Biodiversity Certification Assessment Report

285 – 325 Pacific Highway, and (part) 6W Kemira Road, Lake Munmorah, NSW 2259

20222078

09 December 2022

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Suite 3, 240-244 Pacific Highway,
Charlestown, NSW 2290

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Gilbert Whyte and David Martin Certified by David Martin (BAAS21021) 09/12/2022	Daniel O'Brien	Gilbert Whyte

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1 INTRODUCTION

1.1 SCOPE

Kleinfelder Australia Pty Ltd (Kleinfelder) was engaged by Barker Ryan Stewart (BRS), on behalf of ALDA Group, to prepare a Biodiversity Certification Assessment Report (BCAR) to support the proposed biocertification of land at 285, 287, 295, 305, 315, and 325 Pacific Highway, and (part) 6W Kemira Road, Lake Munmorah, New South Wales (NSW) 2259 (inclusive of Lot 1 DP 626787, Lot 2 DP 626787, Lot 437 DP 755266, Lot 438 DP 755266, Lot 27 DP 755266, Lot 12 DP 771284, Lot 83 DP 650114) (hereafter referred to as the 'Study Area') (see **Figure 1**).

The Study Area is located within the Central Coast Council LGA and is currently zoned *RU6 Transition* and *RE1 Public Recreation* under the Wyong Local Environmental Plan (LEP) 2013. The Planning Proposal seeks to rezone the Study Area to *R2 Low Density Residential* and the construction of a residential subdivision. The proposal also seeks to provide the establishment of *C2 Environmental Conservation* zoned land within the Study Area (hereafter referred to as the "Conservation Area"), in accordance with the requirements of the Gateway Determination issued in September 2020 and the framework for strategic biodiversity certification.

This assessment has been undertaken in accordance with the NSW Biodiversity Assessment Method (BAM) (Department of Planning, Infrastructure and Environment [DPIE] 2020a) under the *Biodiversity Conservation Act 2016* (BC Act) and the *Biodiversity Conservation Regulation 2017* (BC Regulation) to support a Development Application (DA) for the Project.

The following terms are used throughout this report to describe particular geographical areas:

- **Study Area** – 285 – 325 Pacific Highway, Lake Munmorah, NSW (inclusive of Lot 1 and 2 DP 626787, Lot 438 and 437 DP 755266, Lot 27 DP 755266, Lot 83 DP650114 and Lot 12 DP771284) and (part) 6W Kemira Road, (**Figure 1**).
- **Development Site** - The area within the Study Area to be subject to the proposed residential subdivision (rezoning to *R2 Low Density Residential*) (**Figure 2**).
- **Conservation Area** – The area within the Study Area to be rezoned and maintained as a *C2 Environmental Conservation*, inclusive of areas of temporary impact and restoration associated with detention basins (constructed wetlands) (**Figure 2**). Temporary impacts within the Conservation Areas include the construction of detention basins within the north-west and north-east corners of the Study Area (see **Section 5**).
- **Disturbance Footprint**: All areas of the Study Area to be directly impacted by the proposed residential subdivision and associated infrastructural work including detention basins (constructed wetlands).
- **Locality** - Land within a 5 kilometre (km) radius of the Study Area.
- **Assessment Area** – Land within a 1,500 metre (m) buffer of the Study Area.

1.2 LOCAL CONTEXT

The Study Area is located within the suburb of Lake Munmorah within the Central Coast Council Local Government Area (LGA). The majority of the site is zoned *RU6 – Transition* under the Wyong Local Environmental Plan (LEP) 2013. The proposed road corridor to the west lies within an area that is currently Zoned *RE1 – Public Recreation*.

The Study Area is currently comprised of semi-rural properties, characterised by a mix of residence, sheds, and existing infrastructure, including two large telecommunication towers. The vegetation throughout the site is characterised by a mix of remnant low woodland vegetation, scattered mature eucalypts, managed grassland, and windbreaks comprised of planted Radiata Pine (*Pinus radiata*). Groundcover within the Study Area is comprised of native and exotic species (mainly introduced perennial grasses). The lack of plant diversity in the groundcover is likely to be the result of land management practises including grazing and slashing by the current landowners.

Low-lying areas within the eastern portion of the Study Area are predominantly cleared. A small wetland dominated by rush species occurs near in the north-east corner of the Study Area. Four constructed dams also occur in the south. A drainage channel intersects the location of the proposed road reserve adjacent to Chisholm Avenue to the west. A poorly defined drainage channel also flows in a northern direction through the eastern portion of the Study Area (**Figure 2**).

1.3 PROPOSED DEVELOPMENT

The Planning Proposal involves the biocertification of lands within the Study Area including the rezoning of the Development Site from *RU6 Transition* to *R2 Low Density Residential* to support the proposed residential subdivision, local roads, detention basins and other associated infrastructure. The biocertification proposal will also involve the provision of Conservation Areas within the Study Area to be rezoned to *C2 Environmental Conservation* in accordance requirements of the Gateway Determination issued in September 2020 and the framework for strategic biodiversity certification (**Figure 2**).

The objectives of the Planning Proposal are as follows:

- To facilitate future development of the sites for residential uses that are compatible with nearby R2 zoned properties in Lake Munmorah.
- To encourage development that can act as a catalyst for regional employment growth during and after construction.
- To provide additional residential opportunities that are accessible and well located to local services and facilities.

As part of the Planning Proposal, two conservation areas are proposed which include area of remnant native woodland to be retained, Important Habitat for the Critically Endangered Swift Parrot in the north-west corner of the Study Area, and low-lying managed wetland areas within the eastern portion of the Study Area, traversing across the entire extent of the mapped watercourse from the northern boundary to existing constructed dams in the south. These two Conservations Areas are known hereafter as “North-western Conservation Area” and the “Eastern Conservation Area”. Construction of roads and pedestrian pathways will flank the southern extent of the

North-western Conservation Area and Eastern Conservation Area. Parts of the Conservation Areas will be subject to rehabilitation following completion of construction, thereby increasing vegetation condition, habitat values, and connectivity, alongside strategic use of street tree plantings. Furthermore, a five (5) metre vegetation buffer will be implemented along the southern boundary of the Study Area, protecting a number of threatened species (*Angophora inopina*), and be subject to management under a site-specific Biodiversity Management Plan (BMP).

The proposed development includes the provision of a collector road joining Chisholm Road (to the west of the Study Area) and Wallaby Rd (to the east). The proposed collector road is a requirement of Central Coast Council, with the need of internal roads within the area (proposed "New Road 2") proposed as part of the GHD Traffic Study for Lake Munmorah informing The Greater Lake Munmorah Structure Plan: Road Development Strategy. The proposed road will bisect the Eastern Conservation Area, however design of the road avoids key habitat features including hollow-bearing trees, and sensitive road design will ensure impacts to the watercourse are minimal.

Proposed Stormwater Basins

A total of two (2) stormwater retention basins are proposed within the Study Area, located within along the western boundary and within the north-eastern corner of the Study Area (**Figure 2**). The location and layout of the western basin was selected so as to minimise impacts to native vegetation, especially mature trees known to provide foraging habitat for the threatened Swift Parrot (*Lathamus discolor*). Both basins are to be designed as constructed wetlands, involving the rehabilitation of wetland vegetation occurring within the Study Area and representative of PCT 1737 – *Typha Rushland* (Vegetation Zone 7).

The construction of basins for the purpose 'environmental protection works' is permissible within the proposed *C2- Environmental Conservation* zoned land. Construction of the north-eastern basin is associated with the rehabilitation of land towards its natural state, and the management of stormwater for the purposes of wetland protection (i.e. mapped Coastal Wetlands to the north of the site), erosion protection and bush regeneration works. As such, the north-eastern basin will be incorporated as constructed wetlands into the proposed Conservation Areas within the Study Area. The areas in which the basin is proposed is considered a 'temporary impact' within this report owing to the proposed rehabilitation following construction, however this area is included in the disturbance footprint and subject to appropriate offset obligations resulting from the removal of native vegetation.

The western basin will be constructed along the western boundary of the Study Area, outside of areas of remnant vegetation and to the south of the mapped Coastal Wetland. The proposed basin outlet will be located outside of the coastal wetland proximity area to reduce indirect impacts to the coastal wetland. A Stormwater Management Report was also prepared for the proposed development (Barker Ryan Stewart 2022). This report details the modelled water volume and quality expected to enter the environment following the proposed retention basins, post development, see below.

The Stormwater Management Report prepared by Barker Ryan Stewart (2021) demonstrates compliance with on-site detention and water quality requirements of Central Coast Council and considered standards detailed within the Wyong Development Control Plan 2013; Central Coast Council Civil Works Specification Design Guideline 2020; and Australian Rainfall and Runoff, 2019. Water quality modelling was carried out using the MUSIC software program and Central Coast Council's MUSIC-Link data. The proposed treatment train comprises of proprietary gross pollutant traps and bioretention areas and exceeds the minimum pollutant reduction targets

specified by Council. On-site detention (OSD) modelling was carried out using the DRAINS software program and rainfall data adopted from Australian Rainfall and Runoff, 2019. Two (2) OSD basins are proposed with the outlet configuration designed to restrict peak discharges from the site to no more than under existing conditions for the 5%, 20% and 1% AEP storm events. Central Coast Council's water quality treatment requirements are specified in Section 11 of Council's Civil Works Specification – Design Guideline 2020 and is summarised below in **Table 1**.

Table 1: Minimum Pollutant Removal Performance Targets (Australian Runoff Quality 2006)

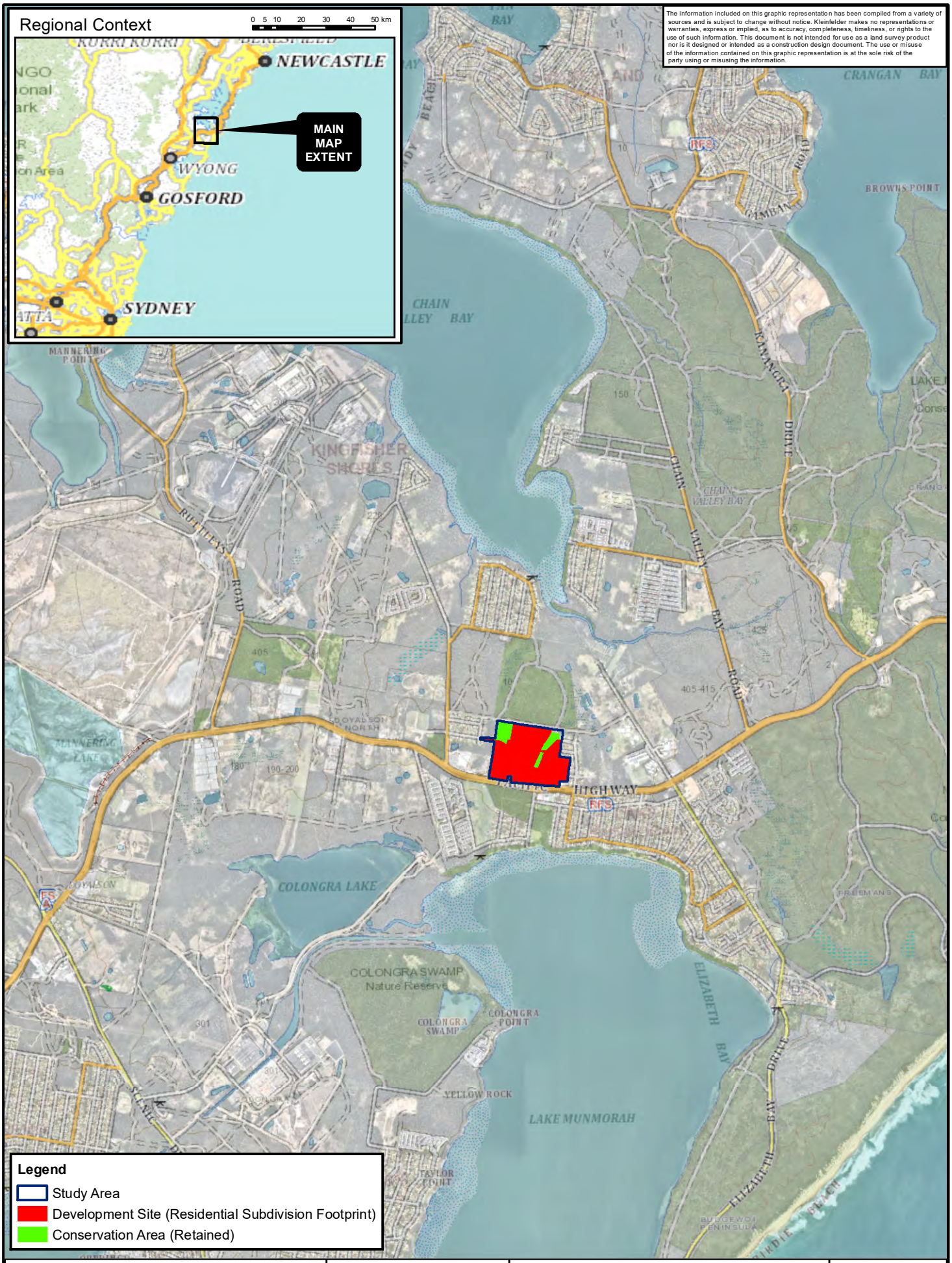
Pollutant	Performance Requirements (Targets)
Total Suspended Solids (TSS)	80% reduction in the post-development mean annual load
Total Nitrogen (TN)	45% reduction in the post-development mean annual load
Total Phosphorous (TP)	45% reduction in the post-development mean annual load
Gross Pollutants	90% reduction in the post-development mean annual load (for pollutants greater than 5mm in diameter)
Hydrology	The post-development peak discharge must not exceed the pre-development peak discharge for flows for the 5, 20 and 100% AEP event

Results of the on-site detention Drains modelling for pre-development and post-development flows are presented below in **Table 2**. The results in the table confirm that the proposed OSD measures reduce flows from the development for both the Eastern Catchment and the Western Catchment to no greater than pre-development conditions for the 20%, 5% and 1% AEP storm events in accordance with Council's requirements. It is therefore concluded that the proposed development meets the requirements of Central Coast Council with respect to on-site detention and water quality.

Table 2: On-site Detention Basin Modelling for pre-development and post-development flows

Catchment	Storm Event	Catchment	Storm Event
Eastern Basin	20%	5.11	5.11
	5%	7.95	5.79
	1%	12.3	11.0
Western Basin	20%	7.54	7.52
	5%	11.5	10.7
	1%	17.6	16.7

Note that the above Post-Developed Flow is a combination of piped and weir flows.



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PROJECT REFERENCE: 20221770

DATE DRAWN: 9/30/2022 11:46 Version 5

DRAWN BY: AMcDonaugh

DATA SOURCE:
NSW DFSI - 2020
Nearmap - 2022

Locality

Barker Ryan Stewart
Biodiversity Certification Assessment Report
285 – 325 Pacific Highway
Lake Munmorah NSW

FIGURE:

1

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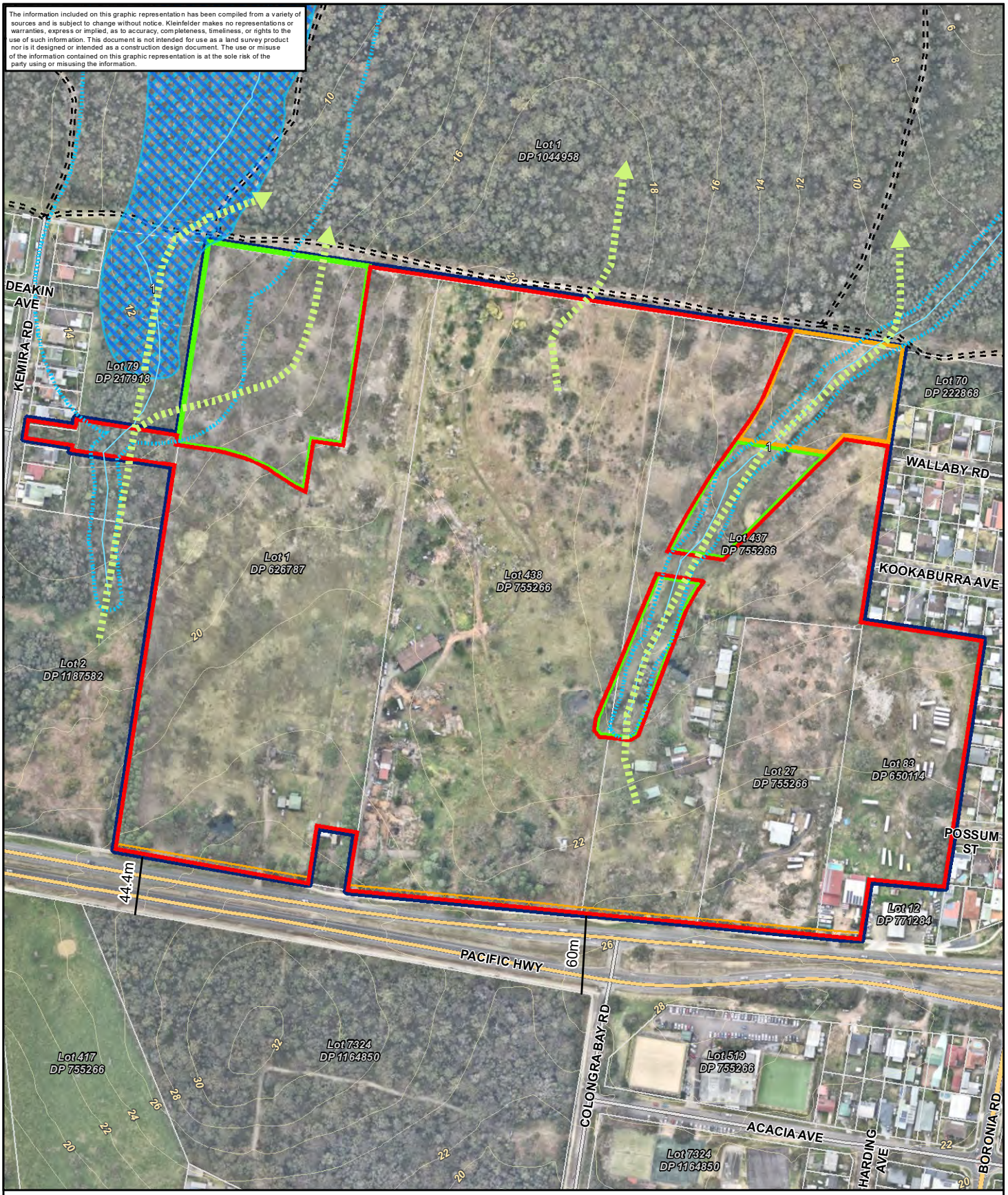

Legend

- Study Area
- Development Site (Residential Subdivision Footprint)
- Development Site (5m Vegetation Buffer)
- Conservation Area (Temporary Impacts - Wetland Rehab)
- Conservation Area (Retained)
- Lot Boundaries (DCDB)
- 2m Contour Lines
- Watercourse (Labelled with stream order)
- Wetlands - Coastal Management Act
- Riparian Buffers
- Primary Road
- Sub-arterial Road
- Local Road
- Track
- Movement Corridors for Wildlife

Metres
0 25 50 100 150 200
N

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PROJECT REFERENCE: 20221770	
DATE DRAWN: 9/30/2022 11:54 Version 5	Study Area and Development Site
DRAWN BY: AMcDonaugh	FIGURE: 2
DATA SOURCE: NSW DFSI - 2020 NSW DPIE - 2021 Nearmap - 2022	Barker Ryan Stewart Biodiversity Certification Assessment Report 285 – 325 Pacific Highway Lake Munmorah NSW

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1.4 INFORMATION SOURCES

The following sources of information were used in to appropriately inform this report:

- The NSW DPIE, BioNet Atlas (DPIE 2022a) for previous records of threatened species, populations and ecological communities within 5 km radius of the Disturbance Footprint.
- The Commonwealth Department of Agriculture, Water and the Environment (DAWE) Protected Matters Search Tool (PMST) (DAWE 2022a) for Matters of National Environmental Significance (MNES) including predicted threatened species, populations and ecological communities
- Lower Hunter and Central Coast Regional vegetation survey VIS_ID 2227 (DPIE 2018a) (NSW National Parks and Wildlife Service [NPWS] 2003) for existing vegetation community mapping within the Study Area and locality.
- The NSW DPIE, BioNet Vegetation Classification Database (DPIE 2022b) for identification and allocation of Plant Community Types (PCTs) to vegetation zones on site.
- The NSW DPIE, BioNet Threatened Biodiversity Data Collection (DPIE 2022c), Threatened Species Profiles (DPIE 2022d) and Final Determinations (DPIE 2022e) for information on threatened species, populations, and ecological communities.
- Preliminary Ecological Assessment – 285 – 335 Pacific Highway, Lake Munmorah NSW 2575 (Document No. NCA21R129565) (Kleinfelder 2021).
- Biodiversity Review Report – Prepared for Gateway Application for Proposed Rezoning Lots 437 & 438 DP 755266 & Lot 1 DP 626787 (Conacher Consulting 2018).
- Central Coast Flora and Fauna Guidelines 2019 (Central Coast Council 2019)
- Relevant published literature (see **Section 9**).

1.5 LEGISLATIVE CONTEXT

This assessment was undertaken in accordance with and/or in consideration of the following Acts and Policies:

- **NSW:**
  - Biodiversity Assessment Method (BAM) (DPIE 2020a).
  - *Biodiversity Conservation Act 2016* (NSW) (BC Act).
  - *Biodiversity Conservation Regulation 2017* (NSW) (BC Regulation).
  - *Biosecurity Act 2015* (NSW).
  - *Coastal Management Act* 2016.
  - *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act).
  - *Local Land Services Act 2013* (NSW) (LLS Act).
  - *State Environmental Planning Policy (Koala Habitat Protection) 2021* (NSW) (Koala SEPP).
  - *State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017* (NSW).
  - *Water Management Act 2000* (NSW) (WM Act).
- **Commonwealth:**
  - *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- **Local:**
  - Wyong Local Environmental Plan (LEP) 2013
  - Wyong Development Control Plan (DCP) 2014

1.5.1 Biodiversity Conservation Act 2016 (NSW)

The NSW Biodiversity Conservation Act 2016 (NSW BC Act), the NSW *Biodiversity Conservation Regulation 2017* (NSW BC Regulation) and amendments to the NSW *Local Land Services Act 2013* (LLS Act) commenced on 25 August 2017. The legislation aims to "maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development". The NSW BC Act repeals several pre-existing Acts, most notably the NSW *Threatened Species Conservation Act 1995* (TSC), the NSW *Nature Conservation Trust Act 2001* and the NSW *Native Vegetation Act 2003*.

The NSW BC Act together with the NSW BC Regulation outlines the framework for addressing impacts on biodiversity from development and clearing. The framework details a pathway to avoid, minimise and offset impacts on biodiversity from development through the Biodiversity Offset Scheme (The BOS).

1.5.1.1 Entry into the Biodiversity Offset Scheme

Entry into the BOS is triggered by developments, projects and activities that meet criteria or certain thresholds for significant impacts on biodiversity in accordance with Section 6.3 of the BC Act. Alternatively, the BOS can be entered into on an opt-in basis.

Criteria to which the BOS applies includes the following:

- Local Development (assessed under Part 4 of the *Environmental Planning and Assessment Act 1979*) that triggers the BOS Threshold or is "likely to significantly affect threatened species" (based on a test of significance pursuant to Section 7.3 of the BC Act). The BOS Threshold has two parts, and is triggered by the following:
  - Clearing of vegetation that exceeds an area threshold (based on the minimum lot size), or
  - Impacts are predicted to occur within an area mapped on the Biodiversity Values Map (the BV Map).
- State Significant Development (SSD) and State Significant Infrastructure projects (SSI), unless "the Secretary of the Department of Planning, Industry and Environment and the environment agency head determine that the project is not likely to have a significant impact".
- Biodiversity certification proposals.
- Clearing of native vegetation in urban areas and areas zoned for environmental conservation that exceeds the BOS threshold and does not require development consent.
- Clearing of native vegetation that requires approval by the Native Vegetation Panel under the *Local Land Services Act 2013.*
- Activities assessed and determined under Part 5 of the *Environmental Planning and Assessment Act 1979* (generally, proposals by government entities) if proponents choose to 'opt in' to the Scheme.

The proposed development will result in impacts to 21.52 ha of native vegetation, which is greater than the area clearing threshold of 1 ha based on the Study Area's minimum lot size of 40 ha. Furthermore, a review of the NSW Biodiversity Values Map (BV Map) (DPIE 2022f) revealed that the Study Area is mapped as containing habitat suitable for "Threatened species or communities with potential for serious and irreversible impacts (SAII)". As such the proposed development triggers entry into the BOS, requiring a BCAR to support the proposed development.

Accredited Assessor

The proposed development has been assessed in accordance with the BAM (DPIE 2020a). The Biodiversity Accredited Assessor System (BAAS) Case number for the Project is 00029825/BAAS21021/21/00029826. David Martin (Assessor Number BAAS21021) is the Biodiversity Accredited Assessor for the proposed development.

1.5.2 Koala Habitat Protection State Environmental Planning Policy (SEPP 2021)

The Koala 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 Koala SEPP applies to each Local Government Area listed in Schedule 1 of the SEPP. Where a Koala Plan of Management (KPoM) applies to the land, Clause 8 of the Koala SEPP applies to the development. In this case the proposed development must be consistent with the approved KPoM that applies to the land.

Central Coast Council LGA is listed in Schedule 1 of the *Koala SEPP*. The Study Area is covered by an approved KPoM. As such, the *Koala SEPP* is the relevant Koala habitat protection planning instrument for the Study Area.

See **Section 7.3** for a summary of the Koala habitat assessment.

1.5.3 Biosecurity Act 2015

Under the *Biosecurity Act 2015* (NSW) all plants are regulated with a general biosecurity duty "to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable." Under the Act, a biosecurity impact "is an adverse effect on the economy, environment, or the community that arises, or has the potential to arise, from a biosecurity matter." This legislation is addressed in **Section 7.2**.

1.5.4 Coastal Management Act 2016

The *Coastal Management Act 2016* replaces the *Coastal Protection Act 1979* and establishes a strategic framework and objectives for managing coastal issues in NSW. The Act promotes a focus on ecologically sustainable development in relation to the 'coastal zone' as defined by the Act comprising of four coastal management areas:

- Coastal wetlands and littoral rainforests area – areas which display the characteristics of coastal wetlands or littoral rainforests that were previously protected by SEPP 14 and SEPP 26
- Coastal vulnerability area – areas subject to coastal hazards such as coastal erosion and tidal inundation
- Coastal environment area – areas that are characterised by natural coastal features such as beaches, rock platforms, coastal lakes and lagoons and undeveloped headlands. Marine and estuarine waters are also included.
- Coastal use area – land adjacent to coastal waters, estuaries and coastal lakes and lagoons.

The Coastal Management SEPP (commenced on 3 April 2018) updates and consolidates into one integrated policy: SEPP 14 (Coastal Wetlands), SEPP 26 (Littoral Rainforests) and SEPP 71 (Coastal Protection), including clause 5.5. of the Standard Instrument – Principal Local Environmental Plan. These policies are now repealed.

The Coastal Management SEPP gives effect to the objectives of the *Coastal Management Act 2016* from a land use planning perspective, by specifying how development proposals are to be assessed if they fall within the coastal zone. It defines the four coastal management areas in the Act through detailed mapping and specifies assessment criteria that are tailored for each coastal management area. Councils and other consent authorities must apply these criteria when assessing proposals for development that fall within one or more of the mapped areas.

The four coastal management areas are:

- **Coastal wetlands and littoral rainforests area** – areas which display the characteristics of coastal wetlands or littoral rainforests that were previously protected by SEPP 14 and SEPP 26.
- **Coastal vulnerability area** – areas subject to coastal hazards such as coastal erosion and tidal inundation.
- **Coastal environment area** – areas that are characterised by natural coastal features such as beaches, rock platforms, coastal lakes and lagoons and undeveloped headlands. Marine and estuarine waters are also included.
- **Coastal use area** – land adjacent to coastal waters, estuaries and coastal lakes and lagoons.

