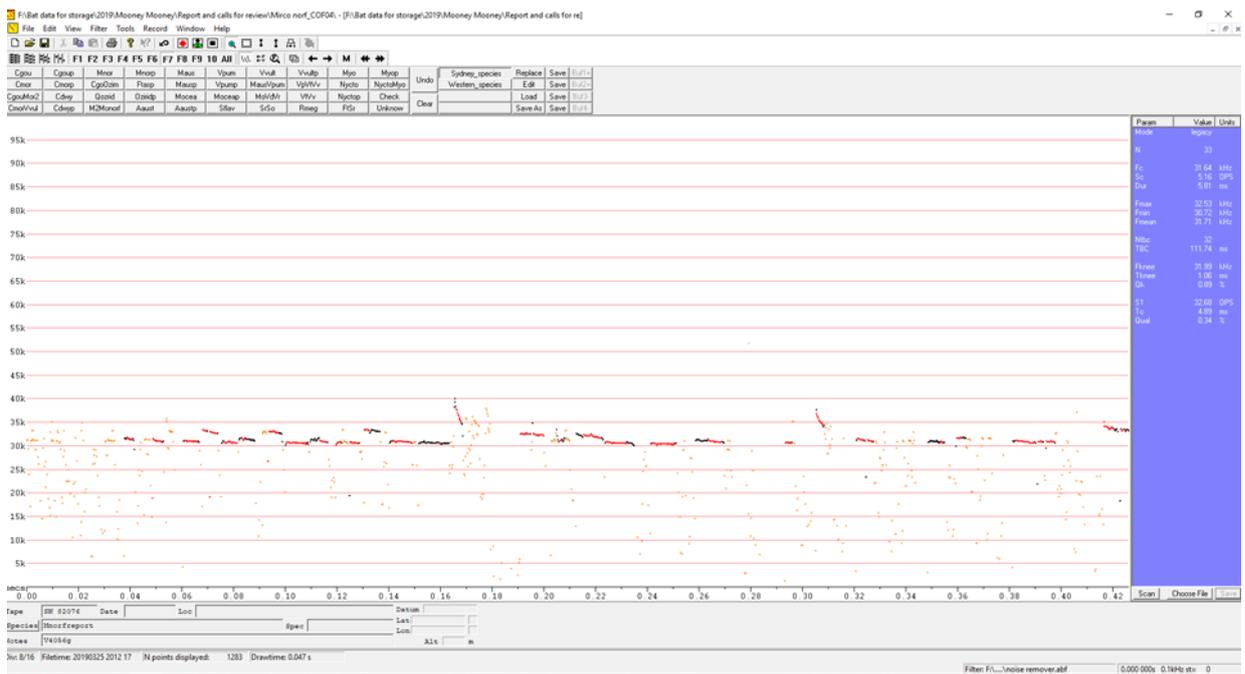


Figure 38: Call profile for *Micronomus norfolkensis* (Eastern Coastal Free-tailed Bat) recorded on COF04 at 2012 (8.12 pm) on 25 March 2019.

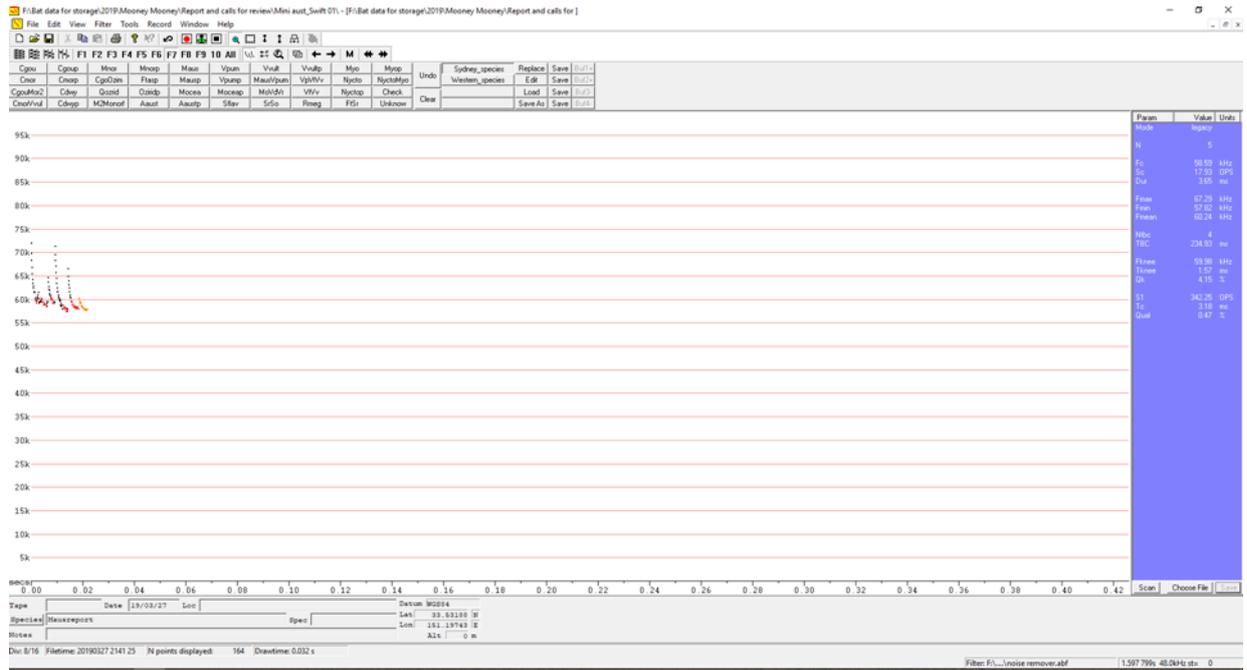


Figure 39. Call profile for *Miniapterus australis* (Little Bentwing Bat) recorded on Anabat Swift 01 at 2141 (9.41 pm) on 27 March 2019.

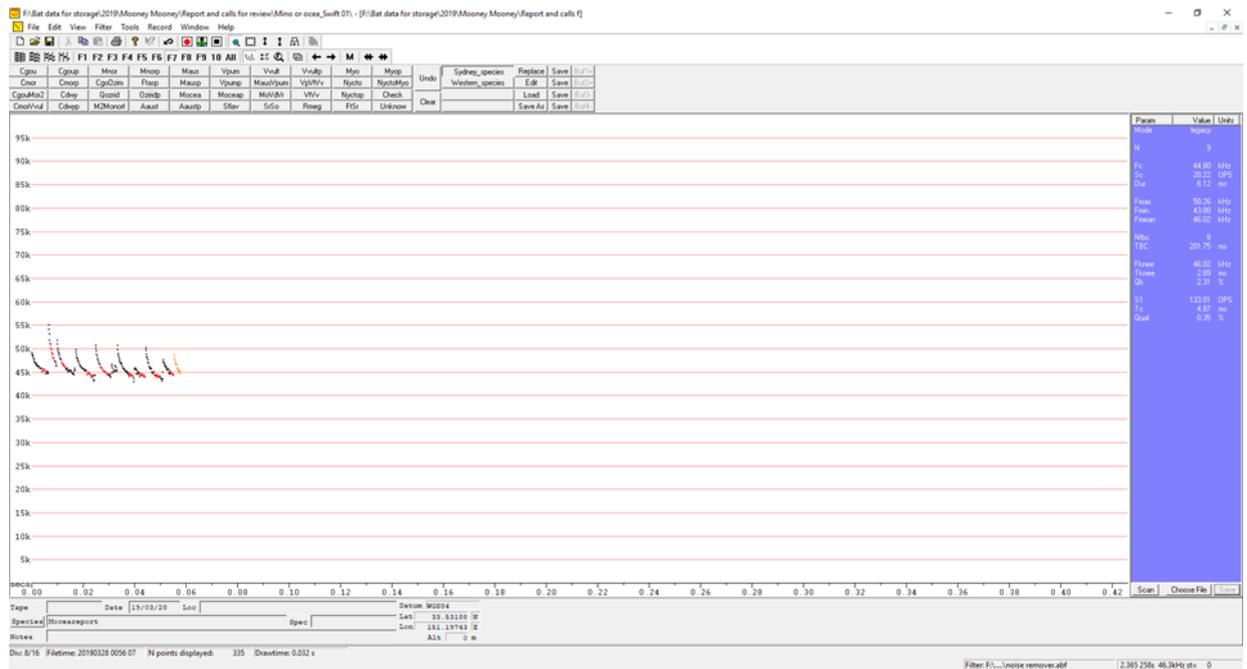


Figure 40. Call profile for *Miniapterus orianae oceanensis* (Eastern Bentwing Bat) recorded on Anabat Swift 01 at 0056 (12.56 am) on 28 March 2019.

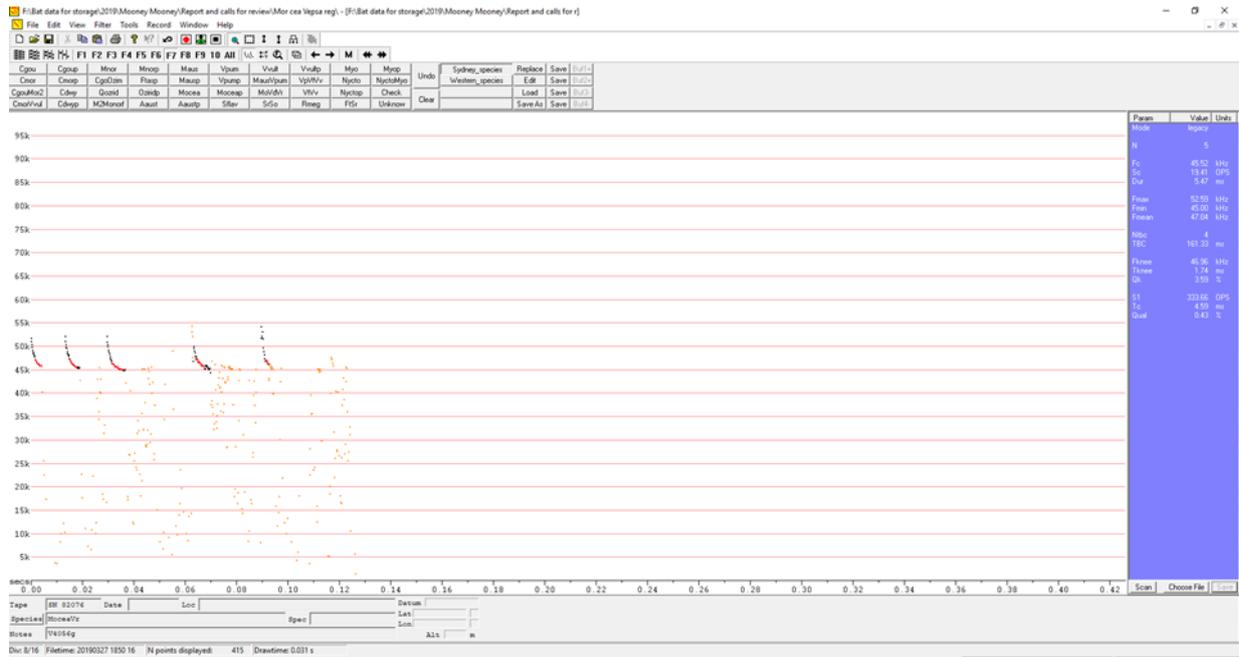


Figure 41. Call profile for *Miniopterus orianae oceanensis* (Eastern Bentwing Bat) / *Vespadelus regulus* (Southern Forest Bat) recorded on COF04 at 1850 (6.5 pm) on 27 March 2019