The north-western portion of the Study Area (Lot 1 DP 626787) occurs within the proximity to a coastal wetland which lies further to the north-west (outside Study Area). As such, the *Coastal Management Act 2016* applies to this development. Potential indirect impacts on wetland habitat are addressed in **Section 5**. Mitigation measures to reduce the potential for these impacts are detailed in **Section 5.3**.

1.5.5 Water Management Act 2000

Controlled activities carried out in, on or under waterfront land are regulated by the Water Management (WM) Act. 'Waterfront land' is defined as the bed of any river, lake or estuary, and the land within 40 m of the river banks, lake shore or estuary mean high water mark.

Two first-order streams are mapped within Study area, however a site assessment and review of available satellite imagery allowed for the determination that much of the extent of these two local watercourses are historical. The location and extent of these two watercourses were amended as part of this assessment, with a riparian buffer applied in accordance with WM requirements (see **Figure 2**). The previously mapped western watercourse has been amended so as to end west of the Study Area, however this watercourse may still subject to impacts within respect to the proposed western road reserve. The southern extent of the eastern watercourse has been amended based on detailed surveys, site inspections and the extent of flowing water, albeit slow and intermittent. As such, two (2) mapped watercourses occur within the Study Area. The eastern watercourse occurs entirely within the Eastern Conservation Area, however temporary impacts to the north-eastern extent of this watercourse (basins) will result in impacts to a mapped watercourse. Impacts to the western watercourse may occur as a result of the proposed western road reserve. The proposed development is therefore likely to constitute a 'controlled activity' as per the WM Act.

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

Under the EPBC Act, an approval is required for actions that are likely to have a significant impact on Matters of National Environmental Significance (MNES). An action includes a project, development, undertaking, activity or

series of activities. When a person proposes to take an action they believe may need approval under the EPBC Act, they must refer the proposal to the Australian Government Minister for the Environment. The Act identifies nine MNES:

1. World Heritage properties.
2. National heritage places.
3. Wetlands of international importance (Ramsar Convention).
4. Listed threatened species and communities.
5. Migratory species listed under international agreements.
6. Great Barrier Reef Marine Park.
7. Commonwealth marine areas.
8. Nuclear actions; and
9. Water resources in respect to CSG and large coal mines.

While this BCAR is not required to address MNES, the proponent is required to address the EPBC Act as part of the development application. Item 4 is relevant to the current proposal.

Refer to **Section 7.1** for a summary of the assessment.

1.5.7 Wyong Local Environmental Plan 2013

The Study Area is located within the Central Coast Council LGA, within the recently amalgamated Wyong Shire. The Wyong Local Environmental Plan 2013 (Wyong LEP) controls development within the Study Area through zoning and development controls. These controls are described in greater detail by the supporting Wyong Development Control Plan 2013 (Wyong DCP).

1.5.8 Wyong Development Control Plan 2013

The Wyong DCP supports the Wyong LEP by providing additional detail and guidance on addressing biodiversity issues associated with development. The purposed of the Wyong DCP is to provide Council's requirements for sustainable quality development and environmental outcomes within Wyong Shire.

Key components of the Wyong DCP relevant to the proposed development include *Chapter 3.4 Conservation Areas for Northern Wyong Shire*, *Chapter 3.6 Tree and Vegetation Management*, and *Chapter 3.10 Wetlands Management*. These three (3) chapters are considered below.

Chapter 3.4 – Conservation Areas for Northern Wyong Shire

The purpose of this chapter within the Wyong DCP is the consideration of biodiversity and landscape planning objectives associated with the establishment and management of a network of green corridors for the North Wyong Shire Structure Plan. The proposed network of corridors aims to provide areas suitable for the conservation of key plant and animal species, as well as the connectivity for the movement of high value biodiversity and allowing for improved climate change resilience for locally occurring threatened species.

This chapter applies to all lands identified on Figure 1 (Appendix B) of the Wyong DCP as being within a “Green Corridor”, “Habitat Network”, or “Conservation Link” as defined in the North Wyong Shire Structure Plan 2012. Whilst the Study Area is not mapped under the Conservation Areas map, an area of “Green Corridor and habitat networks” are mapped to the immediate west of the site. As such, the environmental performance criteria outlined

within this Chapter of the Wyong DCP are considered within this report. This includes consideration of *Survey and Assessment* (see **Section 3.1**, **Section 4.1** and **Section 4.2** for survey methodologies, and **Section 5** for assessments of impacts to threatened species), *Connectivity* (see **Section 2.1**), and *Biodiversity Conservation* (see **Section 5.1** and **Section 5.3** for biodiversity impact avoidance and mitigation measures).

Chapter 3.6 – Tree and Vegetation Management

The aims of this chapter are to protect trees on privately owned land that contribute positively to the amenity, scenic landscape characteristics and ecological values of the Central Coast Local Government Area, facilitate the removal of weeds and minimise impacts to vegetation. This chapter applies to land within the Central Coast LGA, and to which has one of the land zonings listed within Section 1.2 (part a) of the Chapter. However, the Chapter does not apply to vegetation clearing on any land which is identified on the Biodiversity Values Map, or which otherwise exceeds the BOS vegetation clearing threshold (See Section 1.3 of the Wyong DCP). The Chapter does not apply to RU6 Transition, and whilst the Chapter does apply to RE1 Public Recreation, (listed zoning under Section 1.2), the Chapter does not apply to the proposed development as the BOS is triggered.

Impacts to native vegetation including provisions for impact avoidance, mitigation and management of existing biodiversity values are detailed in **Section 5.2**, and **Section 5.3** of this report.

Chapter 3.10 – Wetland Management

The aim of this Chapter is to protect Wyong's natural wetland areas and facilitate the ecological functioning of all wetlands and maintain the significant conservation values of these environments for the benefit of present and future generations.

The Study Area is mapped as occurring within a Wetland Management Area under the Wyong DCP. As such, the proposed development must consider the Wetland Evaluation Chart in Appendix A of the Chapter, detail the impacts of development on wetland vegetation (see **Section 5**), and the provide a summary of commitments to the ongoing management of wetlands within the Study Area (see **Section 5.3**). Consideration of each of these criteria are provided in the forementioned report subsections.

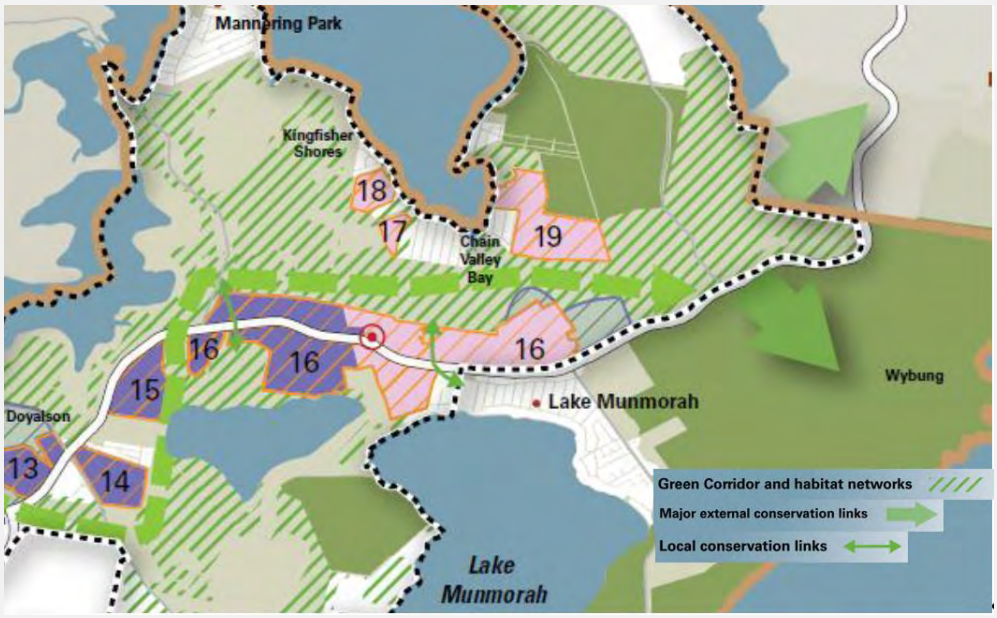
2 SITE CONTEXT

2.1 LANDSCAPE FEATURES

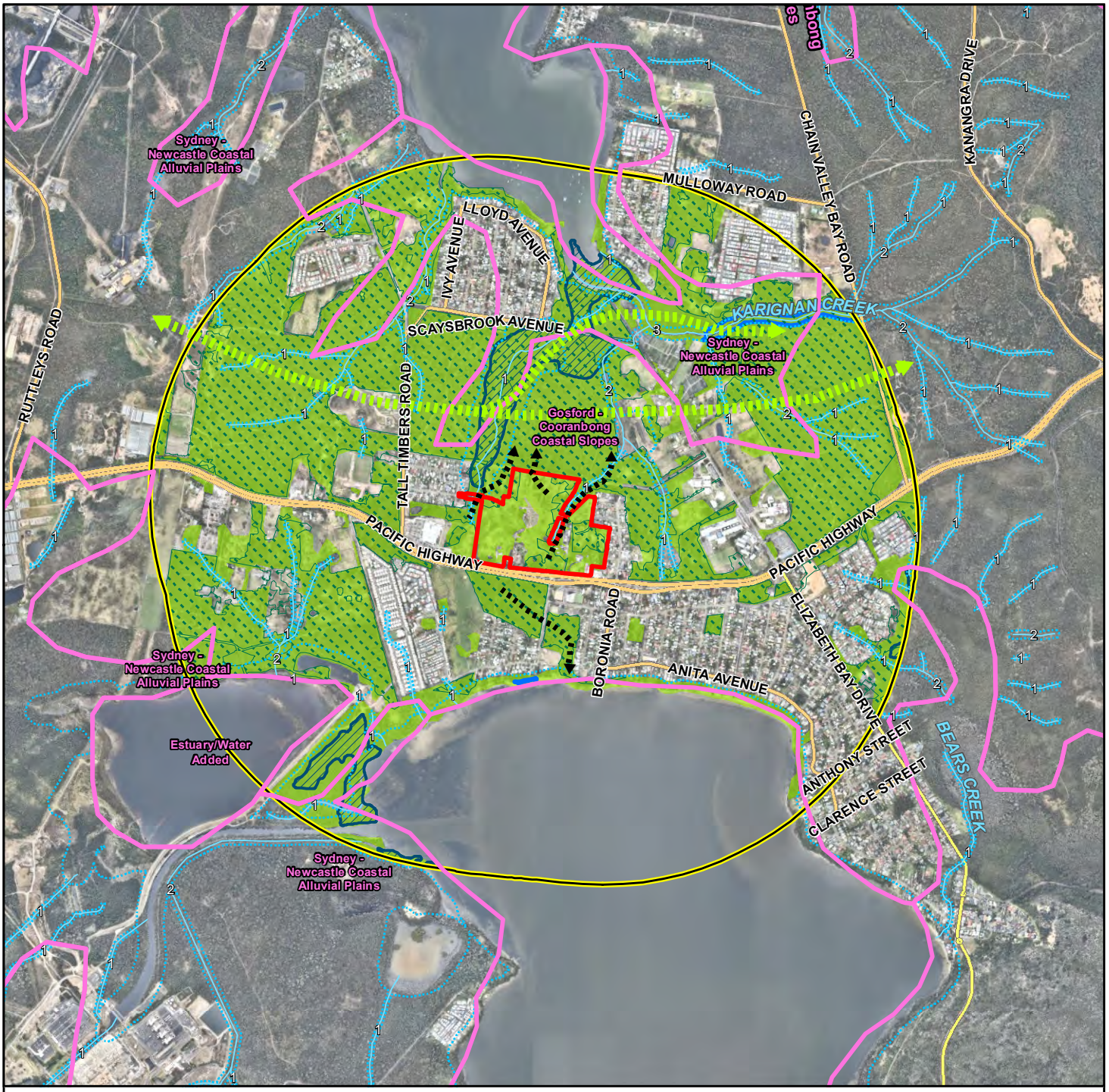
The landscape features detailed in Section 3 of the BAM (DPIE 2020a) and applicable to the planning proposal are described in **Table 3**. These landscape features are also shown on **Figure 3**.

Table 3: Landscape Features relevant to the planning proposal.

Landscape Feature	Summary
IBRA Region	**Sydney Basin** - The Study Area occurs within the Sydney Basin IBRA Region.
IBRA Sub Region	**Wyong** - The Study Area occurs within the Wyong IBRA Sub Region.
Local Government Area (LGA)	Central Coast Council Local Government Area
Mitchell Landscapes	Gosford – Cooranbong Coastal Slopes (Department of Environment and Climate Change [DECC], 2002; Mitchell 2002) Coastal fall of the Sydney Basin, rolling hills and sandstone plateau outliers of Triassic Narrabeen sandstones, extensive rock outcrop and low cliffs along ridge margins, general elevation 0 to 75m. Texture-contrast soils on lithic sandstones and shales. Loamy sand alluvium along creeks. Organic sand and mud in lagoons and swamps. Open forest and woodland of Smooth-barked Apple (*Angophora costata*), Red Bloodwood (*Corymbia gummifera*), Brown Stringybark (*Eucalyptus capitellata*), Sydney Peppermint (*Eucalyptus piperita*), Spotted Gum (*Corymbia maculata*), Bastard Mahogany (*Eucalyptus umbra*), Northern Grey Ironbark (*Eucalyptus siderophloia*) and Grey Gum (*Eucalyptus punctata*) on hills and slopes. Small areas of closed forest with; Turpentine (*Syncarpia glomulifera*), Lilly Pilly (*Acmena smithii*), Mountain Cedar Wattle (*Acacia elata*), coachwood (*Ceratopetalum apetalum*), Sassafras (*Doryphora sassafras*) and Water Gum (*Tristaniopsis laurina*) in gullies under high escarpments Prickly-leaved Tea-tree (*Melaleuca styphelioides*) and other shrubs with Swamp Mahogany (*Eucalyptus robusta*), Swamp Oak (*Casuarina glauca*), sedges and Common Reed (*Phragmites australis*) on swampy creek flats. Coastal heath subject to salt spray on headlands.
Rivers and streams and wetlands	A first order stream within a shallow drainage channel intersects the location of the proposed road reserve adjacent to Chisholm Avenue to the west. A first order stream within a shallow drainage channel also flows in a northern direction through the eastern portion of the Study Area. Both mapped watercourses are indistinct in their southern extents, when compared to original mapping, even following high rainfall events. As such, the extent and location of each watercourse has been re-mapped through a site inspection and aerial imagery. The extent of each watercourse is illustrated in **Figure 2**.
Wetlands	Low-lying areas within the eastern portion of the Study Area are predominantly cleared. A small wetland dominated by rush species with limited open water occurs near in the north-east corner of the Study Area. Four constructed dams also occur in the south. The north-western portion of the Study Area (Lot 1 DP 626787) occurs within the proximity area of a coastal wetland which lies further to the north-west (outside Study Area). A review of Wetland mapping within Chapter 3.10 of the Wyong DCP indicates that the Study Area is mapped as a Wetland Management Area. The wetland within the Study Area likely meets the description of Drainage Lines and Wet Meadows as described in the Wyong DCP. Impacts to wetland vegetation within the Study Area are considered in **Section 5**.
Connectivity of different areas of habitat	The native woodland vegetation within the Study Area is largely fragmented due to historical vegetation clearing and current land management practises. Internal connectivity is moderate to low with sparse occurrences of woodland vegetation, isolated trees and areas of regenerating shrubs. A patch of woodland vegetation in the north-west corner of the Study Area has moderate connectivity with vegetation to the west, despite the occurrence of stock exclusion fencing and a

Landscape Feature	Summary
	four-meter unsealed track on the outside of the northern boundary. The track continues along the length of the northern boundary is likely to have a small influence on connectivity with bushland vegetation to the north. The distance between the Study Area boundary and remnant vegetation to the immediate north of the site is approximately 12 m, inclusive of the unsealed track, power lines and maintained corridor (transmission easement). The Pacific Highway adjoins the southern boundary and creates a 50-70m gap with bushland vegetation to the south of the Pacific Highway. Residential development reduces connectivity with bushland areas to the east. No conservation areas are mapped within the Study Area under the North Wyong Shire Structure Plan 2012. Map 2 of the Structure Plan identifies a Local Conservation Link along the western extent of the Study Area (north-south direction) which connects to vegetation on the southern side of the Pacific Highway. This link is largely absent within the Study Area (owing to sparsely distributed vegetation), and pines occurring within this area have been cleared. Greater connectivity is provided by vegetation within the drainage corridor to the immediate west of the Study Area (though connectivity at the southern end is tenuous due to the sparsely distribution vegetation and the Pacific Highway). The Structure Plan maps the Study Area as a "Proposed Residential Area" and recognises the bushland areas to the north of the Study Area as a "Major External Conservation Link" (west to east).  The Greater Lake Munmorah Structure Plan also identifies a North-South local conservation area within the riparian corridor in the Study Area (see below). 

Landscape Feature	Summary
Areas of geological significance and soil hazard features	There are no areas of geological significance within the Development Site or Study area. The northern-most extent of the Typha wetland in the north-east of the Study Area is mapped as having a low probability of Acid Soils.
Areas of outstanding biodiversity value	There are no areas of outstanding biodiversity value mapped within the Development Site or Study Area.
Geology and Soils	Wyong (9131wy) **-** This Soil Landscape occurs on poorly drained floodplains on Quaternary alluvium in the Central Coast Lowlands. Geology is characterised by quaternary sediments (Matthei 1995).
Native Vegetation Cover	Native Vegetation was assessed as per Section 3.2 of the BAM 2020 (DPIE 2020a). Native vegetation constitutes 46% (486ha) of the projected the 1,500 m site buffer (1062 ha). Native Vegetation Cover therefore is classed as **>30 - 70%.**



Legend

- Development Site
- Landscape Assessment - 1500m Buffer
- Landscape Assessment - Native Vegetation
- IBRA Sub-region Boundary (V7) - Entire map extent is within Sydney Basin region: Wyong sub-region
- Mitchell Landscapes Boundary (V3)
- Watercourse (Labelled with stream order)
- Riparian Buffers
- Watercourses
- Motorway
- Primary Road
- Arterial Road
- Sub-arterial Road

Biodiversity Values (V13.2) within 1500m Buffer

- Biodiverse Riparian Land
- Coastal Management Act - Wetlands
- Threatened species or communities with potential for serious and irreversible impacts
- Local Wildlife Movement Corridors
- Regional Movement Corridors

km
0 0.1 0.2 0.4 0.6 0.8 1

N

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PROJECT REFERENCE: 20221770
DATE DRAWN: 9/30/2022 11:58 Version 5
DRAWN BY: AMcDonaugh
DATA SOURCE:
NSW DFSI - 2020
NSW DPIE - 2021
Nearmap - 2022

Landscape Context

Barker Ryan Stewart
Biodiversity Certification Assessment Report
285 – 325 Pacific Highway
Lake Munmorah NSW

FIGURE:
3

J:\00 CLIENT FILES\132725_BarkerRyanStewart\20221770_PEA_285PacificHwy_LakeMunmorah\Mapping\20221770_BCAR_Fig03_LandscapeContext.mxd

3 NATIVE VEGETATION

3.1 METHODOLOGY

Native vegetation at the Development Site was assessed in accordance with Section 4 of the BAM (DPIE 2020a).

3.1.1 Data Review

Vegetation mapping completed as part of the Lower Hunter and Central Coast Regional Environmental Management Strategy (LHCCREMS VIS_ID 2225) (NPWS 2003) was reviewed to assist with the determination of PCTs within the Study Area.

3.1.2 Vegetation Mapping Surveys

Vegetation Mapping and Surveys

Detailed vegetation surveys were conducted across the Study Area during August 2021. Areas of vegetation to be impacted by the proposed development were mapped during this period.

The boundaries of each of the identified vegetation communities within the Study Area were mapped using a combination of rapid data points (RDP) and walking transects, using the polygons produced through aerial photo interpretation (API) to assist in targeting survey effort. RDPs involved collecting waypoints over the Study Area using a handheld Trimble™ GPS unit and recording dominant species, structure and condition. Walking transects involved verifying polygons where homogenous in floristic composition and condition, as well as walking vegetation ecotones and using the recorded tracks to define vegetation community boundaries. The RDPs and survey tracks were then overlaid on an aerial photograph and used to delineate and/or clarify vegetation boundaries.

3.1.2.1 Linework and Attribution

RDPs and plots were classified and tagged with a PCT by field surveyors. Polygons produced from the API work adopted the PCT of the sample point that they intersected.

3.1.2.2 Plant Community Type and Determination

Each vegetation community identified within the Study Area was assigned to the closest equivalent PCT from those listed in the BioNet Vegetation Classification database (DPIE 2022b). The closest equivalent PCT for each vegetation community was determined through a comparison of the floristic descriptions of PCTs in the database with the plot / transect data collected from the Development Site. In addition to floristic and structural similarity, the landscape position, soil type and other diagnostic features of the vegetation communities on the site were compared to the descriptions in the database to determine the most suitable PCT. Threatened ecological communities (TECs) as defined in NSW and Commonwealth legislation were also identified if present.

3.1.2.3 Vegetation Zones

Vegetation zones were identified and delineated in the Development Site in accordance with Section 4.3 of the BAM (DPIE 2020a). A vegetation zone is defined in the BAM as a relatively homogenous area that is the same vegetation type and broad condition.

3.1.2.4 Assessing Vegetation Integrity (Site Condition)

Following stratification of the Study Area into vegetation zones, plots/transects were undertaken to collect site condition data for the composition, structure and function attributes listed in **Table 4** in accordance with Section 4.3 of the BAM (DPIE 2020a). The location of the plots/transects were selected through stratified random sampling to provide a representative sample of the variation in vegetation composition and condition within each vegetation zone.

Table 4: Composition, Structure and Function components of vegetation integrity

Growth form groups used to assess composition (species richness) and structure (percent foliage cover)	Function attributes
• Tree (TG) • Shrub (SG) • Grass and grass-like (GG) • Forb (FG) • Fern (EG) • Other (OG)	• Number of large trees • Tree regeneration (presence/absence) • Tree stem size class (presence/absence) • Total length of fallen logs • Litter cover • High threat exotic vegetation cover (HTE) • Hollow-bearing trees (HBT)

The number of plots/transects undertaken across the site meets the minimum number of transects required for each vegetation zone area as detailed in Section 4.3.4, Table 3 of the BAM (DPIE 2020a). Fourteen (14) plots were undertaken within the Disturbance Footprint (see **Figure 4**).

3.1.2.5 Floristic Identification and Nomenclature

Floristic identification and nomenclature were based on Harden (1992, 1993, 2000 and 2002) with subsequent revisions as published on PlantNet (http://plantnet.rbgsyd.nsw.gov.au).

3.2 Assessment Results

3.2.1 Vegetation within the Development Site

3.2.1.1 Vegetation Description

Three Plant Community Types (PCTs) were identified within the Study Area:

- PCT 1649 - *Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands.*
- PCT 1638 - *Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast.*
- PCT 1737 - *Typha rushland.*

The above PCTs were further assigned to seven (7) vegetation zones based on floristics and vegetation condition as shown in **Table 5**. The table provides a summary of areas of each vegetation zone to be retained with no direct impacts (Conservation Areas [C2]), development impacts, and impacts resulting from the establishment of two constructed wetlands (which will ultimately be rehabilitated). Note that the Constructed Wetlands form part of both the Disturbance Footprint and the Conservation Area.

Table 5: Vegetation Zones within the Study Area

PCT	Vegetation Zone	Condition Class	Development Site*	Conservation Area		Total Disturbance Footprint	Total Conservation Area	Study Area (ha)
				Constructed Wetland (Temporary Impacts)	Conservation Areas (C2) (No Direct Impacts)			
PCT 1649 – *Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands*	**Zone 1**	Good (EEC)	0.25	0	0.11	0.25	0.11	0.36
	Zone 2	Low- Moderate (EEC)	0.43	0.16	0.40	0.59	0.56	0.99
	Zone 3	Cleared	0.21	0.36	0.42	0.57	0.78	0.99
PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast	**Zone 4**	Moderate	2.87	0.01	0.04	2.88	0.05	2.92
	Zone 5	Low-Moderate	6.66	0	1.93	6.66	1.93	8.59
	Zone 6	Cleared	10.26	0.04	0.05	10.30	0.09	10.36
PCT 1737 – Typha rushland	**Zone 7**	Moderate (EEC)	0.00	0.26	0	0.26	0.26	0.26
Exotic Vegetation – Grassland	**Zone 8**	N/A	0.72	0	0	0.72	0	0.72
Exotic Vegetation – Planted Vegetation	**Zone 9**	N/A	0.71	0	0	0.71	0	0.71
Existing Tracks & Infrastructure			1.53	0	0	1.53	0	1.53
Dams and Watercourse			0.14	0	0	0.14	0	0.14
Total			**23.78**	**0.84**	2.95	24.62	3.79	27.58

*the Development Site includes impacts to vegetation within the 5m vegetation buffer located along the southern boundary of the Study Area, however efforts will be made to retain key fauna habitat features (i.e. hollow bearing trees) and threatened species (i.e. *Angophora inopina*) occurring within the buffer area

The extent of each vegetation zone is illustrated on **Figure 4**.

In accordance with Table 28 of the BAM (DPIE, 2020a) impacts to the Exotic Vegetation have been considered in the context of potential habitat for threatened species throughout this report (see **Section 5.1.2**). The removal of this vegetation from the Study Area does not generate an ecosystem credit obligation.

Full descriptions of each vegetation zone are provided in the following sub-sections. Floristic and structural plot data is provided in **Appendix I**.

Vegetation Zone 1

PCT 1649 – Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands **(Good Condition – EEC)**

Plate 1 **Vegetation Zone 1 -** ***PCT 1649 – Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands*** **(Good Condition – EEC)**

Vegetation Zone 1 - ***PCT 1649 – Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands*** **(Good Condition – EEC)**		
Vegetation Formation and Class	Forest Wetlands Coastal Swamp Forests	
Total area within Study Area	0.36 ha	
Total Area within Disturbance Footprint	0.25 ha	
Conservation Area	Retained (No direct impacts)	0.11 ha (32%)
	Constructed Wetlands (temporary impacts)	0 ha
Survey Effort	**Conducted:** 1 plot/transect (Q01)	
Floristic description	The vegetation within this zone was characterised by canopy dominated by *Eucalyptus racemosa* (Narrow-leaved Scribbly Gum), *Angophora floribunda* (Rough-barked Apple), with a lower density of *Eucalyptus robusta* (Swamp Mahogany), *Eucalyptus capitellata* (Brown Stringybark). The midstorey is dominated by *Melaleuca sieberi*, with *Allocasuarina littoralis* (Black She-oak) with occasional *Pinus radiata* (Radiata Pine). The shrub layer is characterised by a moderate diversity of native sclerophyllous shrubs including *Melaleuca thymifolia* (Thyme Honey-myrtle), *Dillwynia retorta*, *Acacia suaveolens* (Sweet Wattle), *Pimelea latifolia* (Slender Rice-flower), *Mirbelia rubiifolia* (Heathy Mirbelia), and *Daviesia ulicifolia* (Gorse Bitter Pea).	

Vegetation Zone 1 - *PCT 1649 – Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands* (Good Condition – EEC)	
	The groundcover is a mix of native grasses and sedges including *Entolasia stricta* (Wiry Panic), *Themeda triandra* (Kangaroo Grass), *Xanthorrhoea media* (Cadigal), *Lepyrodia scariosa*, and *Lepidosperma laterale* (Variable Sword-sedge). The vegetation zone generally has a low cover of exotic species, however juvenile *Pinus radiata* (Radiata Pine) occur throughout the vegetation zone.
Condition within Study Area	The vegetation within this Zone 1 is in a good condition with an intact native canopy and midstorey and a diverse groundcover. Disturbances include edge effects (including invasion of garden plants and management of grassland [mowing]), invasion of *Pinus radiata* and rubbish.
Justification for PCT selection	The vegetation within the Study Area most closely resembles a Forested Wetland within the Coastal Floodplain Wetland class due to the position of the vegetation alongside a watercourse and beside a mapped Coastal Wetland, and the dominance of species including *Eucalyptus robusta* (Swamp Mahogany), *Angophora floribunda* (Rough-barked Apple), and *Melaleuca sieberi*. PCT 1649 was deemed to be most closely aligned PCT to the vegetation within the Study Area due to the presence of an open forest structure with a canopy of *Angophora costata* (Smooth-barked Apple), and *Eucalyptus robusta* (Swamp Mahogany) and in some parts *Eucalyptus resinifera* (Red Mahogany). A number of midstorey and groundcover species occurring within the vegetation zone are diagnostic to the PCT including *Melaleuca sieberi*, *Melaleuca thymifolia* (Thyme Honey-myrtle), *Lepyrodia scariosa* and *Themeda triandra* (Kangaroo Grass). A number of other Forested Wetland PCTs were considered for this vegetation zone including PCT 1717, 1723 and PCT 1724. However, whilst all communities had *Eucalyptus robusta* and *Melaleuca quinquenervia,* none of these communities were represented by a canopy that included the sub-dominate species found on site such as *Angophora costata* and *Eucalyptus resinifera*. The vegetation within the Study Area also did not contain any *Casuarina glauca* (Swamp Oak) which is represented in most of the alternative PCTs considered for this assessment. As such, PCT 1649 was determined to be the most representative community for the vegetation within this zone.
Conservation Status	**BC Act:** The vegetation within this zone meets the definition for *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (EEC)* under the BC Act. See **Appendix D** for a justification of this community.
	EPBC Act: The vegetation within this zone meets the definition for *Coastal Swamp Sclerophyll Forest of New South Wales North Coast and South-east Queensland (EEC)* under the EPBC Act. See **Appendix D** for a justification of this community.
SAII	No
PCT % Cleared	46%

Vegetation Zone 2

***PCT 1649 – Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands* (Low – Moderate Condition – EEC)**

Plate 2 Vegetation Zone 2 - *PCT 1649 – Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands* (Low – Moderate Condition – EEC)

Vegetation Zone 2 - *PCT 1649 – Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands* (Low – Moderate Condition – EEC)		
Vegetation Formation and Class	Forest Wetlands Coastal Swamp Forests	
Total area within Study Area	0.99 ha	
Area within Disturbance Footprint	0.59 ha	
Conservation Area	Retained (No direct impacts)	0.40 ha (41%)
	Constructed Wetlands (temporary impacts)	0.16 ha
Survey Effort	1 Plot/transect (Q12)	
Floristic description	The vegetation within this Zone 2 was characterised by an open canopy of *Angophora floribunda* (Rough-barked Apple), *Eucalyptus resinifera* (Red Mahogany), *Eucalyptus robusta* (Swamp Mahogany), *Melaleuca quinquenervia* (Broad-leaved Paperbark), and *Eucalyptus haemastoma* (Broad-leaved Scribbly Gum). The midstorey is variable, with areas around waterbodies (constructed dams) and wetlands (Vegetation Zone 7) being characterised by *Melaleuca quinquenervia* juveniles, and *Melaleuca sieberi*. The shrub layer and groundcover is predominantly managed throughout the vegetation zone with occasional *Pittosporum undulatum* (Sweet Pittosporum) and *Livistona australis* (Cabbage Tree Palm). The groundcover is dominated by a mix of native and exotic grasses including *Andropogon virginicus* (Whisky Grass), *Themeda triandra* (Kangaroo Grass), *Sporobolus virginicus* (Sand	

Vegetation Zone 2 - *PCT 1649 – Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands* (Low – Moderate Condition – EEC)	
	Couch), *and Eragrostis leptostachya* (Paddock Lovegrass). Low lying areas had a greater abundance of species such as *Baumea rubiginosa, Cyperus polystachyos*, *Schoenus apogon* (Common Bog-rush), and *Juncus holoschoenus*. The vegetation zone generally has a low cover of exotic species, however *Andropogon virginicus* (Whiskey Grass) occurs throughout the vegetation zone.
Condition within Development Site	The vegetation within this Zone 2 is in low-moderate condition, with a heavily reduced midstorey and shrub layer and managed groundcover.
Justification for PCT selection	**BC Act:** The vegetation within this zone meets the definition for *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (EEC)* under the BC Act. See **Appendix E** for a justification of this community.
Conservation Status	**EPBC Act**: The vegetation within this zone meets the definition for *Coastal Swamp Sclerophyll Forest of New South Wales North Coast and South-east Queensland (EEC)* under the EPBC Act. See **Appendix D** for a justification of this community.
SAII	No
PCT % Cleared	46%

Vegetation Zone 3

PCT 1649 – Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands **(Cleared)**

Plate 3 **Vegetation Zone 3 -** ***PCT 1649 – Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands*** **(Cleared)**

Vegetation Zone 3 - ***PCT 1649 – Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands*** **(Cleared)**		
Vegetation Formation and Class	Forest Wetlands Coastal Swamp Forests	
Area within Study Area	0.99 ha	
Area within the Disturbance Footprint	0.57 ha	
Conservation Area	Retained (No direct impacts)	0.42 ha (42%)
	Constructed Wetlands (temporary impacts)	0.36 ha
Survey Effort	1 Plot/transect (Q11)	
Floristic description	The vegetation within this Zone 3 was characterised by the absence of the canopy and midstorey detailed within Vegetation Zone 1 and 2. The groundcover is comparable to that observed within the two aforementioned vegetation zones.	
Condition within Study Area	The vegetation within this Zone 3 is in low condition with an absence of midstorey and canopy due to continual vegetation management and grazing.	
Justification for PCT selection	See Vegetation Zone 1.	
Status	Not commensurate with either BC or EPBC TECs (see **Appendix D**)	

Vegetation Zone 4

***PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast* (Moderate Condition)**

Plate 4 **Vegetation Zone 4 - *PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Moderate Condition)***

Vegetation Zone 4 - *PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Moderate Condition)*		
Vegetation Formation and Class	Dry Sclerophyll Forests (Shrubby sub-formation) Sydney Coastal Dry Sclerophyll Forests	
Total area within Study Area	2.92 ha	
Area within Disturbance Footprint	2.88 ha	
Conservation Area	Retained (No direct impacts)	0.04 ha (1%)
	Constructed Wetlands (temporary impacts)	0.01 ha
Survey Effort	**Conducted: 2** plot/transect (Q09, Q14)	
Floristic description	The vegetation within this Zone 4 was characterised by a canopy dominated by *Angophora costata* (Smooth-barked Apple), *Eucalyptus haemastoma* (Broad-leaved Scribbly Gum), with *Corymbia gummifera* (Red Bloodwood) and *Eucalyptus capitellata* (Brown Stringybark). The midstorey is sparse and comprised of species including *Allocasuarina littoralis* (She Oak), *Melaleuca* spp. and *Acacia* spp. The ground layer is characterised by a mix of grasses, including *Themeda triandra* (Kangaroo Grass), *Aristida vagans* (Three-awn Speargrass), *Entolasia stricta* (Wiry Panic), *Microlaena stipoides* (Weeping Grass) and *Eragrostis brownii* (Brown's Lovegrass), sedges and other 'grasslike' species (*Lepidosperma laterale*, *Xanthorrhoea fulvum*, and	

Vegetation Zone 4 - *PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Moderate Condition)*	
	Cyathochaeta diandra) and small sclerophyllous shrubs including *Acacia myrtifolia* (Myrtle Wattle), *Acacia brownii* (Prickly Moses), and *Dillwynia retorta*. The vegetation zone is characterised by a predominantly low cover of exotic species, however *Andropogon virginicus* (Whiskey Grass) is widespread.
Condition within Study Area	The vegetation within this Zone 4 is in a moderate condition with an intact native canopy and midstorey and a diverse shrub/grass groundcover. Disturbances include edge effects, invasion of Whiskey Grass and garden plants and management of grassland (mowing).
Justification for PCT selection	The vegetation within this Zone 4 most closely resembles a Dry Sclerophyll Forest within the Shrub/grass sub-formation due to the dominance of a eucalypt canopy, an abundance of sclerophyllous shrubs in the understorey and a groundcover consisting of an almost continuous cover of grasses and herbs, and mixed sclerophyllous shrubs. Within this formation, the vegetation is most closely aligned with the Sydney Coastal Dry Sclerophyll Forests class due to the presence of a canopy of *Angophora costata* (Smooth-barked Apple), *Corymbia gummifera* (Red Bloodwood), and *Eucalyptus haemastoma* (Broad-leaved Scribbly Gum). The vegetation zone also contains a number of shrubs and grasses indicative of the vegetation class PCT 1638 was deemed to be most closely aligned PCT to the vegetation within the Study Area due to the presence of an open forest structure with a canopy of *Angophora costata* (Smooth-barked Apple), and *Eucalyptus haemastoma* (Broad-leaved Scribbly Gum) and *Corymbia gummifera* (Red Bloodwood). A number of midstorey and groundcover species occurring within the vegetation zone are diagnostic to the PCT. One (1) alternative PCT was considered for this vegetation zone, *PCT 1636: Scribbly Gum – Red Bloodwood – Angophora inopina heathy woodland on lowlands of the Central Coast*. The vegetation within the Study Area has a number of similarities with this community, including the presence of one (1) key diagnostic species; *Angophora inopina* (Charmhaven Apple). However, the PCT does not have a number of other key species present on site, of which are better represented in PCT 1638, including *Angophora costata* (Smooth-barked Apple) and *Allocasuarina littoralis* (Black She Oak) which are dominates throughout the vegetation zone. The more intact areas of this vegetation zone and areas with regrowth are also characterised by diagnostic shrub and groundcover species more typical of PCT 1638 including *Acacia myrtifolia* and *Pimelea linifolia.* An inspection of more intact areas of vegetation within the nearby Lake Munmorah State Conservation Area also allowed a better idea of the natural state of the vegetation and the progression into communities commensurate with PCT 1649 in damper and lower areas of the landscape. The vegetation within the Study Area, whilst more commensurate with PCT 1638, it does show influence from PCT 1636 with the inclusion of *Angophora inopina,* however this is likely evidence of a broad ecotone between the two communities, with PCT 1636 occurring to the north of the site, and PCT 1638 more likely to occur to the south and east of the site.
Conservation Status	**BC Act:** Not Applicable.
	EPBC Act: Not Applicable.
SAII	No
PCT % Cleared	50%

Vegetation Zone 5

PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast **(Low-Moderate Condition)**

Plate 5 **Vegetation Zone 5 - PCT *1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast*** **(Low-Moderate Condition)**

Vegetation Zone 5 - PCT 1638 – *Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast* **(Low-Moderate Condition)**		
Vegetation Formation and Class	Dry Sclerophyll Forests (Shrubby sub-formation) Sydney Coastal Dry Sclerophyll Forests	
Area within Study Area	8.59 ha	
Area within Disturbance Footprint	6.66 ha	
Conservation Area	Retained (No direct impacts)	1.93 ha (27%)
	Constructed Wetlands (temporary impacts)	0 ha
Survey Effort	**Conducted: 3** plot/transects (Q02, Q06, Q08)	
Floristic description	The vegetation within this Zone 5 was characterised by a canopy dominated by *Angophora costata* (Smooth-barked Apple), *Eucalyptus haemastoma* (Broad-leaved Scribbly Gum), with *Corymbia gummifera* (Red Bloodwood) and *Eucalyptus capitellata* (Brown Stringybark). The midstorey is sparse and comprised of species including *Allocasuarina littoralis* (She-oak). The ground layer is variable across the Study Area based on management regime (grazing, mowing, or left idle) but can be generally characterised by a mix of native and exotic grasses including *Themeda triandra*, *Andropogon virginicus* (Whiskey Grass),	

Vegetation Zone 5 - PCT 1638 – *Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast* (Low-Moderate Condition)	
	Aristida vagans, *Entolasia stricta* (Wiry Panic), *Microlaena stipoides* (Weeping Grass) and *Eragrostis brownii* (Brown's Lovegrass) Exotic species cover is variable, with Whiskey Grass being widespread and patches of *Rubus anglocandicans* (Blackberry) within the south of the Study Area.
Condition within Study Area	The vegetation within this Zone 5 is in low to moderate condition with a reduced midstorey and canopy as a result of management
Justification for PCT selection	See Vegetation Zone 4
Conservation Status	See Vegetation Zone 4

Vegetation Zone 6

***PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast* (Cleared Condition)**

Plate 6 **Vegetation Zone 6 - PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Cleared Condition)**

Vegetation Zone 6 - PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Cleared Condition)		
Vegetation Formation and Class	Dry Sclerophyll Forests (Shrubby sub-formation) Sydney Coastal Dry Sclerophyll Forests	
Total area within Study Area	10.36 ha	
Area within Disturbance Footprint	10.30 ha	
Conservation Area	Retained (No direct impacts)	0.05 ha (1%)
	Constructed Wetlands (temporary impacts)	0.04 ha
Survey Effort	**Conducted: 3** plot/transects (Q03, Q07, Q13).	
Floristic description	The vegetation within this Zone 6 was characterised by an absence of canopy and midstorey as detailed within Vegetation Zone 4, except for the occasional isolated tree species, such as *Angophora costata* (Smooth-barked Apple), *Eucalyptus haemastoma* (Scribbly Gum), and *Eucalyptus capitellata* (Brown Stringybark). The groundcover is highly variable across the Study Area based on different management regimes but can be generally characterised by a mix of native and exotic grasses including *Themeda triandra*, *Andropogon virginicus* (Whiskey Grass), *Aristida vagans* (Three-awn Speargrass), *Entolasia stricta* (Wiry Panic), *Microlaena stipoides* (Weeping Grass) and *Eragrostis brownii* (Brown's Lovegrass). Herbs including	

Vegetation Zone 6 - PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Cleared Condition)	
	Hypochaeris radicata (Cat's Ear), *Richardia humistrata* and *Gonocarpus teucrioides* (Rasp Wort) occur throughout. Exotic species cover is variable, with Whiskey Grass being widespread.
Condition within Study Area	The vegetation within this Zone 6 is in low condition with an absence of midstorey and canopy due to continual vegetation management.
Justification for PCT selection	See Vegetation Zone 4.
Conservation Status	See Vegetation Zone 4.

Vegetation Zone 7

***PCT 1737 – Typha rushland* (Moderate Condition - EEC)**

Plate 7 Vegetation Zone 7 - *PCT 1737 – Typha rushland* (Moderate Condition - EEC)

Vegetation Zone 7 - *PCT 1737 – Typha rushland (Moderate Condition - EEC)*		
Vegetation Formation and Class	Freshwater Wetlands Coastal Freshwater Lagoons	
Total area within Study Area	0.26 ha	
Area within Disturbance Footprint	0.26 ha	
Conservation Area	Retained (No direct impacts)	0 ha (0%)
	Constructed Wetlands (temporary impacts)	0.26 ha
Survey Effort	**Conducted:** 1 plot (Q05)	
Floristic description	The vegetation within this Zone 7 is dominated by *Typha orientalis* (Broad-leaved Cumbungi) with a mix *Gahnia clarkei* (Tall Saw-sedge), of herbs including *Ranunculus inundatus* (River Buttercup), *Baumea rubiginosa*, *Cyperus polystachyos*, and *Schoenus apogon* (Fluke Bog-rush). The canopy and midstorey is absent, with the exception of occasional emergent of *Melaleuca quinquenervia* (Broad-leaved Paperbark) and *Eucalyptus robusta* (Swamp Mahogany). The vegetation Zone 7 is characterised by a predominantly low cover of exotic species, however *Andropogon virginicus* (Whiskey Grass) is invading the edges of the community.	

Vegetation Zone 7 - *PCT 1737 – Typha rushland (Moderate Condition - EEC)*	
Condition within Study Area	The vegetation within this Zone 7 is in a moderate condition.
Justification for PCT selection	The vegetation within the Study Area most closely resembles a Freshwater Wetland within the Coastal Freshwater Lagoon class due to the periodic inundation of the zone and dominance of *Typha orientalis*. PCT 1737 was deemed to be most closely aligned PCT to the vegetation within the Study Area due to the dominance of *Typha orientalis* and occurrence of *Melaleuca quinquenervia.*
Conservation Status	**BC Act:** The vegetation within this Zone 7 meets the definition for *Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* (EEC) under the BC Act. See **Appendix D** for a justification of this community.
	EPBC Act: Not Applicable.
SAII	No
PCT % Cleared	70%

Vegetation Zone 8

Exotic Vegetation - Grassland

Plate 8 Vegetation Zone 8 – Exotic Vegetation - Grassland

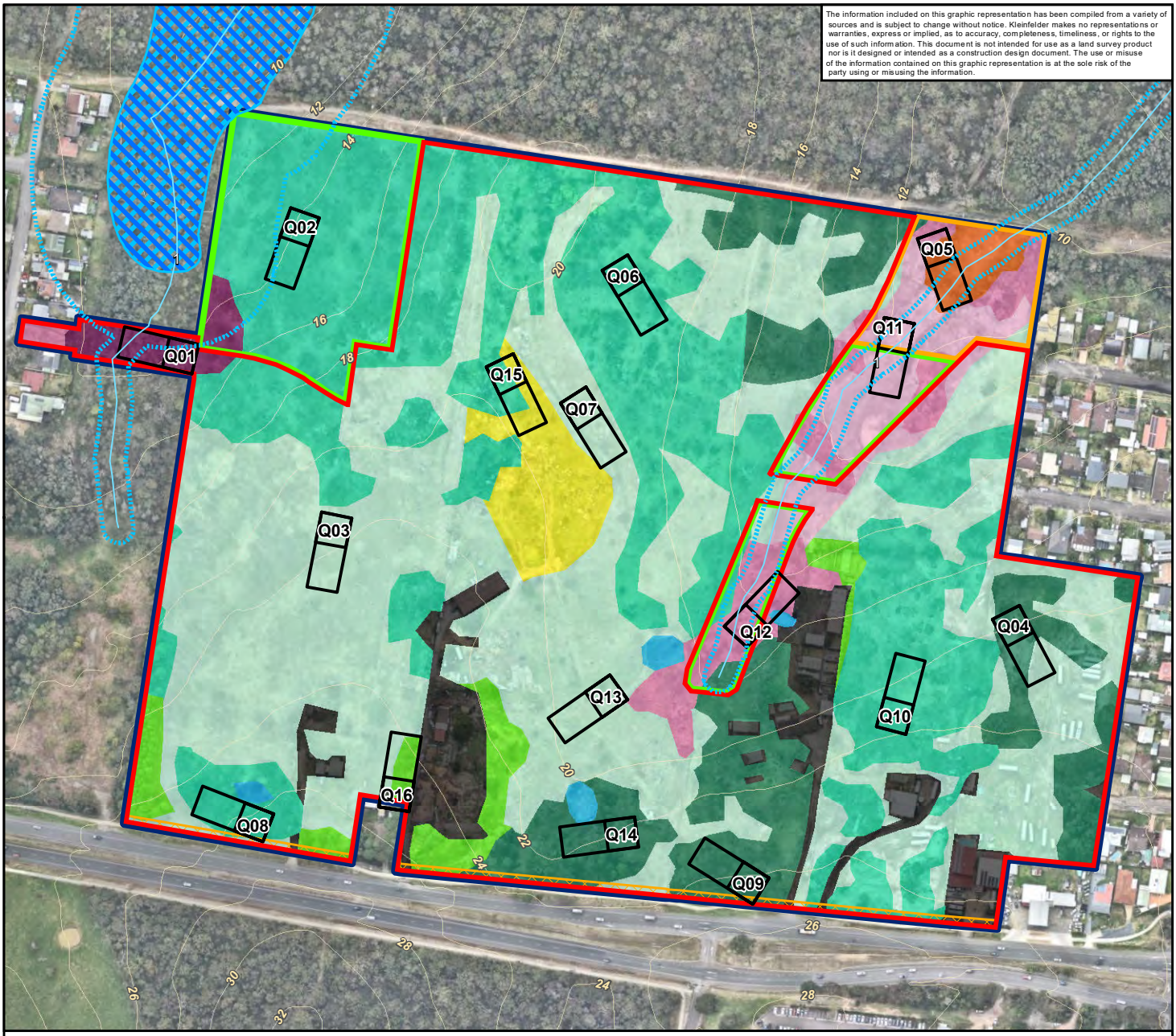
Vegetation Zone 8 – Exotic Vegetation - Grassland	
Vegetation Formation and Class	Not Applicable
Total area within Study Area	0.72 ha
Area within Disturbance Footprint	0.72 ha
Area within Conservation Areas	0 ha
Survey Effort	**Conducted:** 1 plot (Q15)
Floristic description	The vegetation within this zone is highly disturbed, characterised by exotic grassland dominated by a mix of exotic species including *Andropogon Virginius* (Whiskey Grass), *Axonopus fissifolius* (Narrow-leafed Carpet Grass), *Sporobolus africanus* (Parramatta Grass), and *Verbena bonariensis* (Purple top). Native groundcover species constituted a total of 1.2% of the groundcover within this vegetation zone (see **Appendix B**).
Condition within Study Area	The vegetation within this zone is low condition exotic vegetation with a native perennial groundcover of <15% (1.2%). No PCT could be assigned to the vegetation zone owing to the lack of native flora species.

Vegetation Zone 9

Exotic Vegetation – Planted Vegetation

Plate 9 Vegetation Zone 9 – Exotic Vegetation – Planted Vegetation

Vegetation Zone 9 – Exotic Vegetation – Planted Vegetation	
Vegetation Formation and Class	Not Applicable
Total area within Study Area	0.71 ha
Area within Disturbance Footprint	0.71 ha
Area within Conservation Areas	0 ha
Survey Effort	**Walkover**
Floristic description	The vegetation within this zone is highly disturbed, dominated by remnant pine plantations. The zone is floristically largely characterised by a dominance of a canopy of *Pinus radiata* (Radiata Pine) (a legacy of previous landuse), and an exotic dominated groundcover with a mix of *Andropogon Virginius* (Whiskey Grass), *Axonopus fissifolius* (Narrow-leafed Carpet Grass), *Sporobolus africanus* (Parramatta Grass), and *Verbena bonariensis* (Purple top). Native groundcover species constituted a total of 1.5% of the groundcover within this vegetation zone (see **Appendix B**).
Condition within Study Area	The vegetation within this zone is low condition exotic vegetation with a native perennial groundcover of <15% (1.5%). No PCT could be assigned to the vegetation zone owing to the lack of native flora species.



Legend

- Study Area
- Development Site (Residential Subdivision Footprint)
- Conservation Area (Temporary Impacts - Wetland Rehab)
- Development Site (5m Vegetation Buffer)
- Conservation Area (Retained)
- BAM Plots
- Wetlands - Coastal Management Act
- Riparian Buffers
- Watercourse (Labelled with stream order)
- 2m Contour Lines

Vegetation Zones and Plant Community Types

(Vegetation Zones apply with Development Site Only)

- Zone 1 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Good Condition) (EEC)
- Zone 2 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Low-Moderate Condition) (EEC)
- Zone 3 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Cleared)
- Zone 4 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Moderate Condition)
- Zone 5 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Low-Mod Condition)
- Zone 6 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Cleared)
- Zone 7 - PCT 1737: Typha rushland (Moderate Condition) (EEC)
- Exotic Vegetation (Grassland)
- Exotic Vegetation (Planted Vegetation)
- Dam
- Existing Tracks & Infrastructure

Metres
0 25 50 100 150 200
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DRAWN BY: AMcDonaugh
DATA SOURCE:
NSW DFSI - 2020
Nearmap - 2022

Vegetation Mapping

Barker Ryan Stewart
Biodiversity Certification Assessment Report
285 – 325 Pacific Highway
Lake Munmorah NSW

FIGURE:
4

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3.2.1.2 Assessment of Patch Size

The patch size for all vegetation zones was assessed as >100 ha as this vegetation is connected to larger intact areas of native forest vegetation extending to the north and south of the Study Area. Any gaps in the connective vegetation considered for the patch sizes are less than 100 m (appropriate for woody vegetation).

3.2.1.3 Vegetation Integrity Score

The current vegetation integrity score of the vegetation zones is outlined in **Table 6.**

Table 6: Current vegetation integrity score for the vegetation zones within the Disturbance Footprint

Zone	PCT	Condition class	Total area of Disturbance (ha)	Condition scores (Current Score)			Vegetation integrity score
				Composition	Structure	Function	
1	1649	Good (EEC)	0.25	88.4	98.4	39.8	70.2
2	1649	Low-Moderate (EEC)	0.59	44.8	33.5	66.1	46.3
3	1649	Cleared	0.57	39.4	50.1	15.0	31
4	1638	Moderate	2.88	45.4	51.5	60.2	52.0
5	1638	Low-Moderate	6.66	24.1	34.6	56.1	36
6	1638	Cleared	10.30	3.6	5.4	8.9	5.5
7	1737	Moderate (EEC)	0.26	87.0	48.3	N/A	64.9
8	N/A	Exotic (grassland)	0.72	N/A	N/A	N/A	N/A
9	N/A	Exotic (planted vegetation)	0.71	N/A	N/A	N/A	N/A

4 THREATENED SPECIES

4.1 ASSESSING HABITAT SUITABILITY

To inform the assessment of suitable habitat for threatened species and populations within the Study Area, a database search of the NSW DPIE BioNet Atlas (DPIE 2022a) and the Commonwealth DAWE Protected Matters Search Tool (PMST) (DAWE 2022a) were conducted. Results of the database search and 'likelihood of occurrence' assessment are provided in **Appendix A**.

4.1.1 Habitat Assessment

4.1.1.1 Threatened Flora Habitat

The diversity of flora species within the Study Area is generally lower than the diversity expected to occur in good quality intact bushland. Historical vegetation clearing and current land management practices such as slashing, mowing and grazing by livestock has reduced the coverage of native trees and shrubs throughout the site and facilitated the encroachment of exotic plant species such as perennial grasses and herbs.

Although threatened plant species often persist in such degraded environments, the Study Area was determined to represent unsuitable habitat for the majority of threatened plant species previously recorded within the locality. Prior to undertaking surveys, two threatened orchid species and one threatened tree species were determined to have a moderate likelihood of occurrence based on habitat availability and the occurrence of local records:

- *Cryptostylis hunteriana* (Leafless Tongue Orchid) – The nearest known population of this species occurs north of the Study Area within the Lake Munmorah Conservation Area.
- *Diuris praecox* (Rough Doubletail) – The nearest known population of this species occurs at the intersection of Kanangra Drive and the Pacific Highway to the north of the Study Area.
- *Angophora inopina* (Charmhaven Apple) – Numerous records of this species occur in the Lake Munmorah and Wyee areas.

Reference populations of both of the above listed orchid species were confirmed to be in flower prior to undertaking targeted surveys throughout the Study Area on 11th August and 2nd November 2021 (flowering periods for *Diuris praecox* and *Cyrtostylis hunteriana* respectively). Based on the lack of individuals detected, the Study Area was determined to be too degraded to support populations of these species. It is likely that the encroachment of exotic perennial grasses and ongoing mowing and slashing has reduced the availability of habitat for both species.

Several individuals of *Angophora inopina* (Charmhaven Apple) were detected within the Study Area (further discussed in **Section 4.2.1.2**).

4.1.1.2 Threatened Fauna Habitat

The Study Area is characterised by mix of fragmented open woodlands (managed and unmanaged) with a grassy groundcover, grasslands, small areas of shrub regrowth, and scattered mature eucalypts (various species).