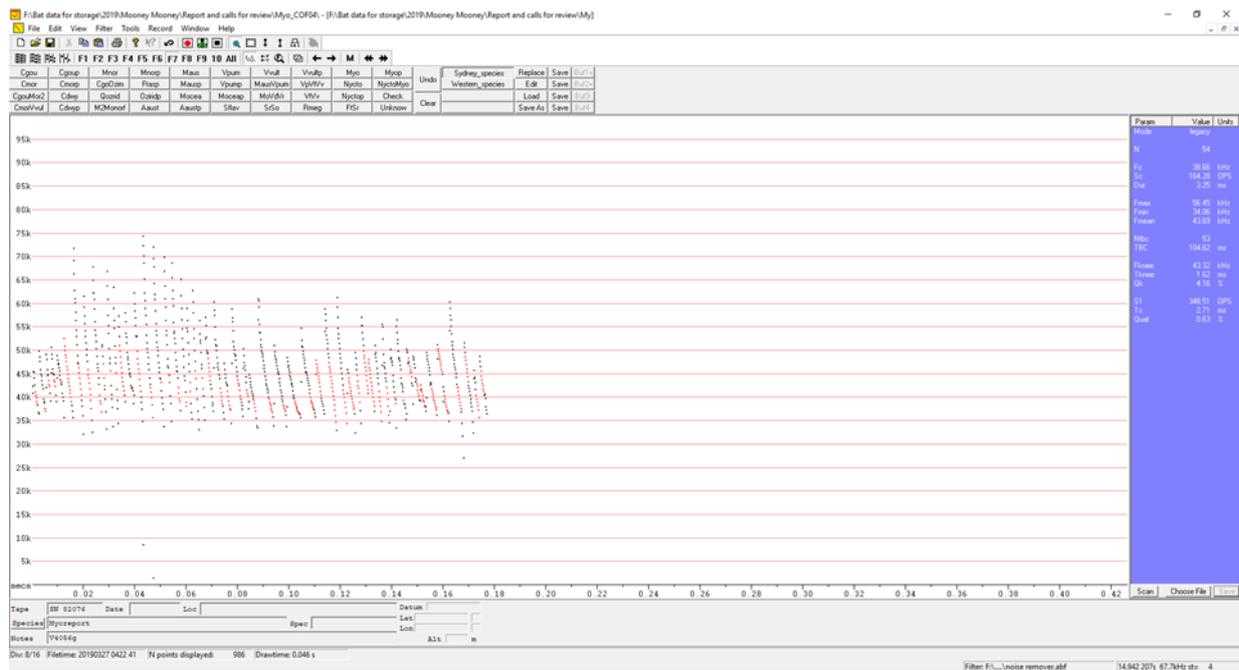


Figure 42: Call profile for *Myotis macropus* (Southern Myotis) recorded on COF04 at 0422 (4.22 am) on 27 March 2019.

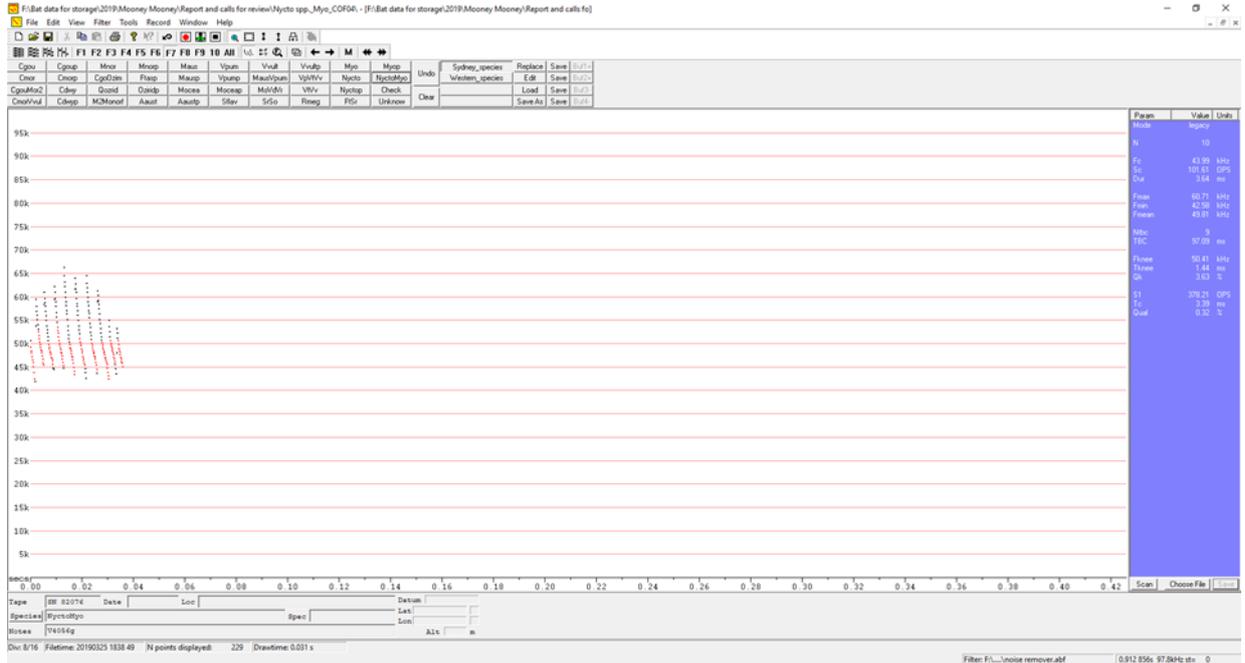


Figure 43: Call profile for *Myotis macropus* (Southern Myotis) / *Nyctophilus* spp. (possibly *Nyctophilus geoffroyi* (Lesser Long-eared Bat), *Nyctophilus gouldi* (Gould’s Long-eared Bat) recorded on COF04 at 1838 (6.38 pm) on 25 March 2019.

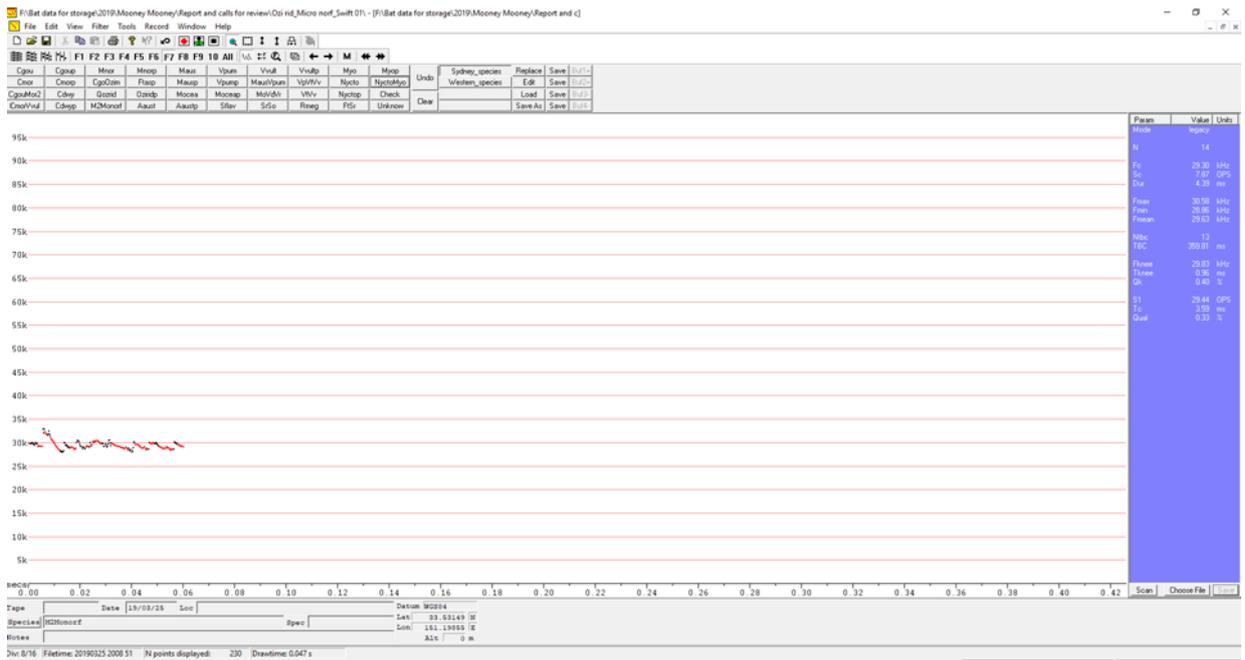


Figure 44: Call profile for *Ozimops ridei* (Ride’s Free-tailed Bat) recorded on Anabat Swift 01 at 2008 (8.08 pm) on 25 March 2019.