Shallow drainage channels intersect the Study Area where surface flows are concentrated. Low-lying wet areas occur in the north and area of Typha Rushland occurs in the north-east corner. Five constructed dams occur in the southern portion of the Study Area.

As stated previously, the coverage of native vegetation within the Study Area has been reduced due to historical vegetation clearing and land management practises such as slashing, mowing and grazing by livestock. The coverage of native shrubs and groundcover species is particularly low throughout most areas of the site, hence, habitat for fauna species that require dense vegetation for cover (refugia) is limited. Additionally, the low lack of native plant diversity also reduces the availability of foraging resources.

Despite historical disturbance within the Study Area, an abundance of hollow-bearing trees (HBTs) occurs. Site inspections revealed that several hollows are occupied by fauna species, mostly locally occurring bird and possum species.

A summary of the key fauna habitat features identified within the Study Area is as follows:

- A total of 127 Hollow-bearing Trees (HBTs) were recorded (including four dead stags with hollows). Of these trees 33 were recorded as having large hollows (>30cm diameter), 28 trees had a maximum size hollow being “medium” (20-29cm diameter) and 70 trees only had small hollows (10-19cm).
- Fallen logs and timber (limited to unmanaged areas).
- Mature eucalypts that may provide foraging and nesting habitat for native bird species.
- Two shallow ephemeral drainage channels that contain pools of water for short periods following high rainfall.
- A small Typha Rushland (0.26 ha) in the north-east corner of the Study Area, though limited open water is present.
- Five constructed dams that contain water on a permanent/semi-permanent basis.

The location of relevant habitat features within the Study Area are presented on **Figure 5**

Several threatened species are likely to utilise the habitat present within the Study Area for foraging and breeding (mainly hollow-dependent species such as microbats, birds, and arboreal mammals). The ‘likelihood of occurrence’ assessment presented in **Appendix A** determined that the following threatened fauna species have a moderate likelihood of occurrence within the Study Area:

- *Glossopsitta pusilla* (Little Lorikeet)
- *Lathamus discolor* (Swift Parrot)
- *Ninox strenua* (Powerful Owl)
- *Pandion cristatus* (Eastern Osprey)
- *Myotis macropus* (Southern Myotis)
- *Petaurus norfolcensis* (Squirrel Glider)
- *Pteropus poliocephalus* (Grey-headed Flying-fox)

- *Crinia tinnula* (Wallum Froglet)

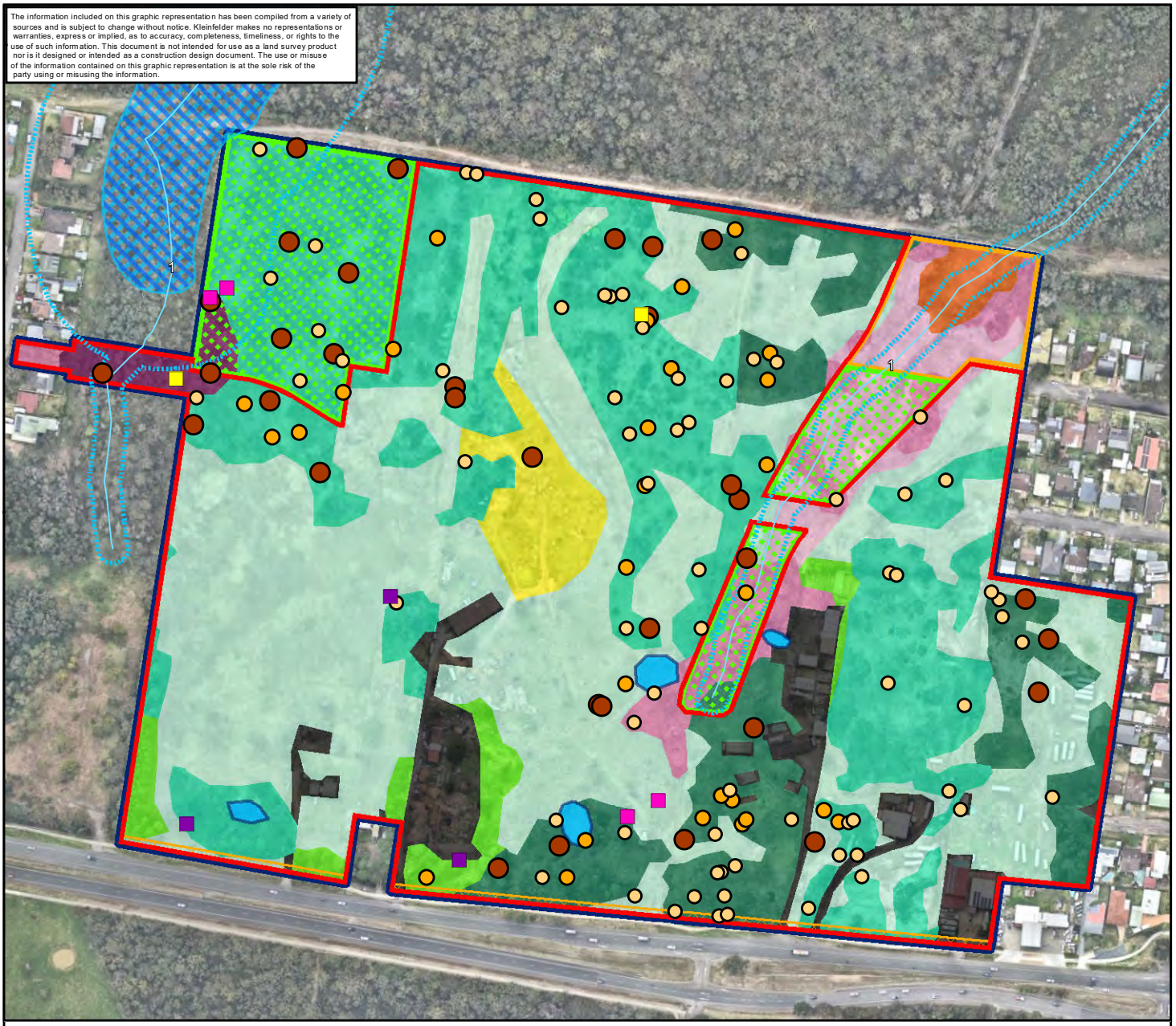
Targeted surveys were conducted for all of the above listed species. During these surveys, only *Pandion cristatus* (Eastern Osprey) and *Myotis macropus* (Southern Myotis) were detected utilising the habitats or artificial structures present (further discussed in **Section 4.2.1.2**). No Swift Parrots were recorded during site assessments completed within the species known migration period, however the Study Area is mapped as constituting important habitat for the species (DPIE 2022f). The absence of some species may be due to the general lack of native vegetation cover and floristic diversity throughout the Study Area.

4.1.1.3 Swift Parrot Habitat

The results of the Swift Parrot Habitat Assessment indicate that the highest value Swift Parrot habitat occurs within Vegetation Zones 1, 2, and 5 owing to their good condition, and canopy species mix, including the occurrence of two (2) preferred Swift Parrot feed tree species (*Eucalyptus robusta* and *Corymbia gummifera*). These vegetation zones also contained the majority of the preferred feed trees occurring within the Study Area (221 trees of 234), the remaining 13 trees occur as scattered paddock trees within Vegetation Zone 6 and the exotic vegetation zone. The highest concentration of preferred feed trees occur within the north western corner of the Study Area, with known nectar feed trees (*Eucalyptus robusta*) occurring in a high density within the creek corridor and known lerp feed trees (*Corymbia gummifera*) occurring in the open woodland area. These areas largely follow existing Important Area Mapping for the Swift Parrot (DPIE 2022). Large areas of mapped Important Habitat within the eastern half of the Study Area have a low occurrence of feed trees in comparison. Swift Parrot foraging resources within the rest of the Study Area is comparatively sparse. See detailed discussion of Swift Parrot Habitat in the site-specific Swift Parrot Habitat Assessment (Wedgetail 2022) in **Appendix I**.

4.1.1.4 Koala Habitat

The vegetation within the Study Area is consistent with suitable habitat for Koalas given the dominance of preferred Koala use trees (listed in Schedule 2 of the Koala SEPP 2021) including *Allocasuarina littoralis* (Black She-oak), *Angophora costata* (Smooth-barked Apple), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus capitellata* (Brown Stringybark), *Eucalyptus haemastoma* (Broad-leaved Scribbly Gum), *Eucalyptus racemosa* (Narrow-leaved Scribbly Gum), *Angophora floribunda* (Rough-barked Apple), *Eucalyptus robusta* (Swamp Mahogany), *Eucalyptus resinifera* (Red Mahogany), and *Melaleuca quinquenervia* (Broad-leaved Paperbark). However, there are no recent (<18 years old) Koala records within the locality (i.e. within 2.5km radius of the Study Area). As such, the likelihood of Koala occurrence within the Development Site is considered low (see **Appendix A**). Targeted Koala surveys were completed as part of the assessment. Requirements of the Koala SEPP 2021 are addressed in **Section 7.3.**



Legend

- Study Area
- Development Site (Residential Subdivision Footprint)
- Conservation Area (Temporary Impacts - Wetland Rehab)
- Development Site (5m Vegetation Buffer)
- Conservation Area (Retained)
- Wetlands - Coastal Management Act
- Riparian Buffers
- Watercourse (Labelled with stream order)

Hollow-bearing Trees/Stags

- Small Hollows (10-19cm)
- Medium Hollows (20-29cm)
- Large Hollows (>30cm)

Habitat Features

- Dead Stag (no hollows)
- Hollow Log (on ground)
- Nest
- Water Feature

Vegetation Zones and Plant Community Types

(Vegetation Zones apply with Development Site Only)

- Zone 1 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Good Condition) (EEC)
- Zone 2 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Low-Moderate Condition) (EEC)
- Zone 3 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Cleared)
- Zone 4 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Moderate Condition)
- Zone 5 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Low-Mod Condition)
- Zone 6 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Cleared)
- Zone 7 - PCT 1737: Typha rushland (Moderate Condition) (EEC)
- Exotic Vegetation (Grassland)
- Exotic Vegetation (Planted Vegetation)
- Dam
- Existing Tracks & Infrastructure

Metres
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DRAWN BY: AMcDonaugh
DATA SOURCE:
NSW DFSI - 2020
Nearmap - 2022

Fauna Habitat

Barker Ryan Stewart
Biodiversity Certification Assessment Report
285 – 335 Pacific Highway
Lake Munmorah NSW

FIGURE:
5

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4.1.2 Ecosystem Credit species

The following assessment of habitat suitability for Ecosystem Credit species was conducted in accordance with Section 6.2 of the BAM. Ecosystem credits represent threatened species that are reliably predicted by the type and condition of vegetation within the site. Targeted survey is not required for Ecosystem Credit species.

Step 1: Identify threatened species for assessment

A list of predicted Ecosystem Credit species for the Disturbance Footprint was reviewed in the BAM calculator, according to PCTs present on the subject land. Predicted Species Report is within **Appendix E.**

Step 2: Assessment of the habitat constraints and vagrant species on the subject land

The potential for identified Ecosystem Credit species to occur on the Disturbance Footprint was assessed according to species specific habitat requirements, as detailed in **Table 7**. Where habitat features were not present due to the degraded condition of the site vegetation, Ecosystem Credit species were determined to not be predicted species and no further assessment was required within these vegetation zones. Predicted species that were added due to the assessment based on detection within the Study Area include the following:

- *Miniopterus australis* (Little Bent-winged Bat)
- *Micronomus norfolkensis* (Eastern Coastal Free-tailed Bat)
- *Scoteanax rueppelli* (Greater Broad-nosed Bat)
- *Calyptorhynchus lathami* (Glossy Black-Cockatoo)

Table 7: Assessment of Ecosystem Credit species within the Disturbance Footprint.

Scientific name	Common name	Confirmed Predicted Species	Sensitivity to Gain	Justification
Anseranas semipalmata	Magpie Goose	Yes	Moderate	-
Anthochaera phrygia	Regent Honeyeater	Yes	High	-
Botaurus poiciloptilus	Australasian Bittern	Yes	Moderate	-
Calidris ferruginea	Curlew Sandpiper	Yes	High	-
Calidris tenuirostris	Great Knot	Yes	High	-
Chthonicola sagittata	Speckled Warbler	Yes	High	-
Circus assimilis	Spotted Harrier	Yes	Moderate	-
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	Yes	High	-
Daphoenositta chrysoptera	Varied Sittella	Yes	Moderate	-
Dasyurus maculatus	Spotted-tailed Quoll	Yes	High	-
Ephippiorhynchus asiaticus	Black-necked Stork	Yes	Moderate	-
Epthianura albifrons	White-fronted Chat	Yes	Moderate	-
Falco subniger	Black Falcon	Yes	Moderate	-

Scientific name	Common name	Confirmed Predicted Species	Sensitivity to Gain	Justification
Glossopsitta pusilla	Little Lorikeet	Yes	High	-
Haliaeetus leucogaster	White-bellied Sea-Eagle	Yes	High	-
Hieraaetus morphnoides	Little Eagle	Yes	Moderate	-
Hirundapus caudacutus	White-throated Needletail	Yes	High	-
Irediparra gallinacea	Comb-crested Jacana	Yes	Moderate	-
Ixobrychus flavicollis	Black Bittern	Yes	Moderate	-
Limicola falcinellus	Broad-billed Sandpiper	Yes	High	-
Limosa limosa	Black-tailed Godwit	Yes	High	-
Neophema pulchella	Turquoise Parrot	Yes	High	-
Ninox connivens	Barking Owl	Yes	High	-
Oxyura australis	Blue-billed Duck	Yes	Moderate	-
Pandion cristatus	Eastern Osprey	Yes	Moderate	-
Rostratula australis	Australian Painted Snipe	Yes	Moderate	-
Scoteanax rueppellii	Greater Broad-nosed Bat	Yes	High	-
Stictonetta naevosa	Freckled Duck	Yes	Moderate	-
Xenus cinereus	Terek Sandpiper	Yes	High	-

4.1.3 Species Credit species

Step 1: Identify threatened species for assessment

A preliminary list of Candidate Species Credit species for the Disturbance Area was reviewed in the BAM calculator. Species credits pertain to threatened species that cannot be reliably predicted by the vegetation present. Candidate Species Report is within **Appendix E.**

Step 2: Assessment of the habitat constraints and vagrant species on the subject land

The potential for identified Species Credit species to occur within the Disturbance Footprint was assessed according to species specific habitat requirements. Fourteen (14) species were added as Species Credit species (in addition to those automatically populated by the BAM-C) based on the findings of a site-specific Preliminary Ecological Assessment (PEA) (Kleinfelder 2021), proximity of records and identification of broadly suitable habitat within the Study Area. Species added include the following: *Acacia bynoeana* (Bynoe's Wattle), *Angophora inopina* (Charmhaven Apple), *Callistemon linearifolius* (Netted Bottle Brush), *Calyptorhynchus lathami* (Glossy Black Cockatoo), *Corunastylis sp. Charmhaven* (*Corunastylis* sp. Charmhaven NSW896673), *Cryptostylis*

hunteriana (Leafless Tongue Orchid), *Diuris praecox* (Rough Doubletail), *Eucalyptus camfieldii* (Camfield's Stringybark), *Genoplesium insigne* (Variable Midge Orchid), *Grevillea parviflora* subsp. *parviflora* (Small-flowered Grevillea), *Lathamus discolor* (Swift Parrot), *Petaurus norfolcensis* (Squirrel Glider), *Phascolarctos cinereus* (Koala), and *Rutidosis heterogama* (Heath Wrinklewort).

Step 3: Identify candidate Species Credit species for further assessment

A number of Species Credit species were excluded as candidate species due to their geographic or habitat constraints not being met by the Study Area, and no further assessment of these species was required. Conversely, a number of species known from the locality which were not initially identified for survey were added as candidate species owing to the availability of suitable habitat for the species within the Study Area (**Table 8**).

Table 8: Species Credit species and justification for inclusion as candidate species.

Scientific name	Common name	Confirmed Candidate Species	Sensitivity to Gain	Justification
Flora				
Acacia bynoeana	Bynoe's Wattle	Yes	High	-
Angophora inopina	Charmhaven Apple	Yes	High	-
Asperula asthenes	Trailing Woodruff	Yes	High	-
Callistemon linearifolius	Netted Bottle Brush	Yes	Moderate	-
Corunastylis sp. Charmhaven (NSW896673)	Corunastylis sp. Charmhaven (NSW896673)	Yes	High	-
Cryptostylis hunteriana	Leafless Tongue Orchid	Yes	Moderate	-
Diuris praecox	Rough Doubletail	Yes	Moderate	-
Eucalyptus camfieldii	Camfield's Stringybark	Yes	High	-
Genoplesium insigne	Variable Midge Orchid	Yes	High	-
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	Yes	High	-
Maundia triglochinoides	*Maundia triglochinoides*	Yes	High	-
Melaleuca biconvexa	Biconvex Paperbark	Yes	High	-
Persicaria elatior	Tall Knotweed	Yes	High	-
Rutidosis heterogama	Heath Wrinklewort	Yes	High	-
Zannichellia palustris	*Zannichellia palustris*	Yes	High	-
Mammals				
Myotis macropus	Southern Myotis	Yes	High	-

Scientific name	Common name	Confirmed Candidate Species	Sensitivity to Gain	Justification
Petaurus norfolcensis	Squirrel Glider	Yes	High	-
Phascolarctos cinereus	Koala	Yes	High	
Birds				
Anthochaera phrygia	Regent Honeyeater	Yes	High	
Burhinus grallarius	Bush Stone-curlew	Yes	High	-
Calyptorhynchus lathami	Glossy Black-Cockatoo	Yes	High	
Calidris ferruginea	Curlew Sandpiper	**No**	High	**Habitat Constraints** (see justification below)
Calidris tenuirostris	Great Knot	**No**	High	**Habitat Constraints** (see justification below)
Haliaeetus leucogaster	White-bellied Sea-Eagle	Yes	Moderate	-
Hieraaetus morphnoides	Little Eagle	Yes	High	-
Lathamus discolor	Swift Parrot	Yes	Moderate	
Limosa limosa	Black-tailed Godwit	No	High	**Habitat Constraints** (see justification below)
Limicola falcinellus	Broad-billed Sandpiper	**No**	High	**Habitat Constraints** (see justification below)
Nettapus coromandelianus	Cotton Pygmy-Goose	Yes	Moderate	-
Ninox connivens	Barking Owl	Yes	High	-
Ninox strenua	Powerful Owl	Yes	High	-
Pandion cristatus	Eastern Osprey	Yes	Moderate	-
Turnix maculosus	Red-backed Button-quail	Yes	High	-
Xenus cinereus	Terek Sandpiper	**No**	High	**Habitat Constraints** (see justification below)
Amphibians				
Crinia tinnula	Wallum Froglet	Yes	Moderate	-
Litoria aurea	Green and Golden Bell Frog	Yes	High	-
Litoria brevipalmata	Green-thighed Frog	Yes	Moderate	-
Uperoleia Mahony	Mahony's Toadlet	Yes	High	-

Scientific name	Common name	Confirmed Candidate Species	Sensitivity to Gain	Justification
Insect				
Petalura gigantea	Giant Dragonfly	Yes	Very High	-

Candidate Species – Further Justification

In Accordance with Section 5.2.3 of the BAM (DPIE 2020a) a *candidate species credit species is considered unlikely to occur on the subject land (or specific vegetation zones) if one of the following applies:*

(a) After carrying out a field assessment:

i. the assessor determines that microhabitats required by a species are absent from the subject land (or specific vegetation zone). The assessor must include a description of the microhabitats assessed as being required by the species in the BAR. This must be based on evidence such as published literature, or

ii. the assessor determines that the habitat constraints or microhabitats are degraded to the point that the species is unlikely to use the subject land (or specific vegetation zones).

(b) An expert report (prepared as per Box 3) states that the species is unlikely to be present on the subject land or specific vegetation zones

A candidate species credit species that does not have suitable habitat as per (2.a.) [point 'a' above] *or (2.b.)* [point 'b' above] *does not require further assessment (BAM 2020a).*

A total of five (5) candidate species credit species were identified as not requiring further assessment based on the absence of suitable habitat in accordance with the requirements of Section 5.2.3 of the BAM (DPIE 2020a). Justification for this determination is detailed below.

Migratory Shorebird Habitat

A review of available *Migratory Shorebird Important Area* Mapping (DPIE 2022f) identified no important habitat for migratory shorebirds within the Study Area. The nearest mapped area of important habitat is associated with the Tuggerah Lakes estuary. Parts of Tuggerah Lake and the estuarine waters at The Entrance provide important habitat and roosting sites for migratory shorebirds when lake levels are low (DEC 2006). Shorebird habitat site maps produced by DEC (2006) for Tuggerah Lake, identified key habitat areas along shoreline between Chittaway Point and Rock Point, and shoreline habitat at The Entrance. Due to the absence of important area mapping and suitable habitat including estuarine sandflats and mudflats, harbors, embayments, lagoons, saltmarshes and reefs within the Study Area five (5) migratory shorebird species were considered unlikely to occur within the Study Area. These species include Curlew Sandpiper (*Calidris ferruginea*), Great Knot (*Calidris tenuirostris*), Broad-billed Sandpiper (*Limicola falcinellus*), Black-tailed Godwit (*Limosa limosa*), and Terek Sandpiper (*Xenus cinereus*).

4.2 THREATENED SPECIES SURVEYS

Step 4: Determine presence or absence of candidate Species Credit species.

4.2.1 Candidate Threatened Flora

The following candidate threatened flora species (**Table 9**) were surveyed in accordance with the *Surveying threatened plants and their habitats - NSW survey guide for the Biodiversity Assessment Method* (DPIE 2020h). Targeted threatened flora surveys were conducted across the Study Area to allow for an assessment of indirect impacts and allow for development design changes.

Table 9: Survey of requirements and timing conducted for candidate flora species

Scientific name	Common name	Survey Requirements	Survey Timing	Survey Effort
Acacia bynoeana	Bynoe's Wattle	All Year	01/11/2021 and 02/11/2021	**Figure 7**
Angophora inopina	Charmhaven Apple	All Year	02/11/2021, 05/11/2021, and 16/09/2022	**Figure 8** and **Figure 10**
Asperula asthenes	Trailing Woodruff	October to December	01/11/2021 and 02/11/2021	**Figure 7**
Callistemon linearifolius	Netted Bottle Brush	October to January	02/11/2021, and 05/11/2021	**Figure 7 & Figure 8**
Corunastylis sp. Charmhaven (NSW896673)	*Corunastylis sp.* Charmhaven (NSW896673)	November to April	01/11/2021 and 02/11/2021	**Figure 7**
Cryptostylis hunteriana	Leafless Tongue Orchid	November to January	01/11/2021 and 02/11/2021	**Figure 7**
Diuris praecox	Rough Doubletail	August	30/08/2021, 31/08/2021, and 16/09/2022	**Figure 6** and **Figure 10**
Eucalyptus camfieldii	Camfield's Stringybark	All Year	02/11/2021 and 05/11/2021	**Figure 8**
Genoplesium insigne	Variable Midge Orchid	September to November	01/11/2021, 02/11/2021, and 16/09/2022	**Figure 7** and **Figure 10**
Grevillea parviflora subsp. parviflora	Small-flowered Grevillea	August to November	01/11/2021 and 02/11/2021	**Figure 7**
Maundia triglochinoides	-	November to March	01/12/2021	**Figure 9**
Melaleuca biconvexa	Biconvex Paperbark	All Year	02/11/2021, 05/11/2021, and 16/09/2022	**Figure 8** and **Figure 10**
Persicaria elatior	Tall Knotweed	December to May	01/12/2021	**Figure 9**
Rhizanthella slateri	Eastern Australian Underground Orchid	September to November	01/11/2021 and 02/11/2021	**Figure 7**

Scientific name	Common name	Survey Requirements	Survey Timing	Survey Effort
Rutidosis heterogama	Heath Wrinklewort	All Year	01/11/2021, 02/11/2021, and 16/09/2022	**Figure 7** and **Figure 10**
Thelymitra adorata	Wyong Sun Orchid	September to October	30/08/2021, 31/08/2021, and 16/09/2022	**Figure 6** and **Figure 10**
Zannichellia palustris	*Zannichellia palustris*	October to January	01/12/2021	**Figure 9**

4.2.1.1 Survey Methodology

The candidate threatened flora species were surveyed in accordance with the *Surveying threatened plants and their habitats - NSW survey guide for the Biodiversity Assessment Method* (DPIE 2020h). All surveys were conducted using systematic parallel transects. Parallel field traverses were separated by 5 to 10 m for orchids, herbs and forbs, 10 to 15 m for sub-shrubs, and 10 to 20 m for species in all other life forms (shrubs and trees).

Surveys were undertaken across the Study Area by suitably qualified ecologists. Known reference populations were inspected for two species prior to surveys being undertaken: *Diuris praecox* (Rough Doubletail) (11th August 2021, and 11th and 12th September 2022), *Thelymitra adorata* (Wyong Sun Orchid) (1st September 2021, and 11th and 12th September 2022, with surveys conducted on 30th and 31st August and additional surveys completed on the 16th September 2022 within a small portion of unsuitable habitat associated with the proposed collector road), and *Cryptostylis hunteriana* (Leafless Tongue Orchid) (2nd November) (see **Section 4.1.1.1**). Survey tracks for each round of targeted surveys are shown on **Figure 6**, **Figure 7**, **Figure 8**, **Figure 9**, and **Figure 10**).

4.2.1.2 Flora Survey Results

A total of 149 flora species were identified during field surveys, 44 of these were exotic species, of which eleven (11) are considered 'High Threat Exotics" and four (4) are listed Priority Weeds for the Greater Sydney Local Land Services Region under the *Biosecurity Act 2015* (NSW). Identified weeds are discussed within **Section 7.2**.

One (1) threatened flora species was identified within the Disturbance Footprint during field surveys, *Angophora inopina* (Charmhaven Apple). The species was recorded mainly within woodland areas (Vegetation Zones 4 and 5). See **Section 4.2.2** for discussion of identified threatened flora species within the Disturbance Footprint.

A list of the flora species identified within the Study Area is provided in **Appendix B**.

Legend

- Study Area
- Development Site (Residential Subdivision Footprint)
- Development Site (5m Vegetation Buffer)
- Conservation Area (Temporary Impacts - Wetland Rehab)
- Conservation Area (Retained)
- Targeted Threatened Flora Search (30-31 August 2021)
- Watercourse (Labelled with stream order)
- Riparian Buffers

Vegetation Zones and Plant Community Types

(Vegetation Zones apply with Development Site Only)

- Zone 1 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Good Condition) (EEC)
- Zone 2 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Low-Moderate Condition) (EEC)
- Zone 3 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Cleared)
- Zone 4 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Moderate Condition)
- Zone 5 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Low-Mod Condition)
- Zone 6 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Cleared)
- Zone 7 - PCT 1737: Typha rushland (Moderate Condition) (EEC)
- Exotic Vegetation (Grassland)
- Exotic Vegetation (Planted Vegetation)
- Dam
- Existing Tracks & Infrastructure

Metres
0 25 50 100 150 200
N

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Targeted Threatened Flora Search 30-31 August 2021

Barker Ryan Stewart
Biodiversity Certification Assessment Report
285 – 335 Pacific Highway
Lake Munmorah NSW

FIGURE: 6

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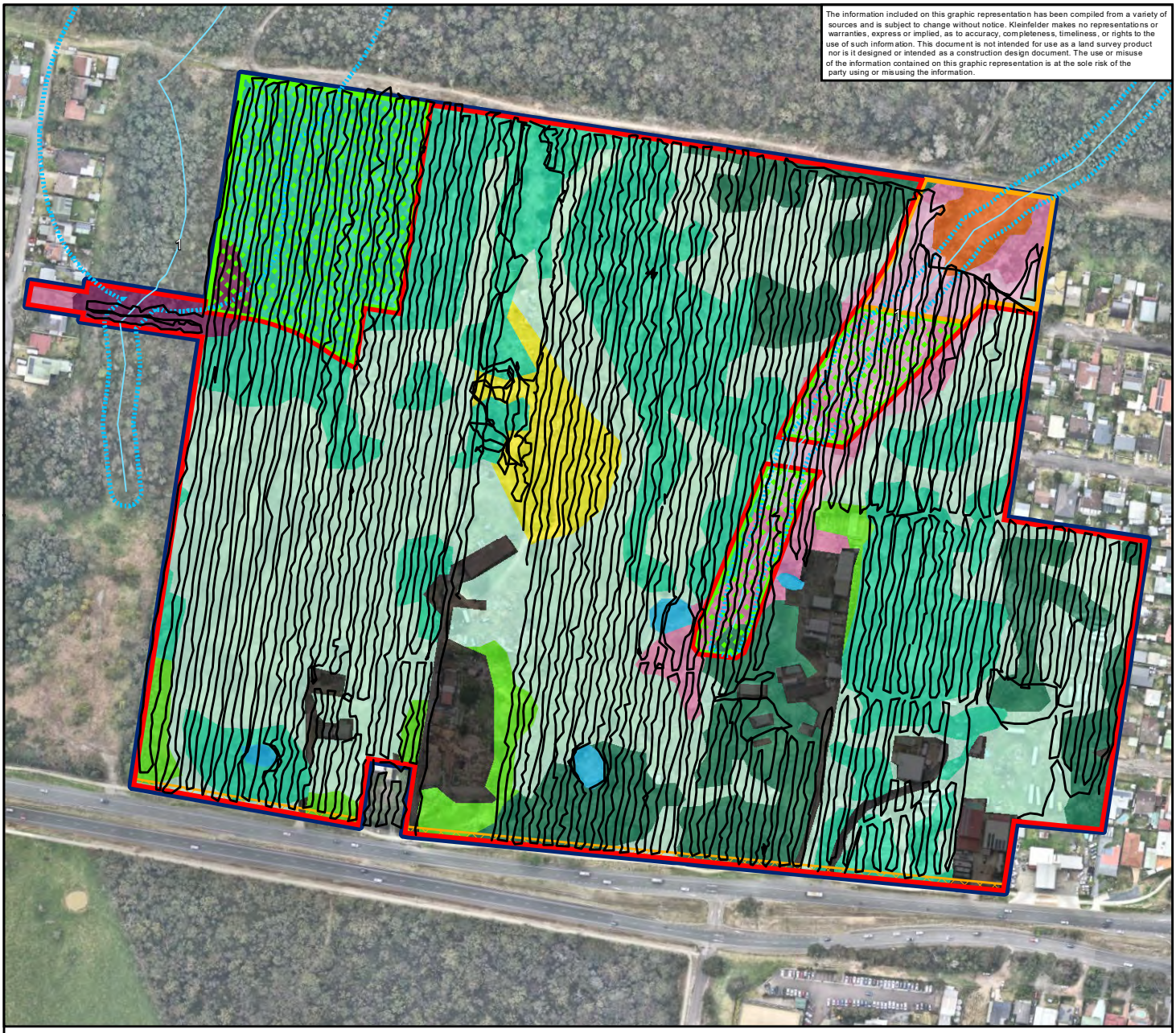

Legend

- Study Area
- Development Site (Residential Subdivision Footprint)
- Conservation Area (Temporary Impacts - Wetland Rehab)
- Development Site (5m Vegetation Buffer)
- Conservation Area (Retained)
- Targeted Threatened Flora Search (1-2 November 2021)
- Watercourse (Labelled with stream order)
- Riparian Buffers

Vegetation Zones and Plant Community Types

(Vegetation Zones apply with Development Site Only)

- Zone 1 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Good Condition) (EEC)
- Zone 2 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Low-Moderate Condition) (EEC)
- Zone 3 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Cleared)
- Zone 4 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Moderate Condition)
- Zone 5 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Low-Mod Condition)
- Zone 6 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Cleared)
- Zone 7 - PCT 1737: Typha rushland (Moderate Condition) (EEC)
- Exotic Vegetation (Grassland)
- Exotic Vegetation (Planted Vegetation)
- Dam
- Existing Tracks & Infrastructure

Metres
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Targeted Threatened Flora Search 1-2 November 2021

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FIGURE: 7

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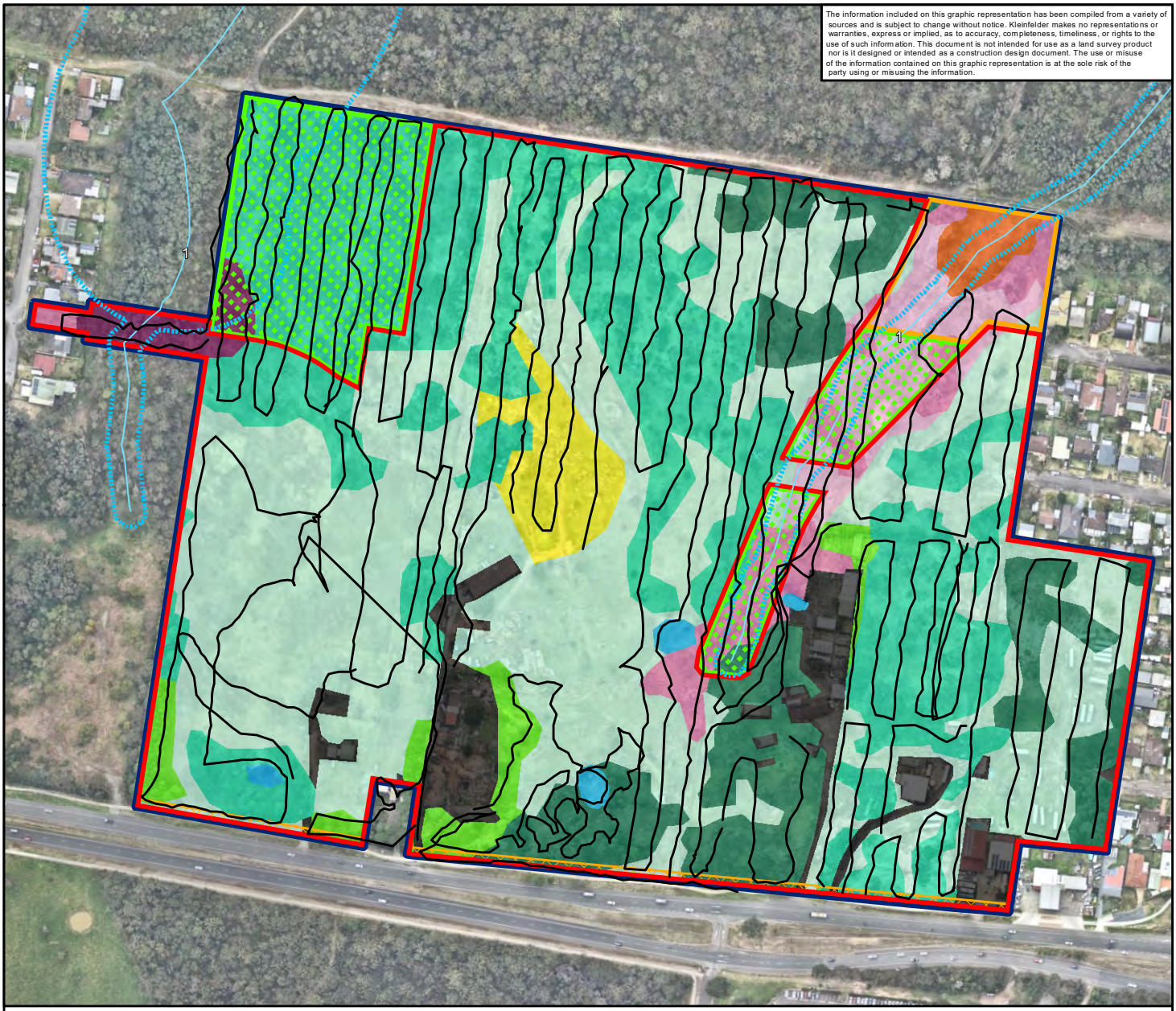

Legend

- Study Area
- Development Site (Residential Subdivision Footprint)
- Conservation Area (Temporary Impacts - Wetland Rehab)
- Development Site (5m Vegetation Buffer)
- Conservation Area (Retained)
- Targeted Threatened Flora Search (2 & 5 November 2021)
- Watercourse (Labelled with stream order)
- Riparian Buffers

Vegetation Zones and Plant Community Types

(Vegetation Zones apply with Development Site Only)

- Zone 1 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Good Condition) (EEC)
- Zone 2 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Low-Moderate Condition) (EEC)
- Zone 3 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Cleared)
- Zone 4 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Moderate Condition)
- Zone 5 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Low-Mod Condition)
- Zone 6 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Cleared)
- Zone 7 - PCT 1737: Typha rushland (Moderate Condition) (EEC)
- Exotic Vegetation (Grassland)
- Exotic Vegetation (Planted Vegetation)
- Dam
- Existing Tracks & Infrastructure

Metres
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Targeted Threatened Flora Search 2 & 5 November 2021

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FIGURE:
8

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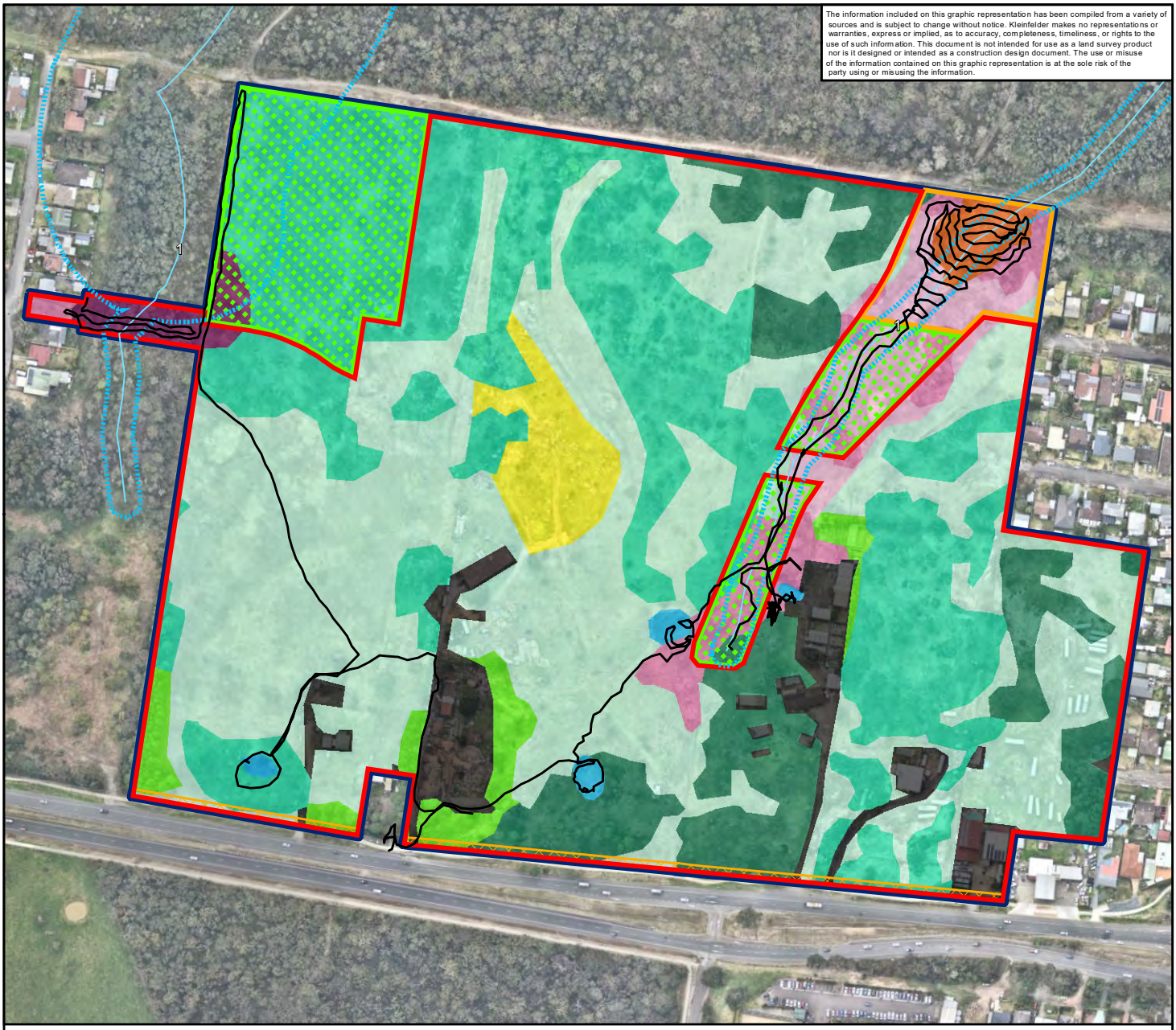

Legend

- Study Area
- Development Site (Residential Subdivision Footprint)
- Conservation Area (Temporary Impacts - Wetland Rehab)
- Development Site (5m Vegetation Buffer)
- Conservation Area (Retained)
- Targeted Threatened Flora Search (1 December 2021)
- Watercourse (Labelled with stream order)
- Riparian Buffers

Vegetation Zones and Plant Community Types

(Vegetation Zones apply with Development Site Only)

- Zone 1 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Good Condition) (EEC)
- Zone 2 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Low-Moderate Condition) (EEC)
- Zone 3 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Cleared)
- Zone 4 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Moderate Condition)
- Zone 5 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Low-Mod Condition)
- Zone 6 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Cleared)
- Zone 7 - PCT 1737: Typha rushland (Moderate Condition) (EEC)
- Exotic Vegetation (Grassland)
- Exotic Vegetation (Planted Vegetation)
- Dam
- Existing Tracks & Infrastructure

Metres
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FIGURE:
9

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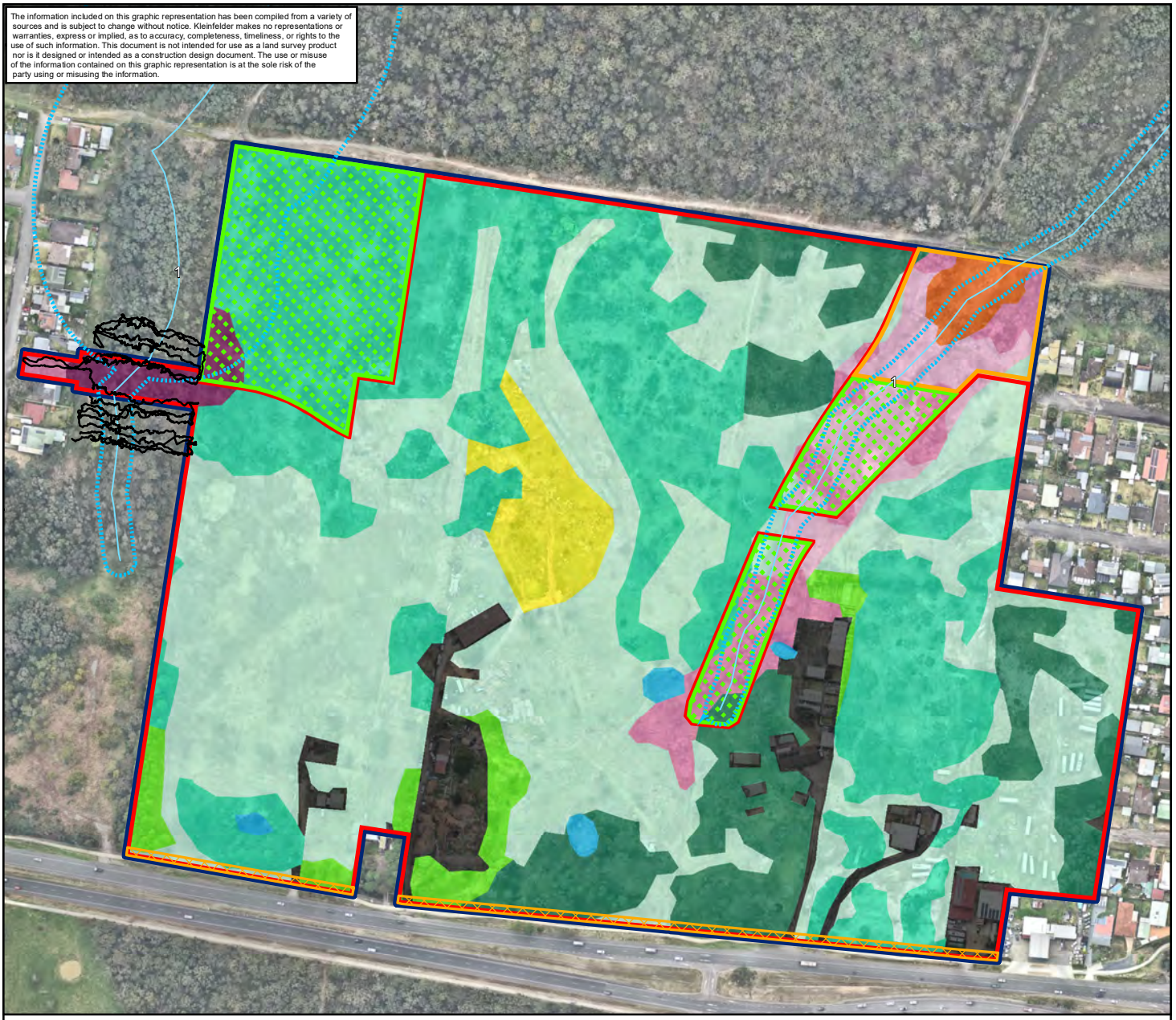

Legend

- Study Area
- Development Site (Residential Subdivision Footprint)
- Conservation Area (Temporary Impacts - Wetland Rehab)
- Conservation Area (Retained)
- Development Site (5m Vegetation Buffer)
- Targeted Threatened Flora Search (16 September 2022)
- Riparian Buffers
- Watercourse (Labelled with stream order)

Vegetation Zones and Plant Community Types

(Vegetation Zones apply with Development Site Only)

- Zone 1 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Good Condition) (EEC)
- Zone 2 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Low-Moderate Condition) (EEC)
- Zone 3 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Cleared)
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- Zone 6 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Cleared)
- Zone 7 - PCT 1737: Typha rushland (Moderate Condition) (EEC)
- Exotic Vegetation (Grassland)
- Exotic Vegetation (Planted Vegetation)
- Dam
- Existing Tracks & Infrastructure

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Targeted Threatened Flora Search 16 September 2022

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FIGURE: 10

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4.2.2 Candidate Threatened Fauna

The following candidate threatened fauna species were surveyed in the appropriate season as per the BAM (**Table 10**). Surveys were undertaken across the Study Area by suitably qualified ecologists. Survey methodologies for each round of targeted surveys are shown on **Figure 11**.

Table 10: Survey of requirements and timing conducted for candidate fauna species

Scientific name	Common name	Survey Requirements	Survey Timing
Mammals			
Myotis macropus	Southern Myotis	October to March	Anabat and Harp Trapping 01/11/2021-05/11/21
Petaurus norfolcensis	Squirrel Glider	All Year	Remote Cameras 25/10/2021 to 05/11/2021 Arboreal Trapping 01/11/2021-05/11/21 Nocturnal Surveys 12, 16, 17, 18, 19, 20, 23, 25, 26 and 30/08/21
Phascolarctos cinereus	Koala	All Year	Remote Cameras 25/10/2021 to 05/11/2021 Nocturnal Surveys 12, 16, 17, 18, 19, 20, 23, 25, 26 and 30/08/21
Birds			
Anthochaera phrygia	Regent Honeyeater	All Year	Dawn Bird Surveys 19/11/21
Burhinus grallarius	Bush Stone-curlew	All Year	Nocturnal Surveys 12, 16, 17, 18, 19, 20, 23, 25, 26 and 30/08/21
Calyptorhynchus lathami	Glossy Black-Cockatoo	January to September	Dawn Bird Surveys 19/11/21 Stag-watching Surveys 12, 16, 17, 18, 19, 20, 23, 25, 26 and 30/08/21
Haliaeetus leucogaster	White-bellied Sea-Eagle	July to September	Stick nest searches 5,10 and 11/08/21
Hieraaetus morphnoides	Little Eagle	August to October	Stick nest searches 5,10 and 11/08/21
Lathamus discolor	Swift Parrot	All Year	Dawn Bird Surveys 19/11/21
Nettapus coromandelianus	Cotton Pygmy-Goose	May to December	Nest searches 5,10 and 11/08/21
Ninox connivens	Barking Owl	May to August	Stag-watching Surveys 12, 16, 17, 18, 19, 20, 23, 25, 26 and 30/08/21
Ninox strenua	Powerful Owl	April to November	Stag-watching Surveys 12, 16, 17, 18, 19, 20, 23, 25, 26 and 30/08/21
Pandion cristatus	Eastern Osprey	All year	Stick nest searches 5,10 and 1108/21
Turnix maculosus	Red-backed Button-quail	All year	Nocturnal Surveys 12, 16, 17, 18, 19, 20, 23, 25, 26 and 30/08/21

Scientific name	Common name	Survey Requirements	Survey Timing
Amphibians			
Crinia tinnula	Wallum Froglet	All Year (4 nights)	Targeted Frog Surveys 8/11/2021, 12/11/2021, 22/11/2021, 01/12/2021
Litoria aurea	Green and Golden Bell Frog	November to March (4 nights)	Targeted Frog Surveys 8/11/2021, 12/11/2021, 22/11/2021, 01/12/2021
Litoria brevipalmata	Green-thighed Frog	October to March (2 nights after suitable rainfall [>50mm])	Targeted Frog Surveys 8/11/2021, 12/11/2021, 22/11/2021, 01/12/2021
Uperoleia Mahony	Mahony's Toadlet	October to March (4 nights)	Targeted Frog Surveys 8/11/2021, 12/11/2021, 22/11/2021, 01/12/2021
Insects			
Petalura gigantea	Giant Dragonfly	December to January	Targeted Survey 01/12/2021

Legend

- Study Area
- Development Site (Residential Subdivision Footprint)
- Conservation Area (Retained)
- Conservation Area (Temporary Impacts - Wetland Rehab)
- Spotlight Survey
- Habitat Assessment
- Frog Survey
- Giant Dragonfly Survey
- Anabat
- Call Playback
- Harp Trap
- Listening Point
- Remote Camera
- Stag Watch Location (multiple trees watched)
- Trap

Metres
0 25 50 100 150 200
N

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PROJECT REFERENCE: 20221770
DATE DRAWN: 10/4/2022 10:36 Version 5
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DATA SOURCE:
NSW DFSI - 2020
NSW DPIE - 2021
Nearmap - 2022

Fauna Survey Effort

Barker Ryan Stewart
Biodiversity Certification Assessment Report
285 – 335 Pacific Highway
Lake Munmorah NSW

FIGURE:
11

J:\00 CLIENT FILES\132725_BarkerRyanStewart\20221770_PEA_285PacificHwy_LakeMunmorah\Mapping\20221770_BCAR_Fig10_SurveyEffort.mxd

4.2.2.1 Survey Methodology

The following sub-sections outline the methods for all fauna surveys conducted across the Study Area. Surveys were completed as per *Threatened Species Survey and Assessment: Guidelines for developments and activities (working draft)* (Department of Environment and Conservation [DEC], 2004), published BAM survey guidelines (OEH 2018, DPIE 2020g) and the Threatened Biodiversity Database Collection (TBDC). Fauna Survey Effort is summarised in **Figure 11.**

Habitat Assessment

The locations of any important habitat features, such as microbat roosting habitat, hollow-bearing trees, terrestrial refugia and nests/burrows were captured with a handheld Trimble device and photographed where appropriate.

Searches for potential habitat for threatened fauna species included but were not limited to:

- Stick Nests
- Foraging trees for threatened birds.
- Hollow-bearing trees.
- Potential roosts for microbats.
- Vegetated ponds, riparian vegetation and drainage lines for frogs and waterbirds.
- Woody debris, leaf litter and bush rock.

Diurnal opportunistic and incidental observations of fauna species were recorded during field surveys. These included opportunistic observation of fauna activity such as scats, tracks, burrows or other traces.

Arboreal Mammals

Targeted surveys for one candidate threatened arboreal mammal species, Squirrel Glider (*Petaurus norfolcensis*), were undertaken through installation of 32 Reconyx HyperfireTM remote trigger cameras placed arboreally at heights of 3 m (**Figure 11**). Cameras installed onsite were active from the 25/10/2021 to 05/11/2021. Cameras were baited with a mixture of honey, oats, peanut butter and treacle in a mesh canister. The surrounding area (tree trunk) was sprayed with honey water mixture. Images were analysed in-house to identify species captured on camera.

Two trapping transects, consistent with the DEC (2004) *Threatened Biodiversity Survey and Assessment Guidelines*, were established targeting the Squirrel Glider (*Petaurus norfolcensis*). Each trapping transect contained ten (10) arboreal Elliott B traps which were placed at heights of 3 m on trees across the Study Area between 01/10/21 to 05/11/21. Traps were baited with a mixture of honey, oats, peanut butter and treacle and the surrounding area (tree trunk) was sprayed with a mixture of honey and water. Each Elliott trap was inspected at sunrise each morning.

Spotlighting surveys were conducted on 12, 16, 17, 18, 19, 20, 23, 25, 26 and 30 August 2021 via random meanders across the Study Area using high-powered headtorches to search for all types of nocturnal fauna.

Koala

Spotlighting and call playback surveys were conducted for Koalas within the Study Area on the 12, 16, 17, 18, 19, 20, 23, 25, 26 and 30 August 2021 in conjunction with other targeted fauna surveys (**Figure 11**). Call playback surveys were completed during spotlighting through the broadcast of recorded calls through a megaphone to attract individuals or to incite a response. After an initial listening period of 15 minutes calls were broadcast for 5 minutes. Directly after the final broadcast, a quiet listening period of 5 minutes was conducted followed by 1-2 minutes of stationary spotlighting.

Microchiropteran Bats

Anabat™ bat-call detectors were used passively to record the calls of passing Microchiropteran bats. Four (4) Anabats™ were set up within suitable microchiropteran bat habitat and along potential flyways and left to record for four consecutive nights between 01-05 November 2021 (**Figure 11**). Nocturnal searches of blossoming trees were also undertaken during spotlighting to detect Megachiropteran bats.

Four (4) Harp traps were set up across the Study Area targeting the flyways of microchiropteran bats and in proximity to water bodies (**Figure 11**). Harp traps were left for four consecutive nights between 01-05 November 2021 and checked each morning at sunrise. Total of 16 trap nights as per the *'Species credit' threatened bats and their habitats – NSW survey guide for the Biodiversity Assessment Method* (OEH 2018).

Birds

Habitat Assessments (nest and hollow surveys) were conducted throughout the Study Area the survey period. Surveys targeted suitable, mature hollow-bearing trees and stick-nests suitable for species including: Powerful Owl, Barking Owl, Masked Owl, Little Eagle, Square-tailed Kite, White-bellied Sea-Eagle, Red-backed Quail and Eastern Osprey. Surveys focused on areas containing large mature trees (**Figure 11**). Bird observations and nests were also noted during threatened flora searches.

One visual and auditory bird survey was conducted throughout the Study Area on the 19 November 2021. The survey was conducted at dawn (between 5.30 am – 8 am). Species were identified visually with the aid of binoculars or aurally from call identification.