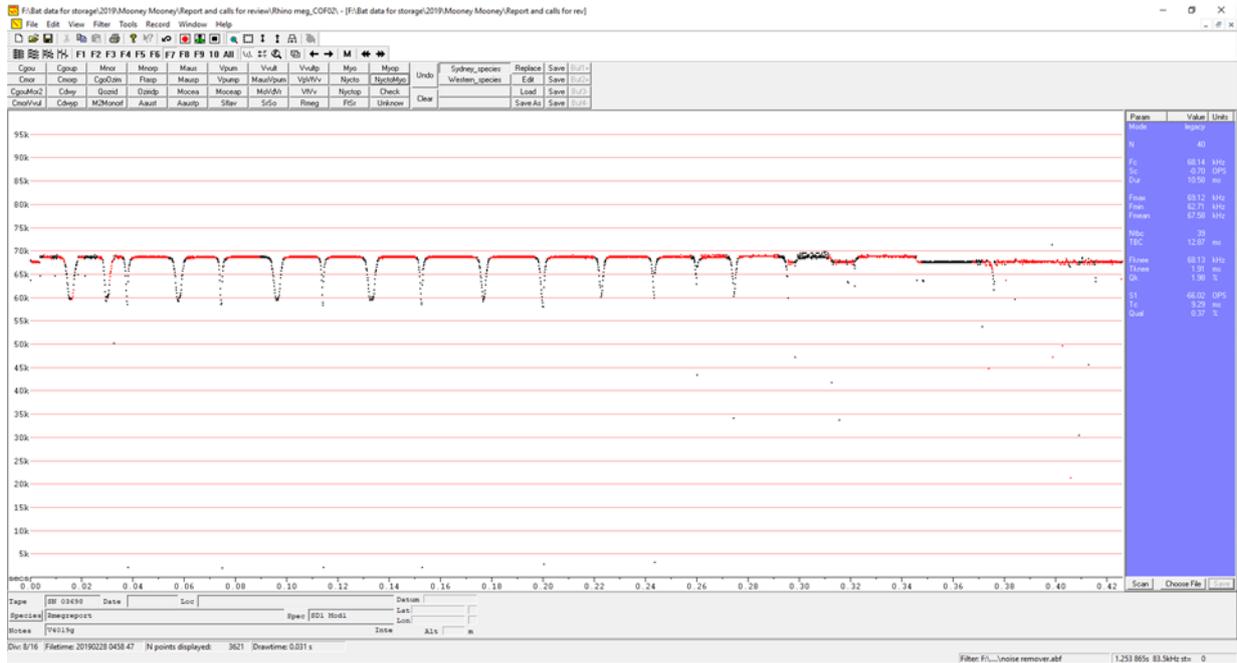


Figure 45: Call profile for *Rhinolophus megaphyllus* (Eastern Horseshoe Bat) recorded on COF02 at 0458 (4.58 am) on 28 March 2019.

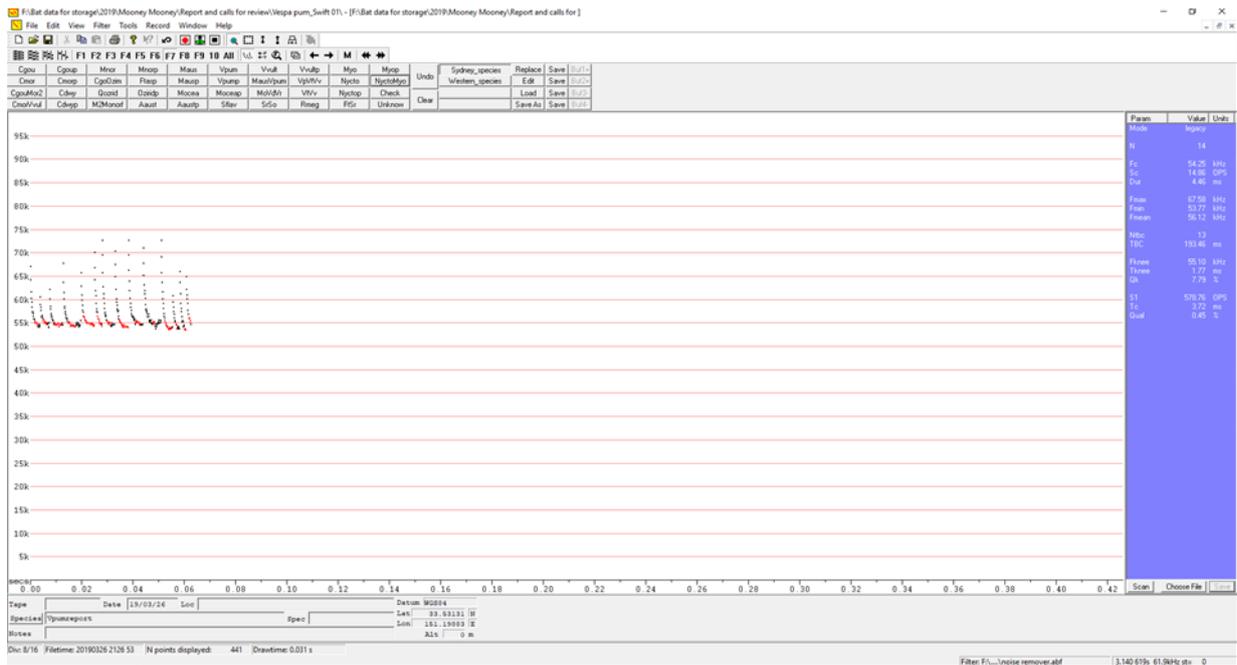


Figure 46: Call profile for *Vespardelus pumilus* (Eastern Forest Bat) recorded on Anabat Swift 01 at 2156 (9.56 pm) on 26 March 2019.

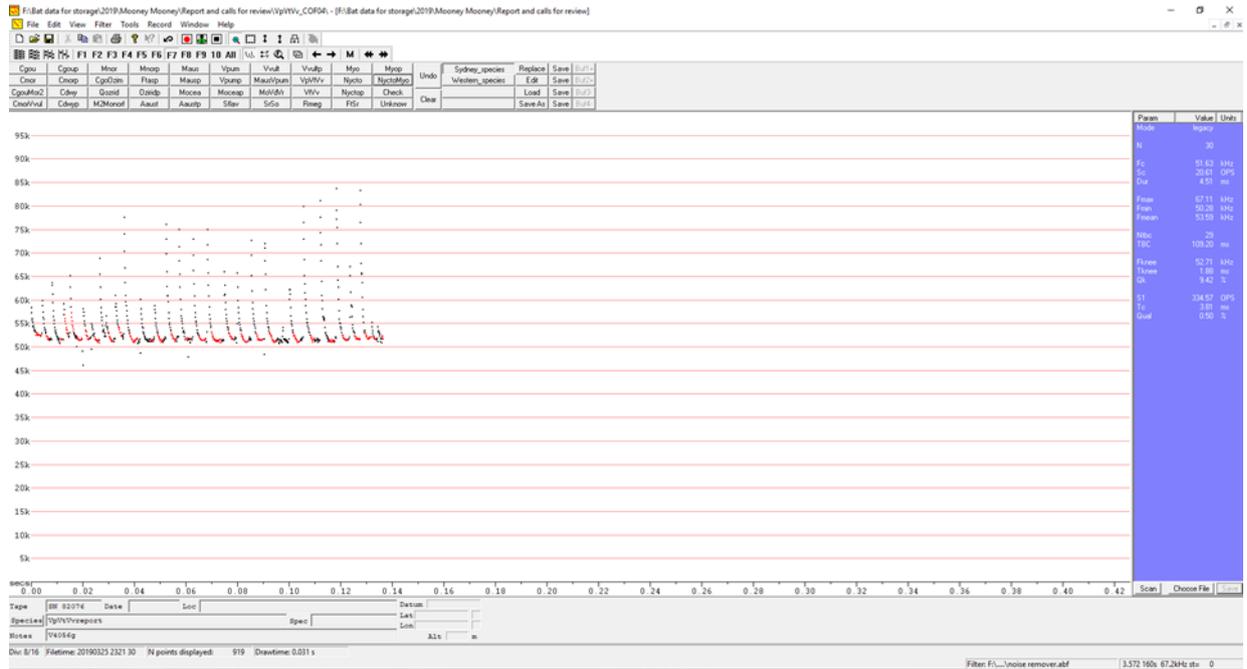


Figure 47: Call profile for *Vespadelus pumilus* (Eastern Forest Bat) / *Vespadelus troungtoni* (Eastern Cave Bat) / *Vespadelus vulturinus* (Little Forest Bat) recorded on COF04 at 2321 (11.21 pm) on 25 March 2019.

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Appendix E *Environment Protection and Biodiversity Conservation Act 1999* - Significant Impact Guidelines

Assessments in accordance with the Significant Impact Guidelines 1.1 – Matters of National Environmental Significance have been undertaken for the following species which have been recorded within the site or have the potential to occur within the biocertification area and potential to be impacted by the development:

- *Anthochaera phrygia* (Regent Honeyeater) – Critically Endangered
- *Calidris ferruginea* (Curlew Sandpiper) – Critically Endangered
- *Lathamus discolor* (Swift Parrot) – Critically Endangered
- *Numenius madagascariensis* (Eastern Curlew) – Critically Endangered and Migratory (recorded close to biocertification area)
- *Rostratula australis* (Australian Painted Snipe) - Endangered
- *Chalinolobus dwyeri* (Large-eared Pied Bat) – Vulnerable (recorded within biocertification area)
- *Pteropus poliocephalus* (Grey-headed Flying-fox) – Vulnerable
- *Actitis hypoleucos* (Common Sandpiper) – Migratory
- *Calidris acuminata* (Sharp-tailed Sandpiper) – Migratory
- *Calidris melanotos* (Pectoral Sandpiper) – Migratory
- *Gallinago hardwickii* (Latham’s Snipe) – Migratory
- *Tringa nebularia* (Common Greenshank) – Migratory

Waterbirds and wading birds have been grouped together into a single assessment due to similar habitat requirements.

Table 54: EPBC Significance assessment for *Anthochaera phrygia* (Regent Honeyeater)

Criterion	Question	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility of the following:		
1)	will the action lead to a long-term decrease in the size of a population	<p>The Regent Honeyeater has been recorded once within 5 km of the biocertification area in 1909 and is unlikely to utilise the habitat available on a regular basis. This species may utilise marginal foraging habitat in the biocertification area on an infrequent basis, however, would not rely on foraging resources in the biocertification area for survival.</p> <p>The proposed development would result in the removal of up to 3.37 ha of marginal foraging for the Regent Honeyeater, which is unlikely to lead to a long term decrease in the size of a population.</p>
2)	will the action reduce the area of occupancy of the species	<p>Only one Regent Honeyeater record, from 1909, is present within 5 km of the biocertification area and this species would only utilise marginal foraging habitat at most on an infrequent basis. While the proposed development would result in a reduction of potential foraging habitat by 3.37 ha, the development is unlikely to result in any significant reduction in the area of occupancy for this species.</p>
3)	will the action fragment an existing population into two or more populations	<p>The Regent Honeyeater is thought to occur as a single population. This highly mobile species may pass through the biocertification area and utilise foraging habitat on a very occasional basis however would not rely on these foraging resources. The proposed development will not significantly fragment any areas of habitat that would result in the fragmentation of the single population of this highly mobile species.</p>
4)	will the action adversely affect habitat critical to the survival of a species	<p>Habitat critical to the survival of the Regent Honeyeater, as defined in the National Recovery Plan for the Regent Honeyeater (DoE 2016) consists of:</p> <ul style="list-style-type: none"> • Any breeding or foraging habitat in areas where the species is likely to occur; and • Any newly discovered breeding or foraging locations. <p>The biocertification area does contain potential foraging habitat within an area where the species is likely to occur, therefore the biocertification area may be considered habitat critical to the survival of the species. It is noted that foraging habitat is marginal and only one key tree species listed in the recovery plan, <i>Corymbia maculata</i> (Spotted Gum), is present as a stand of planted vegetation. The development is unlikely to have a significant adverse impact on habitat critical to the survival of the Regent Honeyeater. It is also noted that the biocertification area does not contain any DPIE mapped important areas for the Regent Honeyeater. .</p>
5)	will the action disrupt the breeding cycle of a population	<p>Only a small number of known breeding sites are present in Australia for this species, none of which are near the</p>

Criterion	Question	Response
		biocertification area. The proposal is unlikely to disrupt the breeding cycle of a population of this species.
6) i	will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The biocertification area contains only marginal foraging habitat for this species. This species has been recorded only once within 5 km of the biocertification area and potential habitat would only be utilised on a very infrequent basis. The proposed development is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
6) ii	will the action result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The proposal is unlikely result in invasive species, such as weeds, that would be harmful to Regent Honeyeater. 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.
7)	will the action introduce disease that may cause the species to decline	The proposed development is unlikely to introduce disease that may cause the species to decline.
8)	will the action interfere with the recovery of the species	The proposed development would result in the loss of approximately 3.37 ha of marginal foraging habitat for the Regent Honeyeater which would at best be utilised on an infrequent basis. This species has not been recorded within 5 km of the biocertification area. The proposed development is unlikely to interfere with the recovery of the species.
Conclusion	Is there likely to be a significant impact?	The action will not affect breeding habitat and will only impact on marginal foraging habitat for this 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 considered unlikely to have a significant impact on this species.

Table 55: EPBC Significance assessment for *Lathamus discolor* (Swift Parrot)

Criterion	Question	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility of the following:		
1)	will the action lead to a long-term decrease in the size of a population	<p>The Swift Parrot has not been recorded within 5 km of the biocertification area and is unlikely to utilise the habitat available on a regular basis. This species may utilise marginal foraging habitat in the biocertification area on an infrequent basis during the winter migration, however, preferred winter foraging habitat is in very low abundance in the biocertification area, with only a small area of planted <i>Corymbia maculata</i> (Spotted Gum) present.</p> <p>The proposed development would result in the removal of up to 3.40 ha of marginal foraging from PCT 1557 (PCTs 1232 and 920 do not contain habitat for this species), which is unlikely to lead to a long term decrease in the size of a population.</p>
2)	will the action reduce the area of occupancy of the species	The Swift Parrot has not been recorded within 5 km of the biocertification area and would only utilise marginal foraging habitat at most on an infrequent basis. While the proposed development would result in a reduction of potential foraging habitat by 3.40 ha, the development is unlikely to result in any significant reduction in the area of occupancy for this species.
3)	will the action fragment an existing population into two or more populations	The Swift Parrot occurs as a single population. This highly mobile species may pass through the biocertification area and utilise foraging habitat on a very occasional basis however would not rely on these foraging resources. The proposed development will not significantly fragment any areas of habitat that would result in the fragmentation of the single population of this highly mobile species
4)	will the action adversely affect habitat critical to the survival of a species	The biocertification area would not constitute habitat critical to the survival of the species, given that there is no evidence of site fidelity from this species and only marginal foraging habitat is available. It is also noted that the biocertification area does not contain any DPIE mapped important areas.
5)	will the action disrupt the breeding cycle of a population	This species breeds only in Tasmania and therefore the development would not disrupt the breeding cycle of the Swift Parrot.
6) i	will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The biocertification area contains only marginal foraging habitat for this species. This species has not been recorded within 5 km of the biocertification area and potential habitat would only be utilised on a very infrequent basis. The proposed development is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
6) ii	will the action result in invasive species that are harmful to a critically endangered or endangered species becoming established in	The proposal is unlikely to result in invasive species, such as weeds, that would be harmful to Swift Parrot. It is unlikely that the proposed action will result in a large increase in the

Criterion	Question	Response
	the endangered or critically endangered species' habitat	number of weeds due to the current disturbed nature of the site.
7)	will the action introduce disease that may cause the species to decline	The proposed development is unlikely to introduce disease that may cause the species to decline.
8)	will the action interfere with the recovery of the species	The proposed development would result in the loss of approximately 3.4 ha of marginal foraging habitat for the Swift Parrot which would at best be utilised on an infrequent basis. This species has not been recorded within 5 km of the biocertification area. The proposed development is unlikely to interfere with the recovery of the species.
Conclusion	Is there likely to be a significant impact?	The action will not affect breeding habitat and will only impact on marginal foraging habitat for this 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 considered unlikely to have a significant impact on this species.

Table 56: EPBC Significance assessment for *Numenius madagascariensis* (Eastern Curlew)

Criterion	Question	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility of the following:		
1)	will the action lead to a long-term decrease in the size of a population	<p>Eastern Curlew was recorded foraging on mudflats approximately 200 m to the east of the biocertification area. Potential habitat is available on the mudflats and vegetation associated with the floodplain in the biocertification area (PCT 920 and 1232). It is noted that the area of PCT 1232 that has been planted is considered to provide suitable habitat for this species. Eastern Curlew has also been recorded foraging on mudflats off Spectacled Island approximately 750 m east of the biocertification area.</p> <p>This species is likely to utilise marginal foraging habitat in the biocertification area on an infrequent basis, however, considering the very limited records, these species are unlikely to rely on these foraging resources for survival. Higher quality habitat is available on mudflats outside of the biocertification area. No individuals were recorded foraging on mudflats in proximity to development around the foreshore recreational area.</p> <p>The proposed development would result in the removal of 0.19 ha of marginal foraging from PCT 920 and 1232, which is unlikely to lead to a long term decrease in the size of a population.</p>
2)	will the action reduce the area of occupancy of the species	The action will reduce the potential area of occupancy of this species by approximately 0.19 ha, which is not considered significant.
3)	will the action fragment an existing population into two or more populations	One individual was recorded approximately 200 m east of the biocertification area during survey and one additional record of Eastern Curlew is present within 5 km of the biocertification area. It is unlikely that there is a resident population within or nearby the biocertification area and these species may only forage on adjacent mudflats on a sporadic basis. The proposed development will not fragment an existing population into two or more populations.
4)	will the action adversely affect habitat critical to the survival of a species	The development site is unlikely to be critical to the survival of these species given that substantial areas of suitable habitat are located outside of the biocertification area within the Hawkesbury River and that the area to be impacted is small (0.19) and of lower quality than the area to be retained.
5)	will the action disrupt the breeding cycle of a population	The proposed development is unlikely to disrupt any breeding populations of the Eastern Curlew, which breeds in Russia and north-eastern China.
6) i	will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The development site contains only a small amount of potential foraging habitat for Eastern Curlew, higher quality habitat is available on mudflats outside of the development site within the Hawkesbury River. The proposed

Criterion	Question	Response
		development is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species are likely to decline
6) ii	will the action result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The proposal is unlikely result in invasive species, such as weeds, that would be harmful to Eastern Curlew. 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.
7)	will the action introduce disease that may cause the species to decline	The proposed development is unlikely to introduce disease that may cause the species to decline.
8)	will the action interfere with the recovery of the species	The proposed development would result in the loss of approximately 0.19 ha of marginal foraging habitat for the Eastern Curlew. The highest quality habitat within the locality is located outside of the development site, on mudflats in the Hawkesbury River. The proposed development is unlikely to interfere with the recovery of the species.
Conclusion	Is there likely to be a significant impact?	The action will not affect breeding habitat and will only impact on a small amount (0.19 ha) of potential foraging habitat for these species. No important populations would be isolated or fragmented and the life cycle of these species is not likely to be affected. Therefore, the action is considered unlikely to have a significant impact on these species.

Table 57: EPBC Significance assessment for *Calidris ferruginea* (Curlew Sandpiper) and *Rostratula australis* (Australian Painted Snipe)

Criterion	Question	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility of the following:		
1)	will the action lead to a long-term decrease in the size of a population	<p>Curlew Sandpiper and Australian Painted Snipe have potential habitat on the mudflats and vegetation associated with the floodplain in the development site (PCT 920 and 1232). It is noted that the area of PCT 1232 that has been planted is considered to provide suitable habitat for this species. Curlew Sandpiper and Australian Painted Snipe have not been recorded within 5 km of the development site and are unlikely to utilise the habitat available on a regular basis.</p> <p>These species may utilise marginal foraging habitat in the biocertification area on an infrequent basis, however, the majority of foraging habitat is present on the mudflats outside of the biocertification area and these species are unlikely to rely on foraging habitat in the biocertification area for survival. .</p> <p>The proposed development would result in the removal of 0.19 ha of marginal foraging from PCT 920 and 1232, which is unlikely to lead to a long term decrease in the size of a population.</p>
2)	will the action reduce the area of occupancy of the species	The action will reduce the potential area of occupancy of these species by approximately 0.19 ha, which is not considered significant.
3)	will the action fragment an existing population into two or more populations	No records for Australian Painted Snipe or Curlew Sandpiper are present within 5 km of the development site. It is unlikely that there is a resident population within or nearby the development site and these species may only forage on adjacent mudflats on a sporadic basis. The proposed development will not fragment an existing population into two or more populations.
4)	will the action adversely affect habitat critical to the survival of a species	The development site is unlikely to be critical to the survival of these species given that substantial areas of suitable habitat are located outside of the biocertification area within the Hawkesbury River and that the area to be impacted is small (0.19) and of lower quality than the area to be retained.
5)	will the action disrupt the breeding cycle of a population	The proposed development is unlikely to disrupt any breeding populations of the Australian Painted Snipe or Curlew Sandpiper as the planning proposal will only impact a small amount of potential foraging habitat.
6) i	will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The biocertification area contains only a small amount of potential foraging habitat for these species. There is a lack of records for these within 5 km of the development site and potential habitat would only be utilised on a very infrequent basis, if at all. The proposed development is unlikely to modify, destroy, remove, isolate or decrease the

Criterion	Question	Response
		availability or quality of habitat to the extent that the species are likely to decline
6) ii	will the action result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The proposal is unlikely result in invasive species, such as weeds, that would be harmful to Australian Painted Snipe or Curlew Sandpiper. 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.
7)	will the action introduce disease that may cause the species to decline	The proposed development is unlikely to introduce disease that may cause the species to decline.
8)	will the action interfere with the recovery of the species	The proposed development would result in the loss of approximately 0.19 ha of marginal foraging habitat for the Australian Painted Snipe or Curlew Sandpiper which would at best be utilised on an infrequent basis. The proposed development is unlikely to interfere with the recovery of the species.
Conclusion	Is there likely to be a significant impact?	The action will not affect breeding habitat and will only impact on a small amount (0.19 ha) of potential foraging habitat for these species. No important populations would be isolated or fragmented and the life cycle of these species is not likely to be affected. Therefore, the action is considered unlikely to have a significant impact on these species.