Stag-watching of the majority of hollow-bearing trees was conducted on the 12, 16, 17, 18, 19, 20, 23, 25, 26 and 30 August 2021 (**Figure 11**). Large hollows and those deemed to be most likely to contain fauna species based were prioritised for stag-watching (**Figure 11**). Each stag-watching event included the completion of dusk surveys for species including the Glossy Black Cockatoo, and followed by spotlighting and call playback surveys for Bush Stone-curlew and threatened forest owls within the Study Area. In accordance with the TBDC nocturnal surveys and flushing out individuals is the recommended survey method for the Red-backed Button-quail. As such, nocturnal surveys were completed on 12, 16, 17, 18, 19, 20, 23, 25, 26 and 30 August 2021. No quails were flushed out during these nocturnal surveys requiring further identification. Call playback wasn't completed for the quail as the TBDC suggests the method is ineffective.

A targeted site-specific Swift Parrot Habitat Assessment was completed in June 2022 by Wedgetail project Consulting (2022). The methods used as part of this assessment were designed in consultation with the BCD and Central Coast Council. The methods, results, and discussion on Swift Parrot habitat condition and extent within the Study Area is provided in **Appendix I**.

Amphibians and Reptiles

Targeted amphibian surveys were carried out within suitable habitats within the Study Area over four (4) nights (8/11/2021, 12/11/2021, 22/11/2021, 01/12/2021) following heavy rainfall (see **Table 11**) and as per the methods described in the *NSW Survey Guide for Threatened Frogs* (DPIE 2020g).

Targeted amphibian surveys involved nocturnal aural-visual surveys along a transect through available breeding habitat. Surveys involved active visual searches inspecting emergent vegetation with a spotlight or head torch, with listening points positioned within suitable habitat, along the transect at approximately 50 m intervals (**Figure 11**). Adult frogs encountered were identified by visual confirmation or by their distinct advertisement calls. Any tadpoles were identified using diagnostic features including mouthparts (tooth rows, jaw sheaths and papillae), pigmentation, body size, tail structure (musculature, fin depth, fin shape, tip shape), eye direction and spacing, pupil pigmentation, nare shape and spacing, spiracle height and direction, vent length and direction, and tadpole behaviour according to Anstis (2002).

Weather Data

Temperature and rainfall data for the survey period is summarised per month in **Table 11**. Daily weather data is provided in **Table 12**. Temperature rainfall data is from the Norah Head weather station (BOM: 061366).

Table 11: Weather data during the survey period

Date	Temperature (°C)		Rainfall	
	Highest Daily	Lowest Daily	Highest Daily (mm)	Monthly Total
August 21	26.8	12.5	33.4	61.6
November 21	26.9	17.9	35.6	207.8
December 21	27.2	27.2	0.2	-

Table 12: Daily weather data during the survey period

Date	Temperature (°C)		Rain (mm) to 9am	Surveys Completed
	Minimum	Maximum		
August				
1/08/2021	12.9	26.8	0	
2/08/2021	10.4	19.5	0	
3/08/2021	13.7	21.5	1.4	
4/08/2021	9.5	16.5	0	
5/08/2021	9.4	18.7	0	Vegetation and Habitat Assessments
6/08/2021	8.6	19.8	0	
7/08/2021	8.6	17.3	0	
8/08/2021	10.2	16.3	1.4	
9/08/2021	12	19.8	3.6	

Date	Temperature (°C)		Rain (mm) to 9am	Surveys Completed
	Minimum	Maximum		
10/08/2021	10.4	22.9	0	Vegetation and Habitat Assessments
11/08/2021	12.5	-	0	Vegetation and Habitat Assessments
12/08/2021	-	-	-	Stagwatching and Nocturnal Surveys
13/08/2021	-	-	-	
14/08/2021	10.1	20.8	-	
15/08/2021	11.5	20.3	0	
16/08/2021	9.8	22.4	0	Stagwatching and Nocturnal Surveys
17/08/2021	8.8	17.6	0	Stagwatching and Nocturnal Surveys
18/08/2021	9.4	18.4	0	Stagwatching and Nocturnal Surveys
19/08/2021	9.9	19.6	0	Stagwatching and Nocturnal Surveys
20/08/2021	11.1	23.1	0	
21/08/2021	13.2	20.1	0.8	
22/08/2021	12	23.6	0	
23/08/2021	16.3	24.4	0	Stagwatching and Nocturnal Surveys
24/08/2021	10.4	12.5	40.4	
25/08/2021	8.9	16.3	18.4	Stagwatching and Nocturnal Surveys
26/08/2021	8.6	16.5	0	
27/08/2021	11.1	19.3	0	
28/08/2021	8.9	18.3	0	
29/08/2021	8.8	21.3	0	
30/08/2021	10.7	19.9	0	Threatened Orchid Surveys (*Diuris praecox*)
31/08/2021	10.5	24	0	Threatened Orchid Surveys (*Diuris praecox*)
October 2021				
1/10/2021	15.4	24.8	0.2	
2/10/2021	13.3	23	4.2	
3/10/2021	14.4	22.7	1	
4/10/2021	16.7	28	0	
5/10/2021	13	22.3	0	

Date	Temperature (°C)		Rain (mm) to 9am	Surveys Completed
	Minimum	Maximum		
6/10/2021	10.9	23.4	0	
7/10/2021	12.6	28.6	0	
8/10/2021	16	23.9	0	
9/10/2021	13.8	25.5	0	
10/10/2021	17.5	31.1	0	
11/10/2021	11.5	16.1	18.2	
12/10/2021	11.5	18.3	7.2	
13/10/2021	14.1	20.9	18.6	
14/10/2021	15.4	24	0.4	
15/10/2021	15.5	22.8	4.8	
16/10/2021	11.7	22.7	0.8	
17/10/2021	12.2	23.1	0.2	
18/10/2021	12.5	24.6	0	
19/10/2021	15.3	25.2	0	
20/10/2021	12.1	21.4	0.8	
21/10/2021	13.7	24.1	0	
22/10/2021	16.4	24.4	4.4	
23/10/2021	16.6	25.9	0.2	
24/10/2021	17.6	20.3	1	
25/10/2021	14.4	23.2	0	Remote Camera Setup
26/10/2021	13.6	22.4	0	
27/10/2021	17.3	23.9	0	
28/10/2021	16.5	26.9	0	
29/10/2021	17.8	32.9	0	
30/10/2021	16.9	20.8	0	
31/10/2021	13.7	21.6	2.4	
November 2021				
1/11/2021	14.2	24.8	0.2	Fauna Trapping Setup (Harp Traps, Anabats, Arboreal Elliot B's). *Cryptostylis hunteriana* surveys
2/11/2021	17.6	23.8	0	*Cryptostylis hunteriana* and *Angophora inopina* surveys
3/11/2021	18.4	26.4	0	
4/11/2021	17.9	22.3	0	

Date	Temperature (°C)		Rain (mm) to 9am	Surveys Completed
	Minimum	Maximum		
5/11/2021	17.2	25.2	2.6	Remote Camera Packup
6/11/2021	15.9	26.1	0.2	
7/11/2021	16.9	24.3	0	
8/11/2021	17.7	25.1	27.4	Targeted Frog Surveys
9/11/2021	17.9	24.9	0	
10/11/2021	17.9	21.1	0	
11/11/2021	18.5	19.4	28.8	Targeted Frog Surveys
12/11/2021	14.7	23.1	35.6	
13/11/2021	13.8	21	0.2	
14/11/2021	13.2	23.3	0	
15/11/2021	13	24.1	0	
16/11/2021	12.3	22.2	0	
17/11/2021	14.9	23.6	0	
18/11/2021	16.9	25.8	0	
19/11/2021	18.7	26.2	0	Dawn Bird Survey
20/11/2021	18.1	20.9	0	
21/11/2021	16.1	19.3	10	
22/11/2021	16.3	23.2	18.8	Targeted Frog Surveys
23/11/2021	16.8	21.8	10.8	
24/11/2021	18.2	26.9	1.6	
25/11/2021	19.6	24.9	7.2	
26/11/2021	17.7	19.1	25.6	
27/11/2021	16	17.9	30.6	
28/11/2021	16	19.6	6.6	
29/11/2021	15.1	23.3	0.4	
30/11/2021	17.8	22	1.2	
December 2021				
1/12/2021	19.1	27.2	0.2	Wetland Flora Surveys, Targeted Frog Surveys and Giant Dragonfly Surveys
2/12/2021	19.1	26.4	0	
3/12/2021	18.6	28.3	0.2	
4/12/2021	18.8	20.9	0.2	

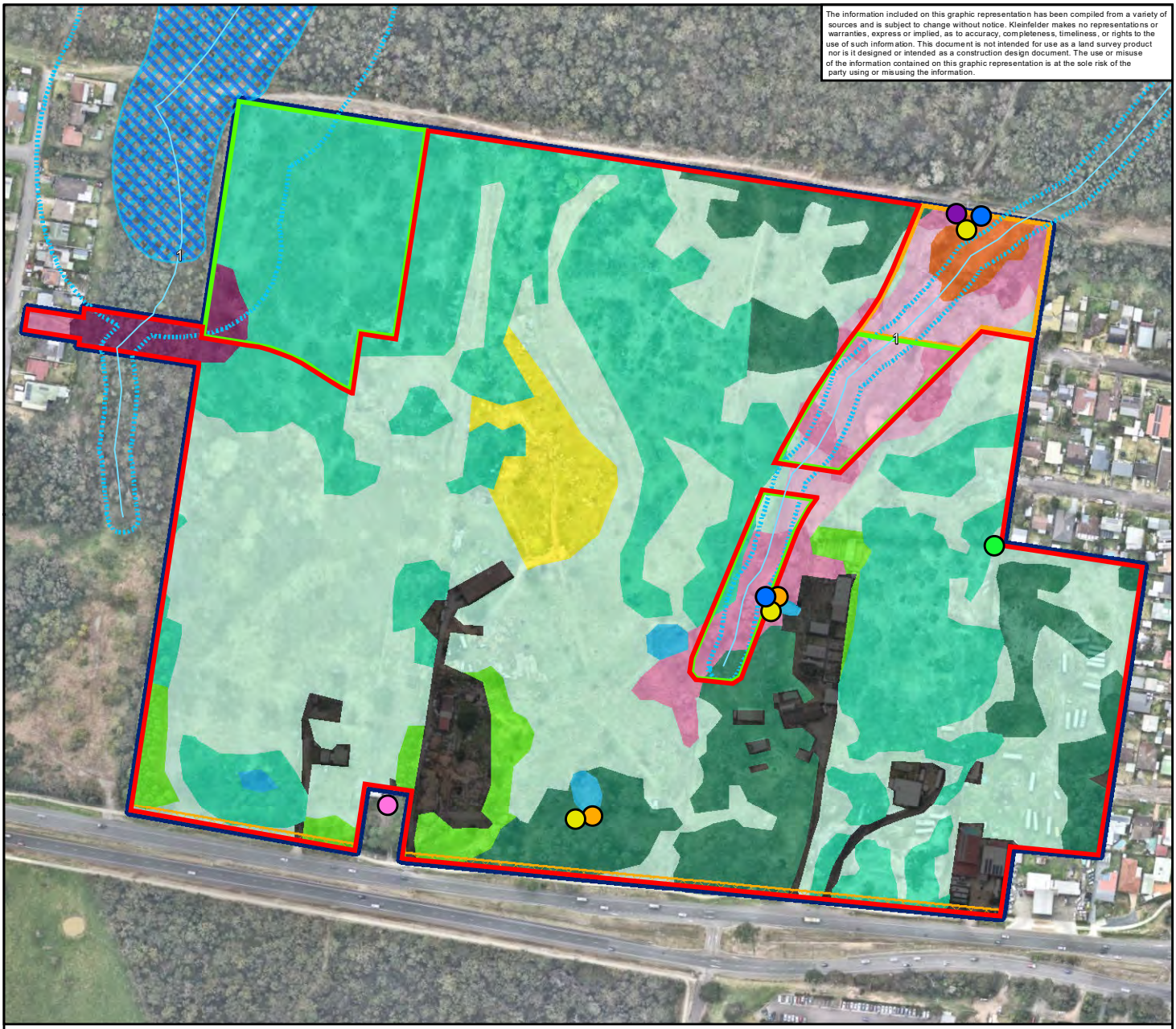
Date	Temperature (°C)		Rain (mm) to 9am	Surveys Completed
	Minimum	Maximum		
5/12/2021	17.9	20.6	0.4	
6/12/2021	17	26.2	0	

4.2.2.2 Fauna Survey Results

A total of 66 species of fauna (six amphibians, 43 birds, 17 mammals) were detected within the Study Area during field surveys (**Appendix C**). A total of six (6) species detected within the Study Area are listed as vulnerable under the BC Act, including the following:

- *Miniopterus australis* (Little Bent-winged Bat) – This species was recorded via Anabat™ within the Disturbance Footprint. This species is a dual credit species: an ecosystem credit species for foraging habitat and a Species Credit species for breeding habitat. No foraging habitat constraints are listed for this species in the Threatened Biodiversity Data Collection. The breeding habitat constraint listed for this species in the Threatened Biodiversity Data Collection (caves) is not present within or in proximity to the Study Area. The occurrence of this species within the site was therefore assessed as an Ecosystem Credit species. Impacts to habitat for this species is offset through calculation of Ecosystem Credits for native vegetation removal.
- *Micronomus norfolkensis* (Eastern Coastal Free-tailed Bat) - An Ecosystem Credit species that was recorded via Anabat™. This species was included in the assessment as a Predicted Species.
- *Myotis Macropus* (Southern Myotis) - This species was recorded via Anabat™ within the Disturbance Footprint. A Species Credit species for foraging habitat (waterbodies >3m and 200m of the waterbody).
- *Scoteanax rueppelli* (Greater Broad-nosed Bat) - This species was recorded via Anabat™ within the Development Site. This species is listed an Ecosystem Credit species only.
- *Calyptorhynchus lathami* (Glossy Black-Cockatoo) - This species is a dual credit species: an Ecosystem Credit species for foraging habitat and a Species Credit species for breeding habitat. No evidence of breeding was detected within the Study Area following targeted survey. The species is assessed as an Ecosystem Credit species.
- *Pandion cristatus* (Eastern Osprey) – This species was detected nesting at the top of a telecommunication tower (approx. height of 40m) near the southern boundary. The habitat to be impacted by the proposed development does not include the removal of tall trees suitable as breeding habitat for this species. The species is assessed as an Ecosystem Credit species.

The locations of where each of the above listed species were detected within the Study Area is illustrated on **Figure 12**.



Legend

- Study Area
- Development Site (Residential Subdivision Footprint)
- Conservation Area (Temporary Impacts - Wetland Rehab)
- Development Site (5m Vegetation Buffer)
- Conservation Area (Retained)
- Watercourse (Labelled with stream order)
- Wetlands - Coastal Management Act
- Riparian Buffers

Fauna Detections and Observations

- Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*)
- Eastern Osprey (*Pandion cristatus*)
- Glossy Black Cockatoo (*Calyptorhynchus lathami*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Little Bent-winged Bat (*Miniopterus australis*)
- Southern Myotis (*Myotis macropus*)

Vegetation Zones and Plant Community Types

(Vegetation Zones apply with Development Site Only)

- Zone 1 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Good Condition) (EEC)
- Zone 2 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Low-Moderate Condition) (EEC)
- Zone 3 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Cleared)
- Zone 4 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Moderate Condition)
- Zone 5 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Low-Mod Condition)
- Zone 6 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Cleared)
- Zone 7 - PCT 1737: Typha rushland (Moderate Condition) (EEC)
- Exotic Vegetation (Grassland)
- Exotic Vegetation (Planted Vegetation)
- Dam
- Existing Tracks & Infrastructure

Metres
0 25 50 100 150 200
N

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DATA SOURCE:
NSW DFSI - 2020
NSW DPIE - 2021
Nearmap - 2022

Threatened Fauna Detections and Observations

Barker Ryan Stewart
Preliminary Ecological Assessment
285 – 335 Pacific Highway
Lake Munmorah NSW

FIGURE:
12

J:\00 CLIENT FILES\132725_BarkerRyanStewart\20221770_PEA_285PacificHwy_LakeMunmorah\Mapping\20221770_BCAR_Fig11_ThreatenedFaunaObservations.mxd

4.3 IDENTIFIED THREATENED SPECIES

Step 5: Determine the area or count, and location of suitable habitat for Species Credit species and Step 6: Determine the habitat condition within the species polygon for species assessed by area

Two Species Credit species were detected within the Disturbance Footprint: *Angophora inopina* (Charmhaven Apple), and *Myotis Macropus* (Southern Myotis). The Study Area contains areas of native vegetation that are mapped as Important Habitat for the Swift Parrot (*Lathamus discolor*). In accordance with the BAM, presence was assumed for this species.

The location and condition of suitable habitat for the identified species credit species is discussed below:

Angophora inopina (Charmhaven Apple)

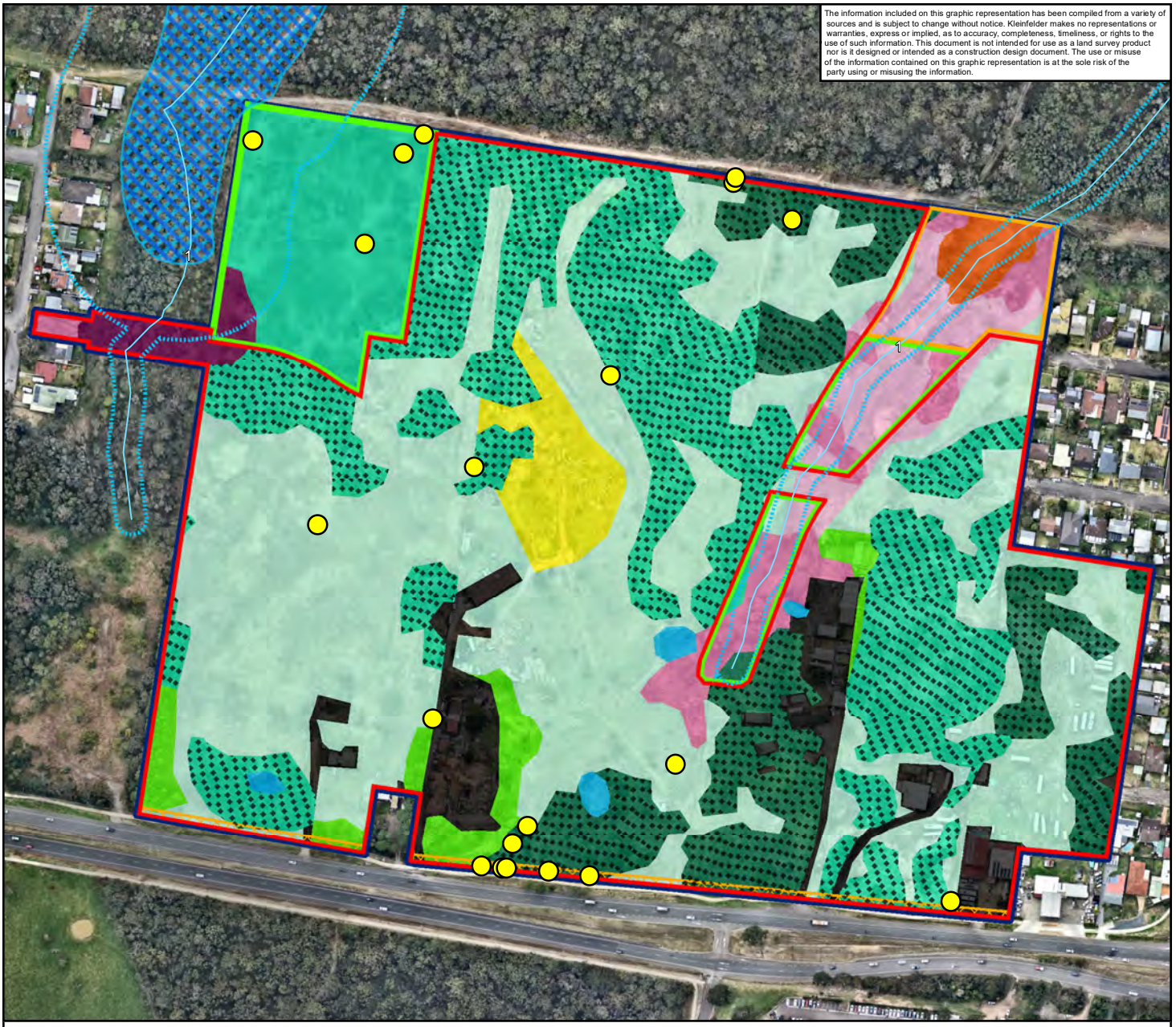
A total of 38 individuals of *Angophora inopina* (Charmhaven Apple) were recorded within Vegetation Zones 4, 5 and 6. No individuals of the species were recorded within Vegetation Zones 1, 2, 3 or 7. As per the BAM guidelines all suitable habitat for the species (PCT 1638) within the Disturbance Footprint was incorporated into a species polygon, with a combined total area of 19.84 ha (**Figure 13**). A total of eight (8) individuals were recorded within the impact area. Four (4) trees occur within the Conservation Areas, another nine (9) plants occur within the proposed vegetation buffer along the Pacific Highway and will be retained.

Lathamus discolor (Swift Parrot)

The Study Area contains areas of native vegetation that are mapped as Important Habitat for the Swift Parrot (*Lathamus discolor*). In accordance with the BAM, presence was assumed for this species. Vegetation Zones 1-6 are included in the species polygon for the species, which was 5.79 ha, as illustrated in **Figure 14**. Vegetation Zone 7 was excluded given that this vegetation is comprised of a Typha Rushland, which is not considered to represent suitable habitat (generally lacks feed tree species for the Swift Parrot).

Myotis macropus (Southern Myotis)

The species was detected within the Study Area during Anabat surveys surrounding an existing dam the eastern portion of the site and the Typha Rushland in the north-east corner. As per the BAM guidelines, vegetation associated with the species within a 200 m buffer around areas of suitable foraging habitat for the Southern Myotis habitat (areas of open water >3 m in diameter) formed the species polygon, which was 16.89 ha, as shown in **Figure 15.**



Legend

- Study Area
- Development Site (Residential Subdivision Footprint)
- Conservation Area (Temporary Impacts - Wetland Rehab)
- Development Site (5m Vegetation Buffer)
- Conservation Area (Retained)
- Watercourse (Labelled with stream order)
- Wetlands - Coastal Management Act
- Riparian Buffers

Angophora inopina

- *Locations*
- Species Polygons

Vegetation Zones and Plant Community Types

(Vegetation Zones apply with Development Site Only)

- Zone 1 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Good Condition) (EEC)
- Zone 2 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Low-Moderate Condition) (EEC)
- Zone 3 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Cleared)
- Zone 4 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Moderate Condition)
- Zone 5 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Low-Mod Condition)
- Zone 6 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Cleared)
- Zone 7 - PCT 1737: Typha rushland (Moderate Condition) (EEC)
- Exotic Vegetation (Grassland)
- Exotic Vegetation (Planted Vegetation)
- Dam
- Existing Tracks & Infrastructure

Metres
0 25 50 100 150 200
N

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DATA SOURCE:
NSW DFSI - 2020
NSW DPIE - 2021
Nearmap - 2022

Angophora inopina Locations and Species Polygons

Barker Ryan Stewart
Biodiversity Certification Assessment Report
285 – 335 Pacific Highway
Lake Munmorah NSW

FIGURE:

13

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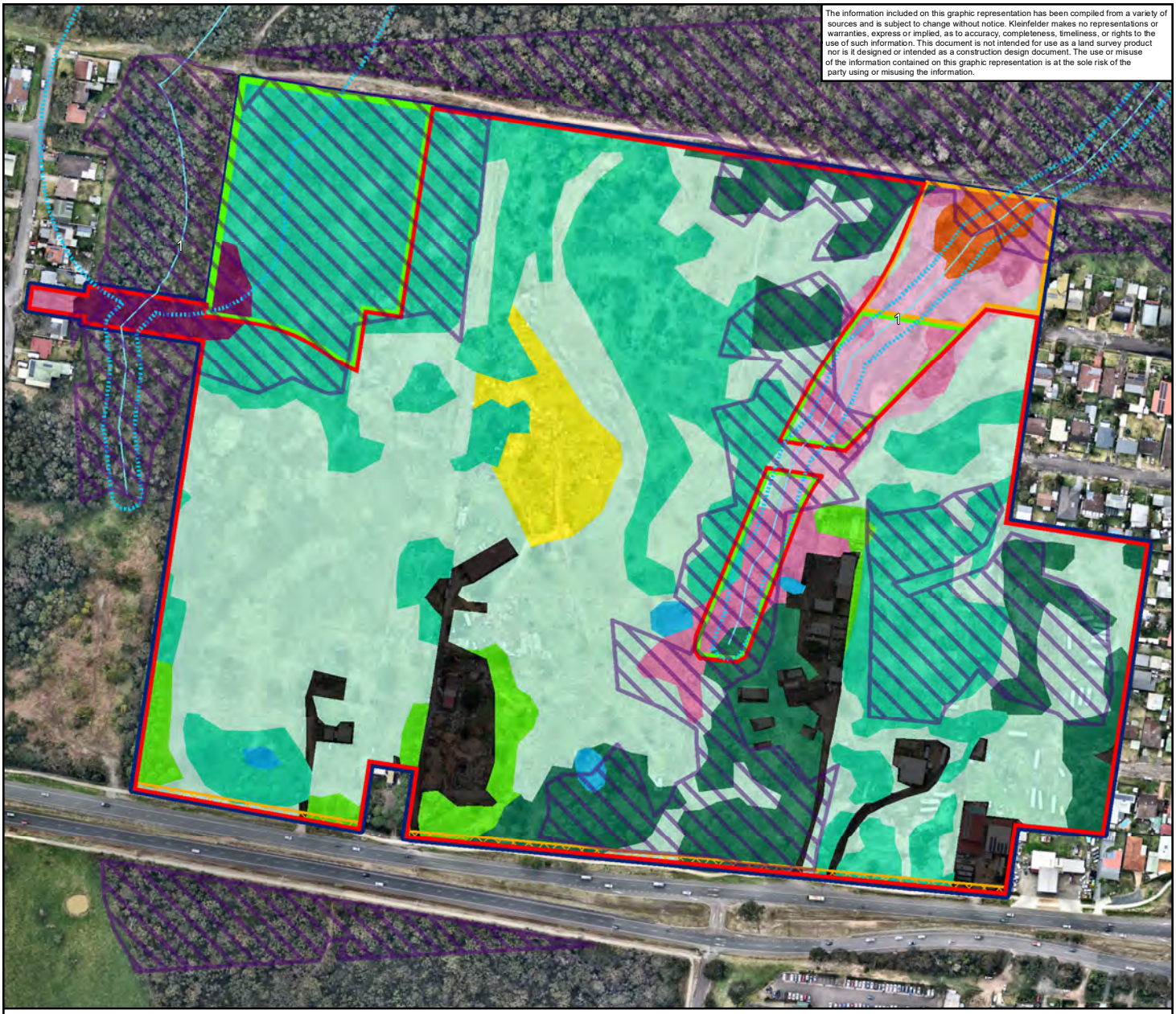

Legend

- Study Area
- Development Site (Residential Subdivision Footprint)
- Conservation Area (Temporary Impacts - Wetland Rehab)
- Development Site (5m Vegetation Buffer)
- Conservation Area (Retained)
- Swift Parrot (*Lathamus discolor*) Important Areas (DPIE)
- Watercourse (Labelled with stream order)
- Riparian Buffers

Vegetation Zones and Plant Community Types

(Vegetation Zones apply with Development Site Only)

- Zone 1 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Good Condition) (EEC)
- Zone 2 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Low-Moderate Condition) (EEC)
- Zone 3 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Cleared)
- Zone 4 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Moderate Condition)
- Zone 5 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Low-Mod Condition)
- Zone 6 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Cleared)
- Zone 7 - PCT 1737: Typha rushland (Moderate Condition) (EEC)
- Exotic Vegetation (Grassland)
- Exotic Vegetation (Planted Vegetation)
- Dam
- Existing Tracks & Infrastructure

Metres
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NSW DPIE - 2022
Nearmap - 2022