Table 58: EPBC Significance assessment on *Chalinolobus dwyeri* (Large-eared Pied Bat)

Criterion	Question	Response
	An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility of the following:	
1)	will the action lead to a long-term decrease in the size of a population	<p>Large-eared Pied Bat was recorded during the Anabat survey within vegetation adjacent to the proposed impact area in north-west of the development site. This species had not been previously recorded within 5 km of the subject land. This species forages in wet and dry sclerophyll forest and roosts in caves, rock overhangs and disused mine shafts. Foraging habitat is abundant within forested parts of the biocertification area. Roosting habitat is available within parts of the subject land where rock overhangs are present, however, roosting habitat is not available within impact areas. Roosting habitat is abundant throughout the locality where extensive cliffs and rock overhangs are present.</p> <p>Under the proposed works up to 3.37 ha of native vegetation is proposed to be removed representing potential foraging habitat for the Large-eared Pied Bat. However, considering the degraded nature of the majority of this vegetation, Large-eared Pied Bat is less likely to utilise more fragmented and disturbed area of vegetation. The proposed works will not result in the removal of roosting habitat.</p> <p>Given the abundance of foraging and roosting habitat in the surrounding landscape, and that breeding habitat will not be impacted, the proposed works are unlikely to affect any populations of this species that would lead to a long-term decrease in the size of an important population of this species.</p>
2)	will the action reduce the area of occupancy of the species	Under the proposal up to 3.37 ha of potential foraging habitat would be removed, which may cause a disturbance to the Large-eared Pied Bat and a small reduction in the total area of occupancy of this species. However, no breeding or roosting habitat will be impacted and large areas of foraging habitat will be retained within the subject land and locality.
3)	will the action fragment an existing population into two or more populations	The Large-eared Pied Bat is a highly mobile species with abundant foraging resources in the subject land and locality. The proposed biocertification will result in impacts in predominantly cleared areas or disturbed vegetation. The biocertification will not cause any significant fragmentation of habitat for this mobile species and vegetated corridors will be retained within the subject land. Therefore, the proposed action is unlikely to fragment the existing important population into two or more populations.
4)	will the action adversely affect habitat critical to the survival of a species	Habitat critical to the survival of Large-eared Pied Bat comprises sandstone cliffs and fertile wooded valley habitat within close proximity of each other. The proposed biocertification will not impact on sandstone cliffs which

Criterion	Question	Response
		could contain potential breeding habitat. The Large-eared Pied Bat recorded was in the north-west of the subject land. Vegetation to be removed in the north-west of the subject land consists of considered fertile wooded valley within proximity to sandstone cliffs, however large areas of suitable habitat adjacent to the impact area will be retained. No roosts or breeding sites are present directly adjacent to proposed impact areas. Vegetated corridors adjacent to the impact areas, in particular along the waterfront, should be retained to allow passage for this species to areas of habitat.
5)	will the action disrupt the breeding cycle of a population	As no breeding habitat would be removed or disturbed, it is unlikely the proposed work would disrupt the breeding cycle of this species.
6) i	will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No breeding sites would be removed, or disturbed, and large areas of foraging habitat will remain immediately adjacent to the subject land and wider locality. 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.
6) ii	will the action result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The proposal is unlikely to result in invasive species, such as weeds, that would be harmful to Large-eared Pied Bat. 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.
7)	will the action introduce disease that may cause the species to decline	The proposed biocertification is unlikely to introduce disease that may cause the species to decline.
8)	will the action interfere with the recovery of the species	A national recovery plan for Large-eared Pied Bat was published in 2011. Management objectives focus on the protection of roosts and avoiding clearing of vegetation in and directly adjacent to roosts. Habitat surveys determined it to be unlikely that any roosts are present within 100 m of the biocertification area and therefore breeding is unlikely to be impacted. A relatively small amount of habitat will be impacted by the proposal. The biocertification is unlikely to significantly interfere with the recovery of the species.
Conclusion	Is there likely to be a significant impact?	The action will not affect known breeding habitat and will only impact on foraging habitat for this 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 considered unlikely to have a significant impact on this species.

Table 59: EPBC Significance assessment on *Pteropus poliocephalus* (Grey-headed Flying-fox)

Criterion	Question	Response
	An action is likely to have a significant impact on a critically vulnerable if there is a real chance or possibility of the following:	
1)	will the action lead to a long-term decrease in the size of a population	<p>The closest known Grey-headed Flying fox (GHFF) camp as identified on the National Flying-fox Monitoring viewer (DAWE 2020) is at Avoca, which is located approximately 23 km to the north-east of the subject land. Counts performed in November 2017 estimated the population to be between 10,000 and 15,999 individuals. Individuals will move between camps to utilise foraging resources.</p> <p>Foraging for this species occurs within a 50 km radius around camp sites. Available foraging resources include street trees, urban bushland and conservation reserves.</p> <p>Under the proposed works up to 3.37 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 remaining subject land and locality. No individuals or camps of Grey-headed Flying-fox were recorded in the subject land would only be used on occasion as foraging habitat. The proposed works will not impact on any part of a known camp.</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 populations of this species that would lead to a long-term decrease in the size of an important population of this species.</p>
2)	will the action reduce the area of occupancy of the species	<p>Native vegetation is important for the Grey-headed Flying-fox as individuals are known to move up to 50 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 a relatively small amount 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 for any known individuals, populations or camps given no works are to be carried out at night, the availability of foraging and roosting habitat present in adjacent areas and the highly mobile nature of this species.</p>
3)	will the action fragment an existing population into two or more populations	<p>The Grey-headed Flying-fox population 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>It is unlikely that any known camp or an important population will be fragmented under the proposed action. The proposed action will only result in a small amount of vegetation removal (3.37 ha of predominantly poor quality vegetation) relative to the large areas to be retained in the</p>

Criterion	Question	Response
		subject land and locality. Therefore, the proposed action is unlikely to fragment the existing important population into two or more populations.
4)	will the action adversely affect habitat critical to the survival of a species	<p>Foraging habitat within a 50-kilometre radius of a roost site with greater than 30,000 individuals is foraging habitat critical to the survival of this species. The subject land is approximately 23 km south-west of the camp at Avoca and 29 km north of the camp at Gordon, which have both had camps recorded greater than 30,000 individuals in the last 5 years. Therefore, foraging habitat at the subject land is consistent with habitat that would be critical to the survival of this species.</p> <p>While the habitat would be critical to the survival of the species, the removal of 3.37 ha is unlikely to significantly impact on the population. There is better, more contiguous habitat available in the surrounding landscape, therefore the species is considered likely to use the subject land on an occasional basis and would not be dependent on the foraging resources within the subject land.</p>
5)	will the action disrupt the breeding cycle of a 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 that roosts in the Sydney Basin
6) i	will the action modify, destroy, remove, 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 foraging habitat will remain immediately adjacent to the subject land and wider locality. 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.
6) ii	will the action result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered 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.
7)	will the action introduce disease that may cause the species to decline	Grey-headed Flying-foxes are reservoirs for the Australian bat lyssavirus (ABL) and can cause clinical disease and mortality in Grey-headed Flying-fox (DECCW 2009). The proposed action is unlikely to present a significant ecological stress on any camps or on individuals that may utilise the subject site and therefore the works are unlikely to introduce or exacerbate this virus or any other disease that may cause this species to decline.
8)	will the action interfere with the recovery of the species	A Draft National Recovery Plan for the Grey-headed Flying-fox was developed in 2009. As no maternity camps would be removed, the proposed action will only remove a relatively small amount of potential foraging habitat. Foraging habitat will be retained within the subject land and large amounts of habitat are available in the wider locality. It is therefore unlikely the proposed action would interfere with the recovery of this species.

Criterion	Question	Response
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 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 considered unlikely to have a significant impact on this species and a Referral is not required.

Table 60: EPBC Significance assessment on *Numenius madagascariensis* (Eastern Curlew), *Actitis hypoleucos* (Common Sandpiper), *Calidris acuminata* (Sharp-tailed Sandpiper), *Calidris melanotos* (Pectoral Sandpiper), *Gallinago hardwickii* (Latham's Snipe) and *Tringa nebularia* (Common Greenshank)

Criterion	Question	Response
	An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:	
1)	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	<p>The proposed development will result in impacts to approximately 0.06 ha of habitat for <i>Numenius madagascariensis</i> (Eastern Curlew), <i>Actitis hypoleucos</i> (Common Sandpiper), <i>Calidris acuminata</i> (Sharp-tailed Sandpiper), <i>Calidris melanotos</i> (Pectoral Sandpiper) <i>Gallinago hardwickii</i> (Latham's Snipe) and <i>Tringa nebularia</i> (Common Greenshank) within PCTs 920 and 1232 (excluding the planted zone of PCT 1232). Only one of the above listed species (Eastern Curlew) has been recorded within 5 km of the biocertification area. Given the general lack of records in the local area, the biocertification area is unlikely to be important habitat for the above listed species. It is noted that the biocertification area has not been mapped as an Important Bird Area (IBA) by Birds Australia (2009).</p> <p>The removal of 0.19 ha of foraging habitat is considered unlikely to destroy or isolate any areas of important areas of habitat for the above listed migratory birds.</p>
2)	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	The proposed development is unlikely to result in an invasive species becoming established in an area of important habitat for the above listed migratory species.
3)	seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	<p>None of the above listed migratory birds have been recorded within the biocertification area. Only the Eastern Curlew has been recorded within 5 km of the biocertification area feeding on mudflats approximately 750 m to the east. Within 20km, records of migratory wading birds are centred around Brisbane Water and waterways closer to the coast. Records are relatively sparse moving upstream in the Hawkesbury River.</p> <p>The proposed biocertification will result in the loss of a small area (0.06 ha) of potential foraging habitat which may be used on a n occasional basis, however, the development is unlikely to significantly disrupt the lifecycle of an ecologically significant proportion of the population of the above listed migratory species.</p>
Conclusion	Is there likely to be a significant impact?	The proposed biocertification is considered unlikely to have a significant impact on the migratory species Eastern Curlew, Common Sandpiper, Sharp-tailed Sandpiper, Pectoral Sandpiper, Latham's Snipe and Common Greenshank.

Appendix F Koala Assessment Report

F1 Introduction

Background

Eco Logical Australia Pty Ltd (ELA) was commissioned by Property & Development NSW to prepare a Biodiversity Certification Assessment Report (BCAR) as part of the Peat Island Mooney Mooney Planning Proposal. This Koala Assessment Report (KAR) has been prepared as a supplement to the BCAR. While the SEPP (Koala Habitat Protection) 2019 applies only to development applications (not biocertifications), the SEPP assessment is not technically required at this stage. However, the purpose of the biocertification is to assess all biodiversity related matters at the planning proposal stage, so that additional biodiversity assessment is not required at the DA stage. Therefore, this assessment has been included in the biocertification stage to avoid the requirement for future assessment during the DA stage.

The subject land covers several lots located at Mooney Mooney, in the Central Coast local government area (LGA) (Figure 1).

The aim of this report is to address requirements of *State Environmental Planning Policy (SEPP) (Koala Habitat Protection) 2019* and the *Koala Habitat Protection Guideline* (NSW Department of Planning, Industry and Environment (DPIE), 2020a).

Proposed works

The proposed biocertification and Peat Island Mooney Mooney concept plan have been described in Section 1.1.2 and shown in Figure 2.

Koalas

Phascolarctos cinereus (Koala) is an Australian arboreal marsupial. The Koala occurs in eastern Australian and has a fragmented distribution from north-east Queensland to the Eyre Peninsula in South Australia. They inhabit a range of eucalypt forests and woodlands, they may also utilise isolated paddock trees. Koalas feed on the foliage of over 70 eucalypt species and 30 non-eucalypt species, however, have preferred species within different regions. The Koala is listed as Vulnerable under the NSW *Biodiversity Conservation Act 2016* (BC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

F2 SEPP (Koala Habitat Protection) 2019

The Koala Habitat Protection SEPP aims to “*encourage the conservation and management of areas of natural vegetation that provide habitat for Koalas to support a permanent free-living population over their present range and reverse the current trend of Koala population decline.*”

Section 9 of the SEPP requires an assessment of impact to koala habitat in certain areas. The Peat Island Mooney Mooney planning proposal requires this assessment as the proposed development is located within an LGA to which the Koala Habitat Protection SEPP applies, and the subject land is mapped on the Koala Development Application Map (DPIE 2020b) (accessed 18 September 2020). The subject land

also contained feed tree species including *Eucalyptus punctata* (Grey Gum) which is a ‘high use’ feed tree in the Central Coast Koala Management Area.

While Koala records do exist within 5 km of the biocertification area, records to the south are across the Hawkesbury Bridge and habitat connectivity is not available for individuals to the south of the river (Figure 49). Similarly, records to the east are separated by Mooney Mooney Creek. Movement between those to the east and the biocertification area within areas of suitable habitat would require Koalas travelling several kilometres to the north around the creek, then several back to the south. The eastern and western portions of the development site are separated by the M1 and there is no suitable connectivity for Koalas between the two portions.

Spotlighting surveys were undertaken within the subject land during the targeted survey, however, the Draft SEPP Guidelines released in March this year require more detailed survey to determine that Koala habitat is not present. This level of survey was not undertaken and therefore the Koala Development Application Map will be used.

Assessment under ‘Tier 1’ can be applied to developments which can be demonstrate to have low or no direct impact on Koalas or Koala habitat if all criteria listed in Table 61 are met. If the development cannot meet all criteria above, then it exceeds a low level of impact on Koalas and/or Koala habitat and the Tier 2 process is triggered.

Table 61: Tier 1 - Low or no direct impact development criteria and response under the proposed works

Tier 1 Criteria	Response to criteria
<i>1. Indirect impacts that will not result in clearing of native vegetation within Koala habitat</i>	Indirect impacts to potential Koala habitat may include increase edge effects through weed incursion and general degradation of habitat adjacent to the biocertification area.
<i>2. The development is below the Biodiversity Offsets Scheme threshold under the BC Act</i>	The BOS thresholds do not apply to biocertification, however, biocertification itself requires entry into the BOS.
<i>3. There is no native vegetation removal</i>	Approximately 3.37 ha of native vegetation will be impacted as part of the biocertification.
<i>4. The development footprint will not impede movement between Koala habitat</i>	The biocertification area will predominantly utilise the existing cleared areas or native vegetation at the edge of cleared areas which would have low-level impacts on potential connectivity for this species. It is also to be noted that there is no connectivity to the south of the biocertification area which is located at the edge of the Hawkesbury River. The only connecting land is over the M1 Motorway which is unsuitable for Koala movement.
<i>5. Adequate mitigation measures such as those listed in Table 1 (of the Koala Habitat Protection Guideline) are implemented as necessary.</i>	Mitigation measures are outlined in Table 65.

The proposed development does not satisfy all the criteria in Table 61 above as native vegetation is expected to be removed. As such a Koala Assessment Report is required under the Koala Habitat SEPP 2019.