Swift Parrot (*Lathamus discolor*) Important Areas

Barker Ryan Stewart
Biodiversity Certification Assessment Report
285 – 335 Pacific Highway
Lake Munmorah NSW

FIGURE:

14

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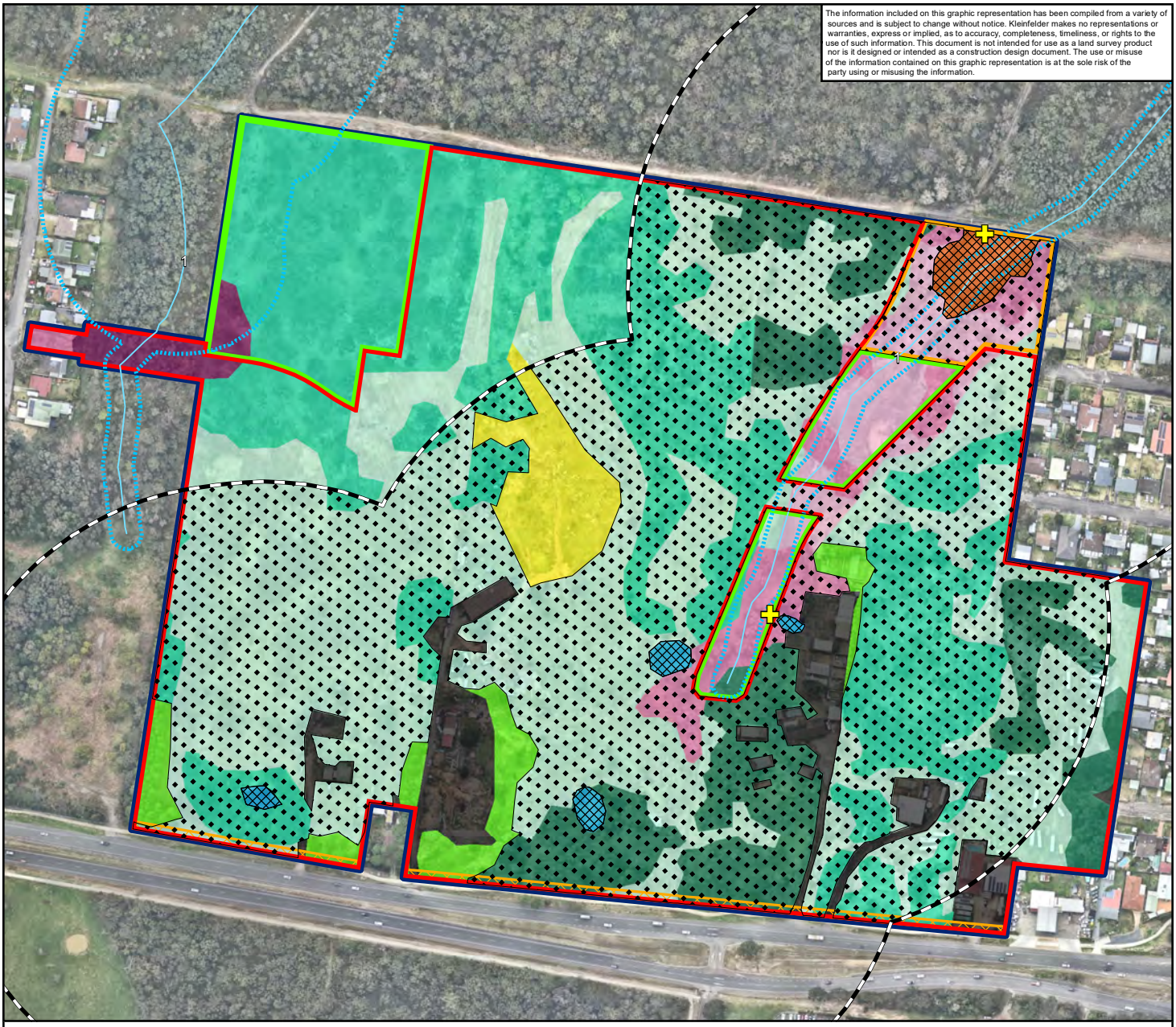

Legend

- Study Area
- Development Site (Residential Subdivision Footprint)
- Conservation Area (Temporary Impacts - Wetland Rehab)
- Development Site (5m Vegetation Buffer)
- Conservation Area (Retained)
- Watercourse (Labelled with stream order)
- Riparian Buffers

Southern Myotis

- Foraging Habitat
- Species Polygon
- 200m Buffer from Foraging Habitat
- Detections

Vegetation Zones and Plant Community Types

(Vegetation Zones apply with Development Site Only)

- Zone 1 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Good Condition) (EEC)
- Zone 2 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Low-Moderate Condition) (EEC)
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Metres
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NSW DFSI - 2020
NSW DPIE - 2021
Nearmap - 2022

Southern Myotis (*Myotis macropus*) Species Polygon

Barker Ryan Stewart
Biodiversity Certification Assessment Report
285 – 335 Pacific Highway
Lake Munmorah NSW

FIGURE:
15

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5 IMPACT ASSESSMENT

5.1 AVOIDING AND MINIMISING IMPACTS

The design of the current proposed development is the product of a process of investigation and review, informed by Preliminary Ecological Assessments (PEAs) (Kleinfelder 2021, Conacher Consulting 2018), and targeted threatened species surveys and habitat assessments completed as part of this report (i.e. the Swift Parrot Habitat Assessment [Wedgetail 2022]). Avoidance and minimisation measures considered during the planning stages of the Project in relation to site selection, project design and alternative technologies are outlined in the following sections.

5.1.1 Impacts on Native Vegetation and Habitat

In accordance with the framework for strategic biodiversity certification, a *C2 Environmental Conservation* zone is proposed as an adoption of a development control under the EP&A Act to conserve and enhance the natural environment.

The design of the proposed Development Site and *C2 Environmental Conservation* zone was initially informed by a site-specific Preliminary Ecological Assessment (Kleinfelder 2021). The assessment was conducted across the entire Study Area, and included vegetation mapping, TEC identification, flora and fauna habitat assessments, and the completion of floristic plots to assess vegetation integrity. Further amendments to the proposed Development Site, and the decision to establish a Conservation Area, was informed by the findings of targeted threatened species surveys and habitat assessments completed as part of this assessment. The proposed Conservation Area is detailed further below.

Proposed Conservation Area

The planning proposal aims to retain areas of threatened species habitat and maintain connectivity within the landscape for locally occurring fauna species as envisaged by the *North Wyong Shire Structure Plan 2012*, the *Greater Lake Munmorah Structure Plan 2021*, and detailed within the Gateway Determination Report (DPIE 2020). Options for the layout of the proposed development and associated infrastructure (detention basins) were reviewed in consideration of the biodiversity values identified within the Study Area, including the extent and condition of native vegetation, threatened flora locations (*Angophora inopina*), threatened species habitat (i.e. Swift Parrot), connectivity, the intent and location of regional biodiversity corridors, natural drainage of the site and the occurrence of key habitat features, such as hollow-bearing trees, wetlands, and watercourses.

The proposed Conservation Areas comprise of a North-Western Portion (northern end of Lot 1 DP 626787) and Eastern Portion (along existing watercourse on Lot 437 DP 755266) (see **Figure 15**). The finalised Conservation Areas are the product of an extensive process of investigation and balancing the need to optimise the conservation of key biodiversity values (i.e. threatened species habitat), maintenance of fauna connectivity, and the promotion of environmentally sustainable development.

Key biodiversity considerations in determining the location of the proposed Development Site and Conservation Areas are detailed below.

Local biodiversity corridors, including those proposed by the *North Wyong Shire Structure Plan 2012* Green Corridor and the Coastal Open Space System, provide habitat for plants and animals and are relevant to the planning proposal. These areas are part of a broader biodiversity corridor network that links to the Great Dividing Range, Hawkesbury River, Ku-ring-gai Chase National Park and Watagans National Park. They are also a part of a national wildlife corridor that extends from Victoria to Far North Queensland (the Great Eastern Ranges Initiative). The Study Area is located to the south of an east-west “Major External Conservation Link” (see **Plate 10**). A “Local Conservation Link" is also illustrated as occurring along within the C2 zoned land adjacent to the western boundary of the site, intersected by the proposed road corridor (see **Plate 10**). This Local Conservation Link crosses the south-western corner of the Study Area, indicating connectivity between areas of native vegetation to the south of the Study Area (southern the Pacific Highway) with the “Major External Conservation Link” to the north (see **Plate 10**). The Greater Lake Munmorah Structure Plan also identifies a North-South local conservation area within the riparian corridor in the Study Area (see **Plate 11** below).

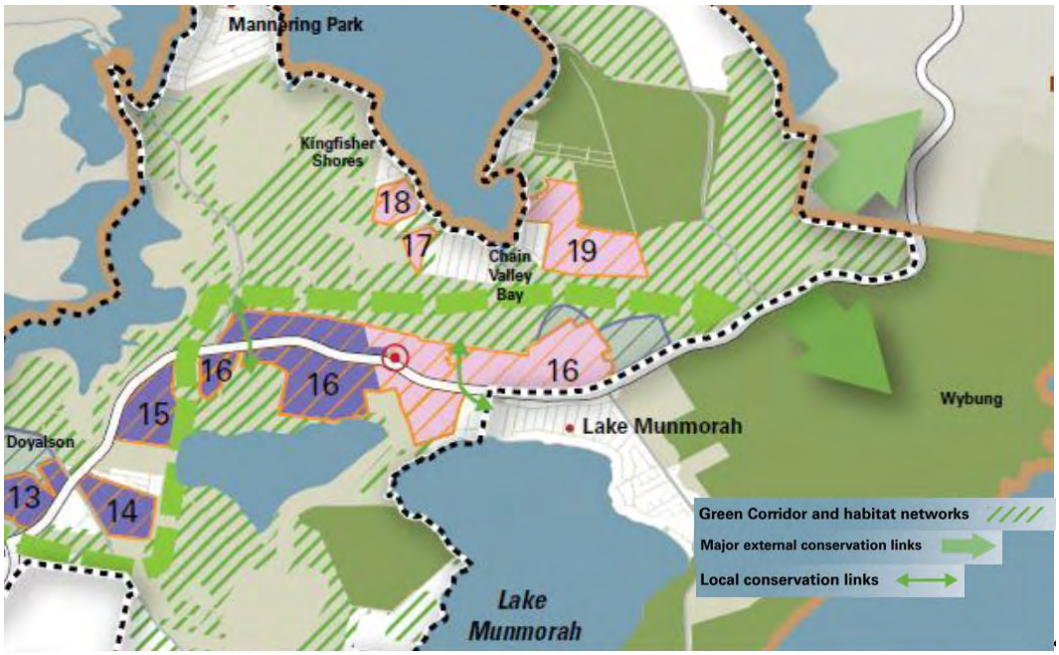


Plate 10 ***North Wyong Shire Structure Plan 2012*** **Green Corridor Mapping**

Plate 11: Greater Lake Munmorah Structure Plan Corridor Mapping

The Study Area is surrounded by a mix of landuses including low and medium residential developments to the immediate east, south and west, commercial development to the south-west and recreational land to the immediate north, and south (opposite the Study Area across the Pacific Highway) (**Figure 2**). Remnant native vegetation is largely absent from both the residential and commercial developments to the east and west, except for mature street trees. Larger areas of intact native vegetation occur to the north and the south of the Study Area. Connectivity within the Study Area is characterised by areas of somewhat sparse remnant native woodland along the northern and south-eastern boundaries adjoined by scattered paddock trees. Barriers to movement include:

- Sparse paddock trees along the watercourse within the eastern portion of the Study Area.
- Cleared vegetation along the western boundary of the Study Area
- Approximately 12 m gap between northern boundary of Study Area and remnant vegetation to the north.
- The Pacific Highway. This results in gaps of >50 m between areas of remnant native vegetation either side of the highway (see **Figure 2**, **Plate 12** and **Plate 13**).

Plate 12 Large Barrier to movement – The Pacific Highway (west looking over towards the Study Area)

Plate 13 Large Barrier to movement – The Pacific Highway (looking east Study Area to the left of image)

Mapped watercourses and wetlands

The Study Area is characterised by two (2) mapped watercourses, one (1) located along the south-western boundary, the other bisecting the eastern portion of the Study Area from the southern boundary with the Pacific Highway, to the northern boundary. The extent and location of both watercourses were amended following site investigations and now reflect the largely historic and managed nature of these overland drainage courses (see **Plate 14** and **Plate 15**).

Two (2) wetland communities occur within the Study Area. This includes one (1) forested wetland community (i.e. **Vegetation Zones 1, 2 and 3**) characterised by a mix of paperbarks (*Melaleuca quinquenervia*) and eucalypts (*Eucalyptus robusta* and *Eucalyptus resinifera*) and areas of intermediate inundation, this community is located along the western boundary and proposed road reserve, and alongside the mapped watercourse in the eastern portion of the Study Area. The other community is a Typha Wetland (i.e. **Vegetation Zone 7**) located in the north east of the Study Area. Furthermore, a mapped Coastal Wetland occurs to the immediate north-west of the Study Area (see **Figure 4**). While the mapped Coastal wetland does not occur within the Study Area, the 100 m wide Coastal Wetland Proximity Area occurs within the north-western corner of the site.

Plate 14 Location of historic south-western mapped watercourse

Plate 15 Southern Extent of the watercourse within eastern portion of the Study Area.

Threatened Species and their habitat

A total of eight (8) threatened species or their mapped habitat were detected within the Study Area, these include:

- *Angophora inopina* (Charmhaven Apple) – recorded throughout the Study Area.
- *Lathamus discolor* (Swift Parrot) – Important habitat mapping throughout the Study Area.
- *Miniopterus australis* (Little Bent-winged Bat) – This species was recorded via Anabat™ in the Study Area.
- *Micronomus norfolkensis* (Eastern Coastal Free-tailed Bat) - This species was recorded via Anabat™.
- *Myotis Macropus* (Southern Myotis) - This species was recorded via Anabat™ within the Study Area at two locations, a dam and near the Typha Wetland in the north-east of the site.
- *Scoteanax rueppelli* (Greater Broad-nosed Bat) - This species was recorded via Anabat™.
- *Calyptorhynchus lathami* (Glossy Black-Cockatoo) - This species was recorded foraging within the Study Area. No evidence of breeding was detected within the Study Area.
- *Pandion cristatus* (Eastern Osprey) – This species was detected breeding atop a 40m telecommunication tower near the southern boundary.

Threatened Ecological Communities

Two threatened ecological communities occur within the Study Area, *Swamp Sclerophyll Forest EEC* (**Vegetation Zone 1** and **2**) and *Freshwater Wetlands Complex EEC* (**Vegetation Zone 7**).

Fauna habitat value

Key habitat values within the Study Area include:

- A total of 131 Hollow-bearing Trees (HBTs) were recorded (including four (4) dead stags with hollows). Of these trees 33 had their largest hollow being “large” (>30cm diameter), 28 had a maximum of “Medium” hollows (20-29cm diameter) and 70 trees only had small hollows (10-19cm). From these hollow-bearing trees a total of 232 hollows were recorded across the Study Area (see **Section 5.2.1.2** for details).
- Fallen logs and timber (limited to unmanaged areas).
- Mature eucalypts that may provide foraging and nesting habitat for native bird species.
- Two shallow ephemeral drainage channels that would contain pools of water for short periods following high rainfall.
- A small Typha Rushland (0.26 ha) in the north-east corner of the Study Area.
- Five constructed dams that contain semi-permanent/permanent water.

Swift Parrot habitat

A site-specific Swift Parrot Habitat Assessment was completed in consultation with the listed BAM species expert (Ross Crates) within the Study Area in response to recommendations by the Biodiversity Conservation Division (BCD) following a review of the BCAR in May 2022. The advice from the BCD was that “an assessment of the quality of impacted areas should be undertaken to justify impacts, in consultation with a Biodiversity Assessment Method (BAM) approved species expert”

Habitat features considered to influence the quality of Swift Parrot habitat within the Subject Site were considered to fall into one of three (3) key measures of Swift Parrot habitat quality, including Foraging Resource Availability, Landscape Productivity, and Threats.

Foraging Resource Availability

- Occurrence of key nectar feed trees - Swamp Mahogany (*Eucalyptus robusta*), Forest Red Gum (*Eucalyptus tereticornis*), Blackbutt (*Eucalyptus pilularis*), and Spotted Gum (*Corymbia maculata*).
- Occurrence of key lerp feed trees - Red Bloodwood (*Corymbia gummifera*), Coastal Grey Box (*Eucalyptus mollucana*), and Rough-barked Apple (*Angophora subvelutina*).
- Maturity of Swift Parrot feed trees
- Occurrence of supplementary feed resources - including other winter flowering eucalypts and mistletoes.

Landscape Productivity

- Vegetation community condition and connectivity to other habitats
- Availability of water to the site

Threats

- Occurrence of resource competitors - large, aggressive nectar feeders and feral bees
- Land Management

The results of the Swift Parrot Habitat Assessment indicate that the highest value Swift Parrot habitat occurs within Vegetation Zones 1, 2, and 5 owing to their good condition, and canopy species mix, including the occurrence of two (2) preferred Swift Parrot feed tree species (*Eucalyptus robusta* and *Corymbia gummifera*). These vegetation zones also contained the majority of the preferred feed trees occurring within the Study Area (221 trees of 234), the remaining 13 trees occur as scattered paddock trees within Vegetation Zone 6 and the exotic vegetation zone. The highest concentration of preferred feed trees occur within the north western corner of the Study Area, with known nectar feed trees (*Eucalyptus robusta*) occurring in a high density within the creek corridor and known lerp feed trees (*Corymbia gummifera*) occurring in the open woodland area. These areas largely follow existing Important Area Mapping for the Swift Parrot (DPIE 2022). Large areas of mapped Important Habitat within the eastern half of the Study Area have a low occurrence of feed trees in comparison. Swift Parrot foraging resources within the rest of the Study Area is comparatively sparse.

A summary of Swift Parrot habitat values occurring within the proposed conservation areas in comparison to the development site is provided below:

Conservation Areas

- The conservation areas contain all three (3) High Habitat Value vegetation zones, which are characterised by high condition vegetation, a diverse native canopy, mature trees, and a mix of tree ages (including signs of regeneration).
- The conservation areas contain a high proportion and density of preferred feed trees (104 [44%]) despite the conservation areas only representing 14% of the Study Area.
- The North-west Conservation Area is located in close proximity to a first order watercourse and mapped coastal wetland. This area is therefore likely to represent a highly productive landscape (high soil water content). The vegetation within this area is also in close proximity to wetlands to the immediate west that are commensurate with PCT 1649, a forested wetland community dominated by a *Eucalyptus robusta* (Swamp Mahogany) canopy. As this is a preferred nectar feed tree it represents a complimentary food

resource with the *Corymbia gummifera* (Red Bloodwood) trees within the conservation area known for their lerp food resource.

- The conservation areas are highly connected to large areas of remnant vegetation to the north of the Study Area where Swift Parrot records occur (Joshua Porter Reserve). This area of vegetation is also associated with a regional corridor for the species.
- The conservation areas are characterised by a high number of birds recognized to have a negative association with Swift Parrot, Noisy Miner (*Manorina melanocephala*) and Rainbow Lorikeet (*Trichoglossus moluccanus*).

Development Site

- The Development Site is characterised by a mix of vegetation zones. The most significant areas of suitable habitat for the Swift Parrot occur within the proposed road corridor connecting the Study Area with Chisholm Avenue to the west.
- The Development Site contains the majority of Swift Parrot Habitat trees within the Study Area (130 [56%]). A large number of these trees (23 of 130) occur entirely within the proposed road corridor, which for bushfire and road access reasons is required and cannot be relocated owing to road access restrictions along the Pacific Highway and the location of the mapped coastal wetland to the north of the proposed road corridor. Preferred feed trees are comparatively sparse throughout the rest of the Study Area.
- The Development Site is characterised by a high number of birds recognized to have a negative association with Swift Parrot, Noisy Miner (*Manorina melanocephala*) and Rainbow Lorikeet (*Trichoglossus moluccanus*).

Summary

In consideration of the biodiversity values detailed above, two (2) options for the Conservation Area were initially considered for the proposed development, the suitability of each option are detailed below.

Option 1 – North – South Watercourse Corridor

This corridor was initially proposed in the Gateway Determination and involved the creation of a 40m wide corridor from the north-east of the Study Area, south to the Pacific Highway. Advantages of this proposal include:

- Promotion of a north-south fauna movement corridor as per the intent of the Local Conservation Link mapped in the *North Wyong Shire Structure Plan 2012*.
- Protection of mapped watercourse traversing the Study Area
- Retention of areas of Threatened Ecological Communities (*Swamp Sclerophyll Forest* and *Coastal Wetland Complex*)
- Retention of threatened species habitat (Southern Myotis)
- Retention of six (6) hollow bearing trees, including four (4) trees with large hollows (>30cm)

The corridor was determined to be inappropriate for the proposed development owing to the low connectivity within the Study Area (largely scattered paddock trees within the centre of the proposed corridor), and significant barriers to fauna movement from the Study Area, across the Pacific Highway (>50 m gap) to areas of remnant vegetation to the south. For example, the Lake Macquarie Squirrel Glider Planning and Management Guidelines (LMCC 2015) details the maximum gap distance allowing regular crossing for a Squirrel Glider (*Petaurus norfolcensis*) as being 35 m. Furthermore, tree heights along the southern edge of the Study Area do not permit

a glider distance over 50 m using the glide trajectory of a Squirrel Glider. Revisions to the extent of the eastern watercourse (as evidenced by lack of surface water, bed, banks or riparian vegetation) also indicates that the availability of aquatic habitat over much of previously mapped southern extent is largely absent. This area is characterised by drier land species and a dominance of exotics including Whiskey Grass (*Andropogon* virginicus) and Blackberry (*Rubus anglocandicans*). As such, the ecological value of this portion of the proposed north-south watercourse corridor is largely in relation to the movement of non-threatened terrestrial fauna species. This movement is proposed to be preserved through the establishment of street trees along road corridors connecting the southern extent of the watercourse to the Pacific Highway to the south (see **Option 2** below).

Option 2 – Conservation Areas, Strategic Plantings and Pocket Parks

The Conservation Area chosen to support the proposed development is the result of an extensive review of the biodiversity values above and efforts to balance the conservation of these values with sustainable development. The final Conservation Area aims to provide a combination of areas of intact native vegetation and fauna habitat (to be retained), strategic plantings of preferred Swift Parrot feed trees within the residential development, and the placement of pocket parks with the aim to improve biodiversity values within the Study Area. The layout comprises two (2) Conservation Areas, the North-western Conservation Area and the Eastern Conservation Area, with the aim of preserving both terrestrial and wetland biodiversity values respectively. Landscaping and urban design also aims to incorporate the retention of hollow-bearing trees and *Angophora inopina* trees along the southern boundary of the Study Area and within road reserves as part of the broader residential subdivision.

This option has gone under further review from the BCD and Central Coast Council. Further assessments completed as part of the Swift Parrot Habitat Assessment (Wedgetail 2022) also provided evidence that larger areas within the Study Area are suitable for incorporation within the proposed conservation areas. The originally proposed Option 2 Conservation Areas (see **Figure 16**) was increased to incorporate a larger portion of highly suitable Swift Parrot habitat in the north-west conservation area, threatened species, and hollow-bearing trees (**Figure 17**). A comparison of the currently proposed conservation areas to those proposed originally is provided in **Table 13** and **Table 14**. The proposed Option 2 Conservation Areas also proposes the planting of 1,290 Swift Parrot preferred feed trees (*Corymbia gummifera* and *Eucalyptus robusta*) within street landscaping (i.e. street trees), the provision of a planted corridor between the Eastern Corridor and the Pacific Highway, and additional plantings within a five (5) metre vegetative buffer alongside the Pacific Highway on the southern boundary of the Study Area. Plantings within the south-western corner of the Study Area and alongside constructed wetlands along the western boundary will also promote the movement of fauna north-south as represented by the mapped Local Conservation Link mapped within the North Wyong Shire Structure Plan 2012 (see Open Space Plan in **Appendix L**).

The advantages of the newly proposed Option 2 Conservation Areas (in comparison to Option 1) include:

- Greater retention of suitable Swift Parrot habitat within the Study Area. The Conservation Areas will preserve 2.53 ha of mapped Swift Parrot habitat, 2.35 ha of which contains suitable foraging habitat. This conservation area will therefore retain 35% of suitable and mapped Swift Parrot habitat within the Study Area (Total mapped = 8.61 ha, total mapped and suitable = 7.00 ha). The North-western Conservation Area is also characterised by a relative high number of mature trees, and comprise of a high proportion of preferred Swift Parrot feed trees (i.e. *Corymbia gummifera* and *Eucalyptus robusta*) (see Swift Parrot Habitat Assessment in **Appendix I**).

- Greater retention of large, medium and small hollows within the Study Area. The proposed Conservation Areas will retain 16 hollow-bearing trees (eight [8] of which contain large hollows [>30cm diameter] – a total of 24% of all large hollows within the Study Area)
- Retention of vegetation with greatest opportunities for restoration. Vegetation within the North-western Conservation Area contains a high proportion of mature trees, with an absent midstorey and highly managed native groundcover and low weed cover. This is a good base for restoration including the cessation of management, and supplementary plantings of shrub species. The placement of this Conservation Area within the north-western corner provides greater protection from edge effects (e.g. lighting and noise) that would be more pronounced if surrounded by urban development.
- Retention of the only defined watercourse within the Study Area.
- Restoration of the wetland in north-eastern corner of the Study Area following the construction of retention basin.

Relevant details relating to the previously proposed Option 2 Conservation Area is summarised in **Table 13.** The advantages of the newly proposed Option 2 Conservation Area are further summarised in comparison to the pre-BCD reviewed version provided in **Table 13** below.