Koala Development Application Map Peat Island Mooney Mooney Planning Proposal

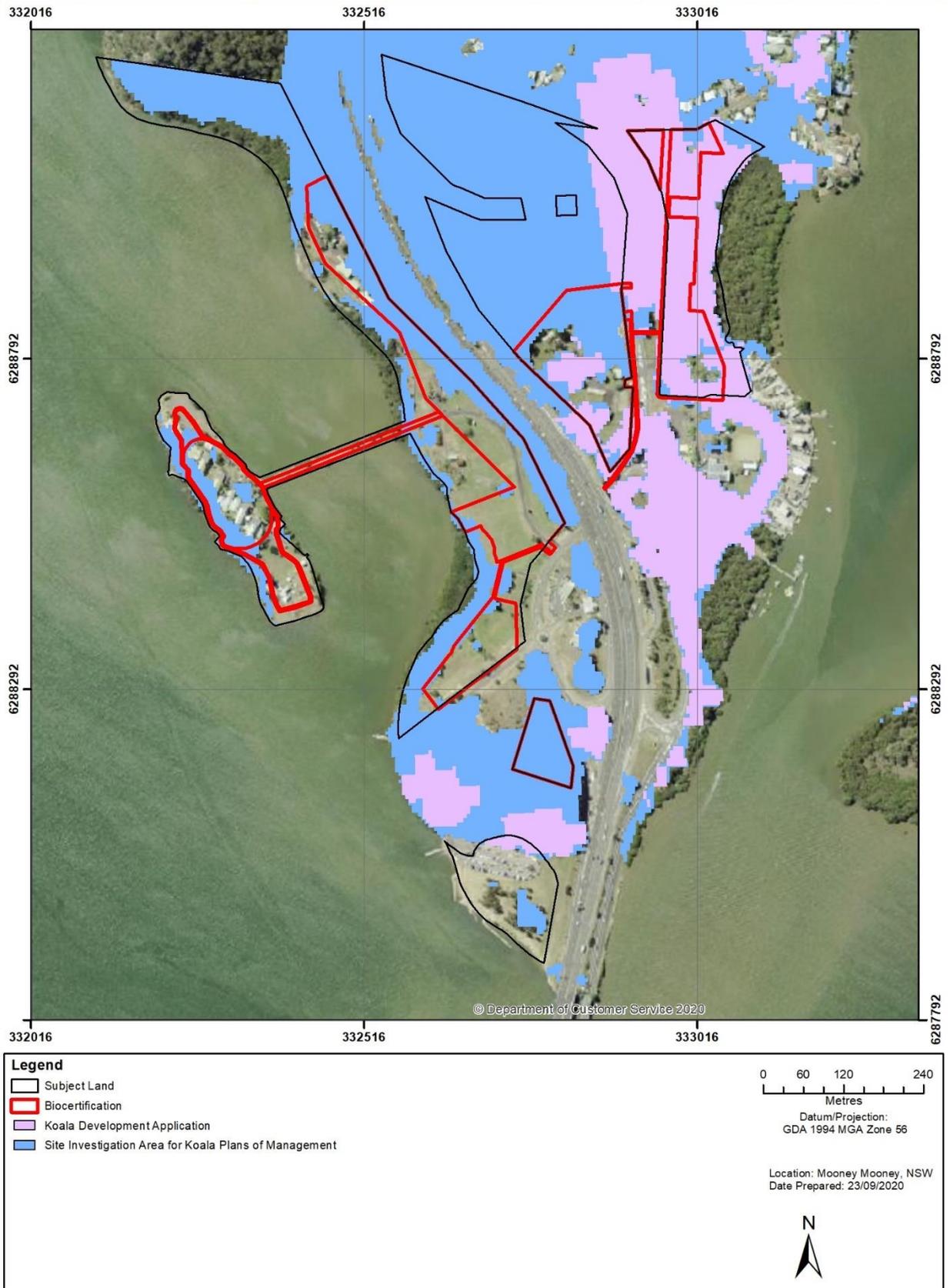


Figure 48: Koala Development Application Map

Koala Records (BioNet 2020) Peat Island Mooney Mooney Planning Proposal

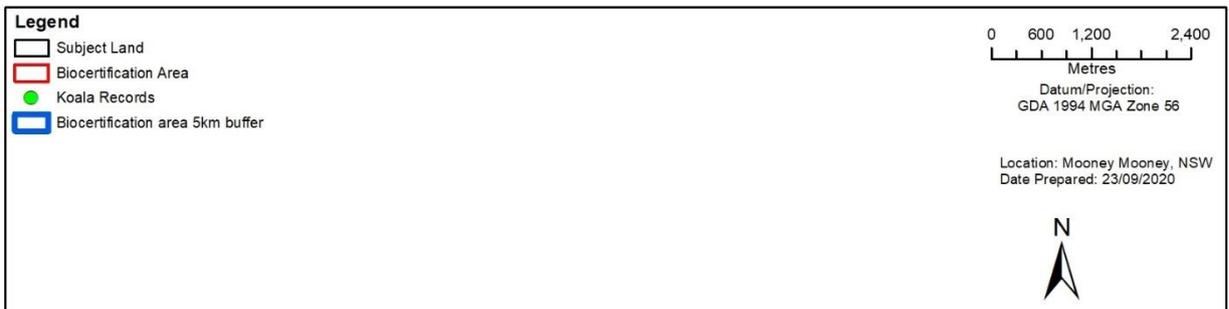
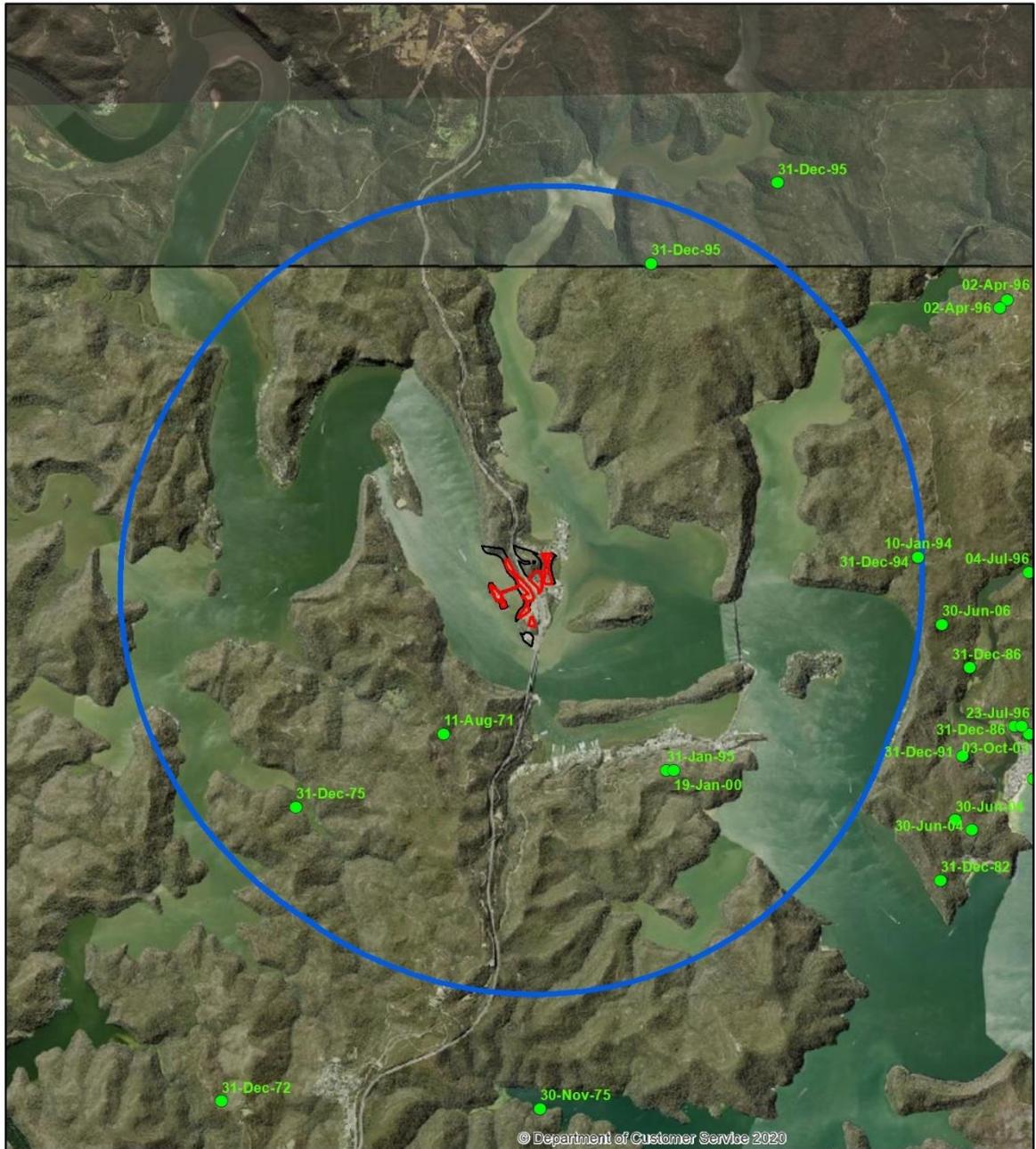


Figure 49: Koala Records (BioNet2020)

F3 Koala habitat values

Description of the subject land

The biocertification area comprises a mixture of development, cleared land and native vegetation of varying quality. The development site in this report refers to the wider subject land, and is not confined to areas that will be impacted by the development. The development footprint refers to the area that will be directly impacted by the proposal.

In the south-west and north-west of the site where the topography slopes upwards, Wet Sclerophyll Forest is the dominant vegetation class. A large knoll in the north of the development site is composed of Wet Sclerophyll Forest on the steep lower to mid slopes, the upper slopes and plateaux is composed of Dry Sclerophyll Forest.

The vegetation communities within the biocertification are outlined in Table 62, including whether Koala habitat is present.

Table 62: Vegetation communities within the biocertification area

PCT ID	PCT Name	Condition	Area (ha)	Koala feed trees present
1557	<i>Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin</i>	Moderate	0.53	Yes
1557	<i>Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin</i>	Gully Influence	0.26	Yes
1557	<i>Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin</i>	Poor	1.84	Yes
1557	<i>Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin</i>	Acacia Regrowth	0.17	No
1557	<i>Rough-barked Apple - Forest Oak - Grey Gum grassy woodland on sandstone ranges of the Sydney Basin</i>	Planted	0.38	Yes
1232	<i>Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion</i>	Degraded	0.16	Yes
920	<i>Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion</i>	Moderate	0.03	No
Total			3.37	

Koala surveys

The Koala Development Application Map will be used and therefore detailed Koala survey in accordance with Appendix C of the Koala Habitat Protection Guideline has not been undertaken. Opportunistic survey was undertaken during vegetation surveys which included:

- Koala habitat assessment

- Spotlighting

No Koalas were detected during spotlighting surveys. Parts of the biocertification area contain potential foraging habitat with the presence of feed trees such as *Eucalyptus punctata* (Grey Gum).

Koala habitat values

As outlined in Section F2, there are very few records within 5 km of the biocertification area. Of those records within 5 km, most are greater than 20 years old, and they are separated from the biocertification area by major roads (M1 motorway) and large waterbodies (Hawkesbury River and Mooney Mooney Creek). There are no historic records within the suburb of Mooney Mooney or in adjacent vegetation in Popran National Park and no evidence to suggest a local population exists within or adjacent to the biocertification area.

A population is located further to the east within Brisbane Water National Park, however, this population is separated by Mooney Mooney Creek and requires travelling a significant distance to reach the biocertification area. It is unlikely that the biocertification area would form part of the area of occupancy of this population. As the biocertification area is located at the edge of the Hawkesbury River, it does not serve as an important movement corridor between larger areas of habitat.

Despite the biocertification area being unlikely to contain or support Koalas, potential foraging habitat is available within the biocertification area and adjacent vegetation in the subject land and as such for the purpose of the assessment it was assumed that vagrant individuals may forage in available vegetation on a very infrequent basis. The following feed trees listed in Schedule 2 of the SEPP were recorded in the subject lands:

- *Allocasuarina littoralis* (Black She-oak)
- *Angophora bakeri* (Narrow-leaved Apple)
- *Angophora costata* (Smooth-barked Apple)
- *Angophora floribunda* (Rough-barked Apple)
- *Casuarina glauca* (Swamp Oak)
- *Corymbia maculata* (Spotted Gum)
- *Eucalyptus crebra* (Narrow-leaved Ironbark)
- *Eucalyptus piperita* (Sydney Peppermint)
- *Eucalyptus punctata* (Grey Gum).

A map showing vegetation zones containing potential feed trees is shown in Figure 50.

Koala Habitat

Peat Island Mooney Mooney Planning Proposal

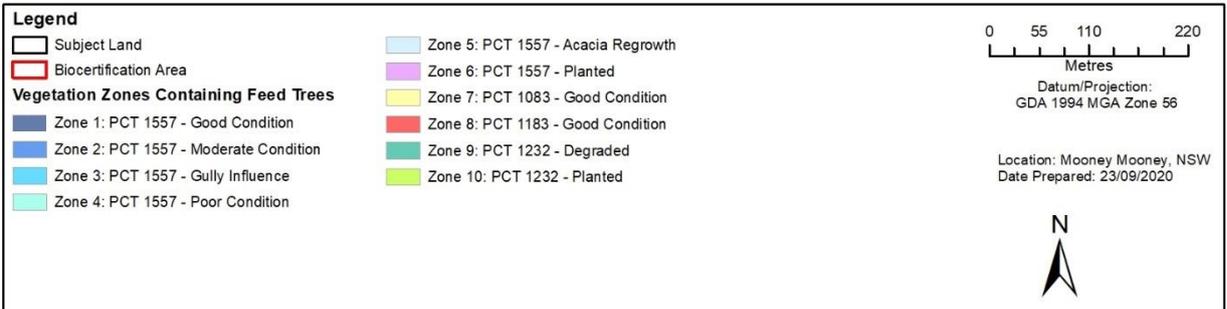


Figure 50: Vegetation zones containing Schedule 2 Feed Trees

F4 Avoiding impacts to Koalas

Avoidance of impacts through site selection

The majority of the development footprint is located in areas where potential Koala habitat is not present, including areas of cleared/exotic grassland or where previous development currently exists. Where impacts to biodiversity is unavoidable, the majority of vegetation to be removed is in poor to moderate condition. Large areas of higher quality potential habitat will be retained within conservation areas in the north of the subject land. Vegetation will also be retained within public recreation areas throughout the subject land. Ongoing consultation was undertaken between Property & Development NSW and ELA to minimise impacts to native vegetation.

The purpose of the planning proposal is to facilitate the future redevelopment of the Mooney Mooney area. It is considered that the layout has been selected in a feasible way with regard to Koala habitat by locating predominantly in cleared areas or in predominantly modified or degraded vegetation at the edge of cleared areas. The biocertification area has also been selected such that no major vegetated corridors which would facilitate the movement of Koalas across the landscape would be impacted. The locality is already highly fragmented due to the M1 and the Hawkesbury River.

F5 Analysis of potential impacts

Direct impacts

An assessment of direct impacts is provided in Table 63.

Table 63: Assessment of direct impacts

Nature of Impact	Extent of impact	Assessment of impact
Removal of 3.16 ha of potential foraging habitat in PCT 1232 and PCT 1557	Approximately 3.16 ha of potential habitat within PCT 1557 and PCT 1232 will be removed	Only minor impacts to low quality foraging habitat will occur as a result of the vegetation removal. As discussed, Koalas are not known to inhabit the locality, and any individuals would be rare vagrants. The biocertification area does not provide and connectivity between larger areas of suitable habitat. The impact of the biocertification on Koalas is considered low.

Indirect impacts

Table 64: Assessment of potential indirect impacts

Nature of impact	Extent of impact	Assessment of impact
Dog attack	Potential injury or death of Koala due to dog attack on occasional basis.	Attacks by dogs are a significant cause of Koala death and injury (NSW Department of Environment & Climate Change (DECC) 2008). The subject land contains existing residential development where dogs are present. Considering the existing presence of dogs, and that there are no records of dog attacks in the locality, the incidence of dog attacks is unlikely to increase as result of the proposal.
Vehicle strike	Potential injury or death of Koala due to vehicle strike on occasional basis.	The subject land is intersected by the M1, the Old Pacific Highway, and contains a number of smaller roads for existing residential development. Considering the existing high risk of vehicle strike, and absence of any historic vehicle strike of Koalas in the locality, the proposal is unlikely to result in an increased risk of vehicle strike to Koalas.
Bushfire	Impacts to Koala habitat due to bushfire.	Incidence of bushfire within the site or adjacent habitat is unlikely to increase as a result of the proposal.
Introduction or spread of disease	Increased mortality resulting from disease spread.	Introduction or spread of disease within the site or adjacent habitat is unlikely to increase as a result of the proposal.
Disturbance to Koalas during construction or operation	Potential injury or death of Koalas resulting from disturbance/machinery strike during construction or operation.	There is a very small chance for Koalas to be present within the site during construction works. Machinery strikes or removal of vegetation containing individual(s) has the potential to result in injury/mortality of Koalas. Impacts would be unlikely to impact the viability of the population in the locality. Provided mitigation measures are implemented this impact is unlikely to occur. If a Koala is identified within the site during vegetation clearance works, work should cease until the Koala has moved on.

Nature of impact	Extent of impact	Assessment of impact
Impediments to movement	to Potential exclusion of habitat within the site from Koalas.	<p>The subject land as a whole contains a range of impediments to movement across the locality including the M1, Hawkesbury River, residential dwellings and existing fencing.</p> <p>Fencing that may be installed within the site as a result of the development is unlikely to substantially impede Koala movement more than would currently occur as a result of those impediments described above. The biocertification area is generally located in cleared areas or at the edges of cleared areas and vegetation. The clearing required would not significantly fragment any significant movement pathways for Koalas or isolate any areas of habitat.</p>

F6 Management and protection of Koalas and their habitat

Management measures

Proposed management measures for identified impacts are described in Table 65.

Table 65: Mitigation measures for direct and indirect impacts

Impact	Management measure	Key outcomes	Performance target
Removal of 3.16 ha of potential foraging habitat	- Clear delineation of habitat to be removed and fencing to exclude retained habitat	- Clearing limited to designated area.	- Long term retention of retained habitat. - Vegetation impacts limited to approved areas
Degradation of habitat during operational and construction phase	- Briefing of contractors on importance of habitat to be retained.	- Protection of Koala habitat within site.	- Quality of retained habitat within the site is maintained throughout life of project.
Disturbance to Koalas during construction	- A pre-clearance survey should be undertaken prior to native vegetation removal to ensure no native fauna (including Koalas) are present in vegetation removed. - Project manager and contractors must contact WIRES if injured Koalas or other wildlife is encountered during construction works. WIRES can be contacted on 1300 094 737.	- No injury/death of Koalas during construction/vegetation clearance works.	- No Koala injury or death during construction.

Compensatory measures

Formal compensatory measures (such as offsetting through the Biodiversity Offsets Scheme) have been undertaken and detailed within the BCAR.

F7 Monitoring Plan

Aim of the monitoring plan

The Koala Monitoring Plan has the following aims:

- Long-term retention of available Koala habitat within the remaining vegetation of the subject lands.
- Ensure connectivity of habitat from the subject land to areas of adjacent habitat to the north (no connectivity exists to the east, south or west).
- Prevent injury or death of Koalas within the site resulting from construction or operational activities associated with the proposal.

Outcomes, performance targets and reporting requirements

Details of the monitoring plan are outlined in Table 66. Mitigation and management measures required to achieve key outcomes are outlined above in Table 65.

Table 66: Monitoring Plan

Key outcomes	Performance target	Reporting and adaptive management
<ul style="list-style-type: none"> - Clearing limited to designated area. - Increase quality of retained habitat within the site. 	<ul style="list-style-type: none"> - Long term retention and management of habitat. - Vegetation impacts limited to approved areas. 	<ul style="list-style-type: none"> - Post clearance report detailing that vegetation clearing has been within designated areas.
<ul style="list-style-type: none"> - Protection of Koala habitat within site. 	<ul style="list-style-type: none"> - Quality of retained habitat within the site is maintained throughout life of project. 	<ul style="list-style-type: none"> - VMP monitoring reports to demonstrate ongoing protection/maintenance of Koala habitat.
<ul style="list-style-type: none"> - No injury/death of Koalas during construction/vegetation clearance works. 	<ul style="list-style-type: none"> - No Koala injury or death during construction. 	<ul style="list-style-type: none"> - Clearance supervision report to be submitted following construction. - If any Koala injuries/deaths during construction reported works should stop immediately and reported to Central Coast Council. - Clearing works will require presence of ecologist on site at all time if a Koala injury/death occurs.

F8 References

DECC 2008. *Recovery plan for the Koala (Phascolarctos cinereus)*.

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DPIE 2020c. BioNet Atlas Search for Koalas within Wingecarribee LGA.

https://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx?who=cdfdf58e-cfbb-4acf-af26-8c9ebb0b5056 [Accessed 24 April 2020].

NSW Government 2019. *State Environmental Planning Policy (Koala Habitat Protection) 2019*.

Queensland Department of Environment and Heritage Protection 2012. 'Koala Sensitive Design Guideline - A guide to koala-sensitive design measures for planning and development activities'. November 2012. Queensland Government, Brisbane.

Appendix G Microbat Management Plan

Appendix H Response to Submission from Central Coast Council

It is a requirement of a biocertification application that applicants who are not planning authorities consult with local council prior to public consultation. The Peat Island Mooney Mooney BCAR (Draft) prepared in October 2019 was submitted to Central Coast Council for comment. In December 2019, feedback from council was received on the report. The comments from Central Coast Council have been addressed below in

Table 67: Response to council comments on Draft BCAR

Council Comment	How addressed
The BAM credit summary report has not been finalised. It is a requirement that the BAM credit report be finalised and certified as BAM compliant within 14 days of the submission date as per Section 6.15 of the BC Act.	This updated BCAR and credit report will be finalised within 14 days of the submission as per Section 6.15 of the BC Act.
Only part of the development area has been covered by Biocertification (see figure below) and therefore, biodiversity impacts identified in the BCAR are likely to be underestimated. Additional offsets are likely to be required at the DA stage. It is Council's preference that all potential biodiversity impacts are assessed up from in the BCAR during the planning proposal stage.	The development area has been updated to include all potential impacts likely to occur as a result of the biocertification.
None of the required shape files have been submitted with the BCAR – refer to the requirements in Appendix 10 of the BAM.	The shapefiles will be submitted upon finalisation of the credit calculator within the 14 day window, as required in Appendix 10 of the BAM.
Plot data summaries that were used to generate vegetation integrity score are missing from the BCAR. Therefore, Council has not been able to undertake independent BAM calculations and verify specific requirements set out in the BAM calculator. Biodiversity impacts identified in this BCAR may change once the BCAR and BAM calculations have been finalised in the BOAMS portal. Please provide plot data summaries necessary for Council to verify and run BAM calculations in the BOAMS portal.	Entire plot data summaries have been provided in Appendix B of the BCAR.
Targeted surveys for Little Cave Bat (<i>Vespadelus troughtoni</i>) and Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>) have not been conducted during the recommended breeding survey period as stipulated in the threatened biodiversity database collection. Targeted surveys need to be conducted during appropriate seasons as per Section 6.5.1.3 of the BAM. This is especially important considering that these are identified as Serious and Irreversible Impact (SAIL) species.	Targeted survey was undertaken for Eastern Cave Bat and Large-eared Pied Bat in the breeding season, including emergence surveys in December and harp-trapping in January. Roost searches were also undertaken in April (outside of the breeding season). Eastern Cave Bat was recorded roosting within two buildings, including a maternal female within a building on Peat Island during the breeding season. Large-eared Pied Bat was not recorded during these surveys, and this species is not known to breed in buildings or human structures, however, is known to utilise the biocertification area as it was detected on ultrasonic recorders.
Avoid and minimise section needs to be updated to address the BAM stage 2 operational manual	Avoid and minimise requirements have been addressed in Section 2.1 in accordance with the BAM and with the Stage 2 Operational Manual.

Council Comment	How addressed
SAll assessment needs to be update once targeted surveys for Little Cave Bat and Large-eared Pied Bat have been completed.	The SAll assessment has been updated for Eastern Cave Bat in Section 2.2.6.1. Large-eared Pied-Bat is unlikely to be breeding within buildings (not detected during targeted survey) or in adjacent rocky areas within 100 m, therefore, detailed SAll assessment was not required.
It is Council's preference for offsets to be secured within the LGA.	Where available, offsets should be sourced from the market within the LGA prior to payment into the BCF.

Appendix I Biodiversity credit report

Appendix J CVs