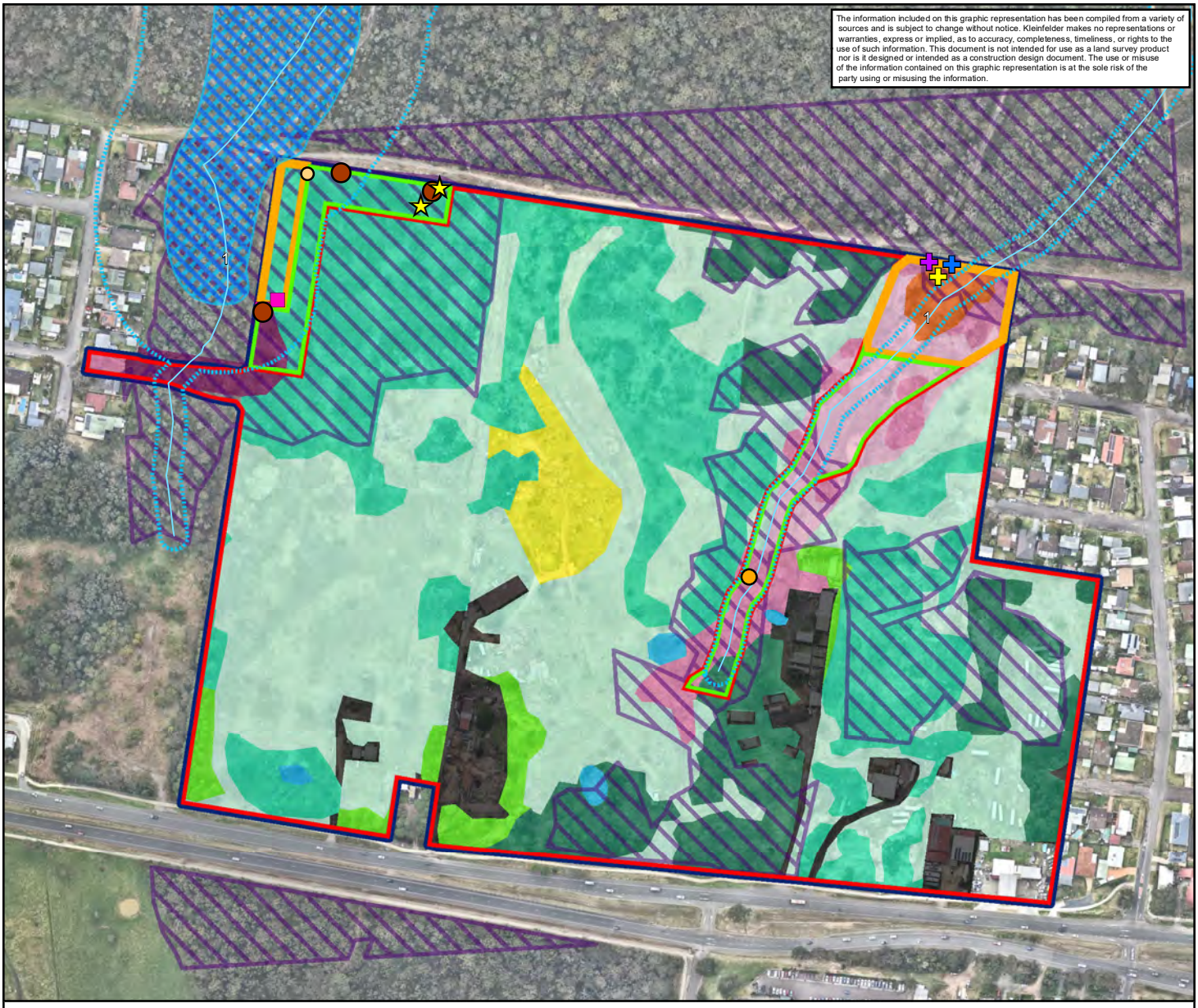
Table 13: Summary of Conservation Areas (Alternative Option 2 Conservation Area)

Zone	Restoration (temporary impact) (ha)	Retained (ha)	Total Area (ha)	Biodiversity Values
North-western Conservation Area	0.22 ha (Constructed Wetland)	0.6 ha	0.82 ha	• Retention of 0.99 ha of mapped Swift Parrot Habitat (7% of Study Area Total) • Retention of two *Angophora inopina* (5% of Study Area Total) • Retention of 4 Hollow-Bearing Trees (6 hollows) • Restoration of wetland within basin
Eastern Conservation Area	0.65 ha (Constructed Wetland)	0.82 ha	1.47 ha	• Retention of watercourse and wetland habitat. • Retention of 2 Hollow-Bearing Trees (5 hollows) • Restoration of wetland within basin
TOTAL	0.86 ha	1.43ha	**2.29 ha**	

Table 14: Summary of Conservation Areas (Proposed Option 2 Conservation Area)

Zone	Restoration (temporary impact) (ha)	Retained (ha)	Total Area (ha)	Biodiversity Values
North-western Conservation Area	0 ha (Constructed Wetland) **(Reduction of 0.22 ha)**	1.99 ha **(Increase of 2.12 ha)**	1.99 ha	• Retention of 2.53 ha of mapped Swift Parrot Habitat within suitable habitat (35% of suitable and mapped Swift Parrot Habitat within the Study Area) • Retention of four *Angophora inopina* (11% of Study Area Total) within the Conservation Areas. 24 plants will be retained within the 5m vegetative buffer and site boundary, as such a total of 74% of *A. inopina* trees will be retained (28 retained from 38 within the Study Area). • Retention of 14 Hollow-Bearing Trees (21 hollows) • Relocation of North-western basin to outside of the conservation area

Zone	Restoration (temporary impact) (ha)	Retained (ha)	Total Area (ha)	Biodiversity Values
Eastern Conservation Area	0.28 ha (Constructed Wetland) **(Reduction of 0.37 ha)**	1.47 ha **(Increase of 0.51 ha)**	1.79 ha	• Increased retention of watercourse and wetland habitat. • Retention of 2 Hollow-Bearing Trees (5 hollows) • Restoration of wetland within basin
TOTAL	0.28 ha	3.51 ha	**3.79 ha**	



Legend

- Study Area
- Development Site (Residential Subdivision Footprint)
- Conservation Area (Temporary Impacts - Wetland Rehab)
- Conservation Area (Retained)
- Watercourse (Labelled with stream order)
- Wetlands - Coastal Management Act
- Riparian Buffers
- Swift Parrot (*Lathamus discolor*) Important Areas (DPIE)
- *Angophora inopina* Locations within Conservation Area

Fauna Detections and Observations within Detention Basin

- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Little Bent-winged Bat (*Miniopterus australis*)
- Southern Myotis (*Myotis macropus*)

Hollow-bearing Trees within Conservation Area

- Small Hollows (10-19cm)
- Medium Hollows (20-29cm)
- Large Hollows (>30cm)

Habitat Features within Conservation Area

- Dead Stag (no hollows)

Plant Community Types within Conservation Areas

(Vegetation Zones apply with Development Site Only)

- Zone 1 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Good Condition) (EEC)
- Zone 2 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Low-Moderate Condition) (EEC)
- Zone 3 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Cleared)
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Previously Proposed Conservation Areas

Barker Ryan Stewart
Biodiversity Certification Assessment Report
285 – 335 Pacific Highway
Lake Munmorah NSW

FIGURE:

16

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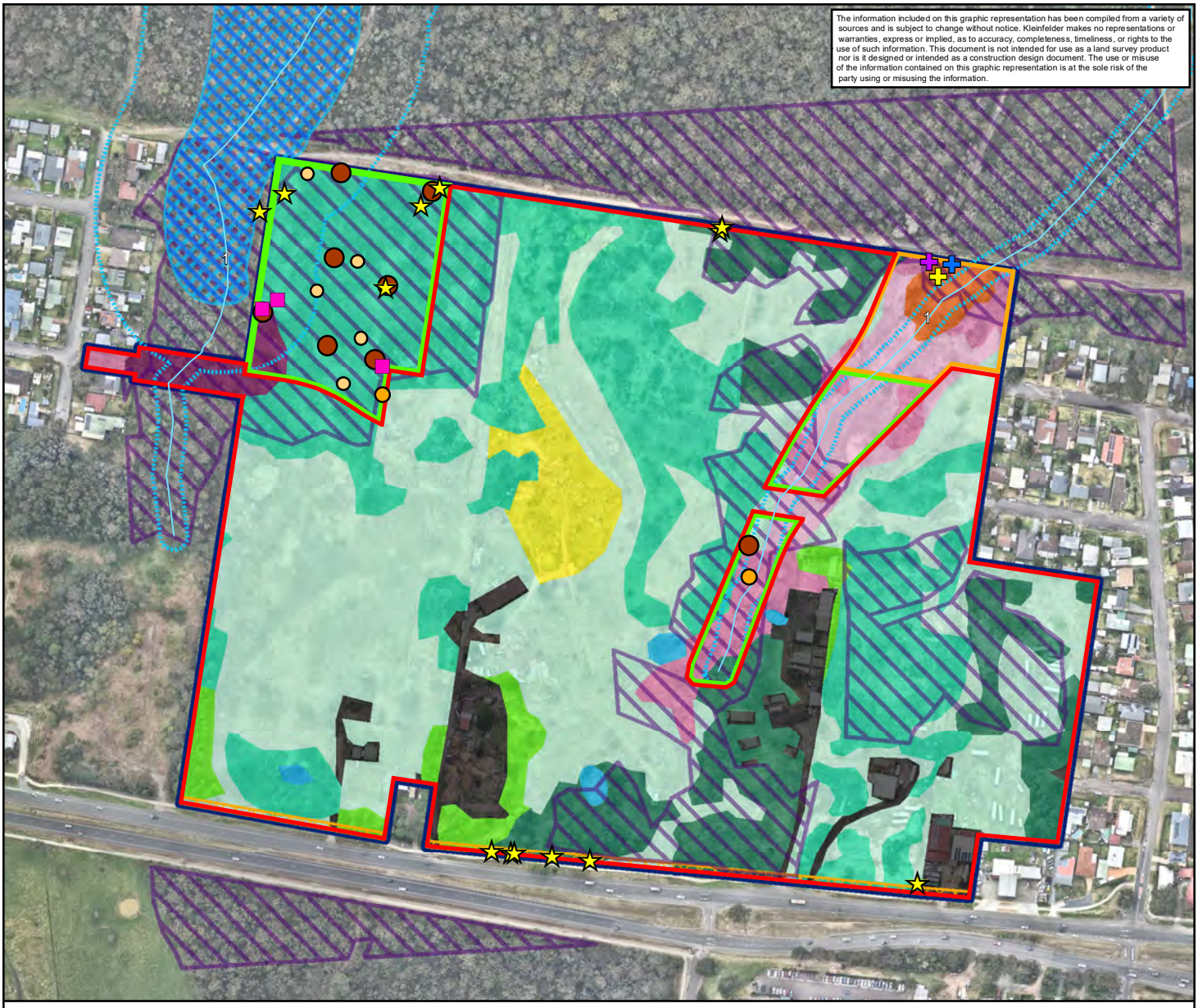

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- Conservation Area (Temporary Impacts - Wetland Rehab)
- Development Site (5m Vegetation Buffer)
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- Swift Parrot (*Lathamus discolor*) Important Areas (DPIE)
- *Angophora inopina* Locations within Conservation Area

Fauna Detections and Observations within Detention Basin

- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Little Bent-winged Bat (*Miniopterus australis*)
- Southern Myotis (*Myotis macropus*)

Hollow-bearing Trees within Conservation Area

- Small Hollows (10-19cm)
- Medium Hollows (20-29cm)
- Large Hollows (>30cm)

Habitat Features within Conservation Area

- Dead Stag (no hollows)

Plant Community Types within Conservation Areas

(Vegetation Zones apply with Development Site Only)

- Zone 1 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Good Condition) (EEC)
- Zone 2 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Low-Moderate Condition) (EEC)
- Zone 3 - PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Cleared)
- Zone 4 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Moderate Condition)
- Zone 5 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Low-Mod Condition)
- Zone 6 - PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Cleared)
- Zone 7 - PCT 1737: Typha rushland (Moderate Condition) (EEC)
- Exotic Vegetation (Grassland)
- Exotic Vegetation (Planted Vegetation)
- Dam
- Existing Tracks & Infrastructure

Metres
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PROJECT REFERENCE: 20221770

DATE DRAWN: 10/4/2022 10:31 Version 5

DRAWN BY: AMcDonaugh

DATA SOURCE:
NSW DFSI - 2020
Nearmap - 2022

Currently Proposed Conservation Areas

Barker Ryan Stewart
Biodiversity Certification Assessment Report
285 – 335 Pacific Highway
Lake Munmorah NSW

FIGURE:

17

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5.1.2 Prescribed Biodiversity Impacts

The following are prescribed impacts which need to be considered as per section 8.3 of the BAM (DPIE 2020a).

Impacts of the development on the habitat of threatened species or ecological communities associated with significant geological features, human made structure or non-native vegetation.

The planning proposal will result in impacts to human-made structures and 1.43 ha of non-native vegetation. These areas are not considered to represent threatened ecological communities, or habitat for threatened species. Mitigation measures to minimise any indirect impacts to biodiversity values within the Study Area (i.e. TECs and threatened species habitat) are detailed in **Section 5.3**.

Impacts of the development on the connectivity of different habitat which facilitates movement of threatened species

The vegetation within the Disturbance Footprint is not considered to provide significant connective habitat for threatened terrestrial fauna species. Habitat connectivity is restricted to local movement of fauna from the Subject Site to extant vegetation to the north and west of the site (see **Figure 1**). The gap across the Pacific Highway is a significant barrier to movement of threatened species within the locality (to the south). Consideration of impacts to mapped wildlife corridors is provided below.

North Wyong Structure Plan 2012

No regionally important conservation areas or biodiversity corridors are mapped within the Study Area under the North Wyong Shire Structure Plan 2012.

Map 2 of the Structure Plan identifies a Local Conservation Link along the western extent of the Study Area (north-south direction) which connects to vegetation on the southern side of the Pacific Highway. This link is largely absent within the Study Area (owing to sparsely distributed vegetation), while greater connectivity is provided by vegetation within the drainage corridor to the immediate west of the Study Area (though connectivity at the southern end is tenuous due to the sparsely distribution vegetation and the Pacific Highway). The Structure Plan maps the Study Area as a “Proposed Residential Area” and recognises the bushland areas to the north of the Study Area as a “Major External Conservation Link” (west to east). Currently the mapped Local Conservation Link through the Study Area does not provide connective habitats from bushland on the southern side of the Pacific Hwy to bushland on the north side of the Study Area (Major External Conservation Link) due to vegetation gaps, including that of the 50m wide Pacific Highway.

The Greater Lake Munmorah Structure Plan 2021

The recently approved Greater Lake Munmorah Structure Plan details the north-south Local Conservation Link illustrated along the western site boundary in the North Wyong Structure Plan and an additional north-south link through the Subject Site, in association with the watercourse and proposed eastern conservation area (**Plate 16**). Despite the mapping, the watercourse corridor is unlikely to represent an actual important corridor facilitating the movement of threatened species within the locality owing to the significant barrier to movement existing along the southern boundary of the site, i.e. the Pacific Highway. The proposed development will however, aim to largely preserve and maintain the movement value of this corridor through the establishment of the Eastern Conservation Area, the rehabilitation of the corridor through supplementary plantings, and the establishment of an additional

planted corridor within the development site connecting the Conservation Area with the Pacific Highway and a 5m vegetated buffer along the southern boundary of the site with the Pacific Highway (**Plate 17**). Proposed Conservation Areas and strategic plantings of locally occurring native trees aim to facilitate the movement of threatened species throughout the Study Area and immediate surrounds.

Plate 16: Greater Lake Munmorah Structure Plan Corridor Mapping

Plate 17: Conservation Area Design and provision of a Future Green Corridor within the Development Site

Impact of the development on movement of threatened species that maintains their life cycle

Following establishment of the Conservation Areas, the Project would have limited impacts on the movement of threatened species in the local area. While areas of native vegetation would be removed, existing movement corridors and higher quality vegetation within the Study Area will be retained within two Conservation Areas. The maintenance of vegetation and fauna habitat values within these Conservation Areas will be maintained under a site specific Biodiversity Management Plan (BMP).

Impacts of the development on water quality, bodies and hydrological processes that sustain threatened species or ecological communities.

The proposed Conservations Areas were selected on the basis of retaining native vegetation and ephemeral aquatic habitat within a mapped waterway. This will reduce the extent of impacts to local hydrological processes.

Key habitat features for threatened fauna within the Study Area are to be retained or restored within the Conservation Areas, including the waterbody in the North-western Conservation where the wetland will be restored. Currently this wetland has limited open water (high dominance of Typha) for the Southern Myotis to forage. Following restoration there will likely to be greater foraging potential for the species.

A mapped coastal wetland occurs to the north-west of the Study Area, whilst the mapped wetland does not occur within the Study Area, the proximity area for the coastal wetland (100m buffer to the wetland) enters the Study Area. Available groundwater dependent ecosystem mapping (GDE Atlas – BoM 2022) also identifies vegetation within, and adjacent to, the Study Area as having a low-moderate potential as a terrestrial Groundwater Dependent Ecosystem (GDE). As such, development within the Study Area has the potential to result in indirect impacts to water quality, bodies and hydrological processes that sustain threatened species or ecological communities (i.e. *Swamp Sclerophyll Forests EEC* to the west and north-west of the Study Area. In accordance with Chapter 2 (Coastal Management) of the *State Environmental Planning Policy (resilience and Hazards) 2021*, the proponent has sought to ensure no significant impacts to a) *the biophysical, hydrological or ecological integrity of the adjacent coastal wetland or littoral rainforest, and* b) *the quantity and quality of surface and groundwater flows to and from the adjacent wetland or littoral rainforest.* Relevant avoidance and minimisation measures are detailed below.

Impacts to the biophysical, hydrological or ecological integrity of the adjacent coastal wetland.

Direct impacts to the mapped coastal wetland have been avoided through the placement of the proposed collector road to the south of the mapped wetland. Whilst the current proposed road corridor does intercept the mapped Proximity Area to the Mapped Coastal Wetland, the placement of this road along the western boundary was a requirement of bushfire safety requirements, met further Council requirements for an east-west collector road, and reflected access restrictions along the Pacific Highway. The alternative design would have seen the road located to the north of the current position, however this site would have resulted in direct impacts to the mapped coastal and fragmentation of the proposed North-West Conservation Area.

Indirect impacts to the mapped coastal wetland including weed invasion, water runoff, soil erosion and most other damage and edge effects have been avoided through the design of the north-west conservation area encompassing the Proximity Area to the Mapped Coastal Wetland and a buffer zone of at least 100m in accordance with the Conservation Advice for the EPBC Act listed Swamp Sclerophyll Forest Ecological

Community (DAWE 2021). The threat of weed invasion and edge effects have been further minimised through the implementation of a site-specific Biodiversity Management Plan (BMP) for the long-term management of weeds and adaptive management of the woodland.

Impacts to the quantity and quality of surface and ground water flows to and from the adjacent coastal wetland.

Indirect impacts to the coastal wetland through changes to water quantity and quality have been addressed through consultation with Central Coast Council and the BCD, and consideration of relevant guidelines. The water quality and quantity standards considered for the proposed development are largely consistent with that described for subdivisions, multi-unit dwellings, commercial and industrial developments in the *Developments adjacent to National Parks and Wildlife Service lands Guidelines for consent and planning authorities* (DPIE 2020) including;

- No increase in pre-development peak flows from rainfall events with a 1 in 5 year and 1 in 100 year recurrence interval.
- No increase in the natural annual average load of nutrients and sediments.
- No increase in the natural average annual runoff volume.

A Stormwater Management Report (Barker Ryan Stewart 2022 [BRS 2022]) was prepared for the proposed development detailing changes to water quality and quantity parameters between pre and post development scenarios, and thus any influence the proposed development will have on surface and groundwater outputs, and therefore indirect impacts to the mapped coastal wetland and Swamp Sclerophyll Forest EEC.

The Stormwater Management Plan (BRS 2022) modelled stormwater runoff quality from the site under existing conditions using the MUSIC software package. The water quality modelling utilised Central Coast Council's MUSICLink data that is built into the MUSIC software program. MUSIC software Version 6.3.0 was utilised with MUSICLink data Version 6.34 for 'Upland' area. Existing land uses for the pre-development scenario have been assessed from site observations and aerial photography. Details of modelled existing land uses, areas and imperviousness used as part of the assessment are detailed in the Stormwater Management Plan (BRS 2022) provided in **Appendix J**.

The proposed plan for managing stormwater runoff within the Study Area includes the provision of the following;

- 5kL tanks to each future lot connected to outdoor taps and toilets.
- 25sqm of infiltration area for each lot accepting overflow from the rainwater tanks.
- Gross pollutant traps upstream of the bioretention areas.
- Bioretention areas to the eastern (800m²) and western (500m²) basins.
- Additional 600m² infiltration area to the eastern creek line, upstream of the bioretention area.
- Additional 800m² infiltration area to the western catchment, downstream of the bioretention, prior to discharge.

The result of the above provisions ensure that the water flow (quantity) and pollutants (quality) entering the coastal wetland from the development site will now be less than that modelled for the pre-development state (see **Table 15** below for a summary of the MUSIC model results). As such, the proposed development is expected to meet the water quality requirements detailed through consultation with the Central Coast Council and BCD (no change in water quantity or quality), and therefore is not expected to result in any detrimental impacts to the adjacent mapped coastal wetland and *Swamp Sclerophyll Forest* EEC.

Furthermore, the results of the on-site Drains modelling (BRS 2022) illustrate that the proposed OSD measures reduce flows from the development for both the Eastern Catchment and the Western Catchment to no greater than pre-development conditions for the 20%, 5% and 1% AEP storm events in accordance with Council's requirements (see **Table 16**).

Table 15: MUSIC Modelling Water Quantity and Quality results (pre and post development) (BRS 2022)

	Pre-Development			Post Development (with treatment)			Difference		
	West	East	Total	West	East	Total	West	East	Total
Flow (ML/yr)	25.8	95.7	121.5	25.4	95.3	120.7	-0.4	-0.4	-0.8
Total Suspended Solids (kg/yr)	3820	14000	17820	1960	3030	4990	-1860	-10970	-12830
Total Phosphorus (kg/yr)	7.08	25.2	32.28	4.44	12.4	16.84	-2.64	-12.8	-15.44
Total Nitrogen (kg/yr)	56.5	210	266.5	38.4	124	162.4	-18.1	-86	-104.1
Gross Pollutants (kg/yr)	163	850	1013	52.2	0	52.2	-110	-850	-960.8

Table 16: Drains Modelling for pre and post development flows (BRS 2022)

Catchment	Storm Event (AEP)	Pre-Development Flow (m^3/s)	Post-Development Flow (m^3/s)
Eastern Catchment	20%	5.11	5.11
	5%	7.95	5.79
	1%	12.3	11.0
Western Catchment	20%	7.54	7.50
	5%	11.5	11.0
	1%	17.6	16.6

As such, through the implementation of appropriate Impact Avoidance and Minimisation measures the proposed development is not expected to result in direct or indirect impacts to water quality, bodies and hydrological processes that sustain threatened species or ecological communities.

Impact of wind turbine strikes on protected animals

Not applicable to the current application.

Given the nature of the proposed development, it is likely that there will be an increase in vehicle movement within proximity to the Study Area. However, separation of the proposed development and areas of vegetation to be retained will ensure impacts (such as vehicle strikes) during operation will be minimised. Measures to minimise impacts of vehicle movements during the construction phase are outlined in **Section 5.3.**

5.2 ASSESSMENT OF IMPACTS

5.2.1 Impacts on Native Vegetation and Habitat

5.2.1.1 Direct Impacts (Native Vegetation)

The Project will impact approximately 21.51 ha of native vegetation. Each vegetation zone equates to one management zone, and the future value of each attribute (composition, structure, and function) and the vegetation integrity score for all management zones will be zero. Impact areas including the entire disturbance footprint (residential development and temporary impacts associated with the proposed detention basins), and the predicted change in vegetation integrity (VI) scores within each vegetation zone is detailed below (**Table 17**).

Table 17: Native Vegetation Impacts

Vegetation Zone	Disturbance Footprint (ha)	Current VI Score	Future VI Score
Vegetation Zone 1: *PCT 1649 - Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands* (Good Condition (EEC))	0.25	70.2	0
Vegetation Zone 2: *PCT 1649 - Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands* (Low- Moderate Condition (EEC))	0.59	46.3	0
Vegetation Zone 3: *PCT 1649 - Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands* (Low Condition)	0.57	31	0
Vegetation Zone 4: *PCT 1638 - Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast* (Moderate Condition)	2.88	52.0	0
Vegetation Zone 5: *PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast* (Low-Moderate Condition)	6.66	36	0
Vegetation Zone 6: *PCT 1638 - Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast* (Cleared)	10.30	5.5	0
Vegetation Zone 7: *PCT 1737 – Typha rushland* (Moderate (EEC))	0.26	64.9	0

5.2.1.2 Direct Impacts (Habitat Trees)

A total of 131 hollow-bearing trees occur within the Study Area (including four (4) dead stags with hollows), of which contain a total of 232 hollows. A total of 115 hollow-bearing trees (HBTs) will be removed for construction of the proposed development (**Table 18**). A total of 16 hollow-bearing trees containing 23 hollows will be retained. The majority of the retained trees lie within the proposed Conservation Areas.

Table 18: Habitat Trees within Study Area

Hollow type	Disturbance Footprint	Retained within Conservation Areas	Total
Largest Hollow type within HBT			
Large Hollow (>30cm)	25	8	33
Medium Hollows (20-29cm)	26	2	28
Small Hollows (10-19cm)	64	6	70
Total HBT	**115**	**16**	**131**
Hollows			
Large Hollow (>30cm)	49	11	60
Medium Hollows (20-29cm)	102	7	109
Small Hollows (10-19cm)	58	5	63
Totals	**209**	**23**	**232**

5.2.1.3 Indirect Impacts

The proposed development has the potential to lead to edge effects on the adjoining retained vegetation. Potential indirect impacts include:

- Increased weed invasion and potential spread or introduction of pathogens from the site to adjacent vegetation.
- Accidental incursions during clearing or earthworks.
- Reduced viability of adjoining habitats due to increased noise, dust or light spill; or
- Increase in rubbish dumping in adjoining habitats.
- Changes to hydrological processes during and post earthworks and associated works to improve stormwater drainage.

These potential indirect impacts may have an effect on the adjacent vegetation and habitat for threatened species within the Study Area. However, provided appropriate mitigation measures and management plans (Vegetation Management Plan and Wildlife Management Plan) are enforced, the Project is unlikely to have significant indirect impacts on threatened species, ecological communities and their habitats during construction and operational phases.

Indirect impacts to coastal wetlands as a result of the proposed development have been considered and subject to stormwater modelling (Barker Ryan Stewart 2021) and a redesign of the basin locations and size. Results of the on-site detention Drains modelling for pre-development and post-development flows are presented below in **Table 2**. The results in the table confirm that the proposed OSD measures reduce flows from the development

for both the Eastern Catchment and the Western Catchment to no greater than pre-development conditions for the 20%, 5% and 1% AEP storm events in accordance with Council's requirements. It is therefore concluded that the proposed development meets the requirements of Central Coast Council with respect to on-site detention and water quality.

5.2.2 *Prescribed Biodiversity Impacts*

The Project has the potential to contribute to two recognised prescribed impacts, changes to hydrological processes and an increase in vehicle movements that may impact threatened species, ecological communities and/or their habitat. Impact avoidance and impact minimisation measures have been considered throughout the planning process (including the provision of a Stormwater Management Plan). Further mitigation measures to reduce residual impacts are detailed in **Section 5.3**.

5.3 MITIGATE AND MANAGE IMPACTS ON BIODIVERSITY VALUES

The measures outlined in **Table 19** are proposed to minimise and avoid potential impacts associated with the proposed development.

Table 19: Summary of mitigation and management measures for direct, prescribed and indirect impacts of the proposed development

Impact	Mitigation Measure	Responsibility	Timing	Efficacy
Direct impact / prescribed impact				
Clearing of native vegetation	▪ Avoid and minimise clearing impacts to native vegetation where possible. ▪ An arborist would be required to assess extent of allowable incursion to TPZ / SRZ for all retained trees within close proximity of the proposed development and proposed detention basins. ▪ Clearly delineate the boundaries of the project footprint to prevent any unnecessary clearing beyond its extent. This includes the installation of appropriate fencing along the eastern extent of the Development Site. Fencing should prohibit entry into the retained vegetation area and the minimise indirect impacts during construction such as the movement of dust and rubbish into the forest and wetland. ▪ Ensure vehicle and equipment parking areas and stockpile areas are identified and positioned to avoid areas containing ecological value. Stockpiling must not occur within, or in close proximity (5m) to, areas of native vegetation retained under the proposed development. ▪ Appropriate signage such as 'no go zone' or 'environmental protection area' should be installed surrounding the area of retained native vegetation and wetlands. ▪ Clearly identify and communicate the location of any 'no go zones' in site inductions. ▪ Tree protection measures will be implemented to protect retained trees surrounding the development site. Tree protection measures should consider allowances for Tree Protection	Construction site manager	Prior to and during vegetation clearing	**High Efficacy** – risk of failure is low if proposed mitigation measures and those detailed within the site-specific BMP are followed.

Impact	Mitigation Measure	Responsibility	Timing	Efficacy
	Zones in accordance with AS4970 (Standards Australia, 2009).			
Removal of hollow-bearing trees / habitat trees, resulting in fauna injury and mortality	▪ Limit removal of trees to that required within the project footprint where possible. ▪ A pre-clearing protocol will be implemented during clearing works, as follows: ▪ Pre-clearance surveys will be undertaken to determine if any inhabiting fauna, or habitat features (i.e. nests or hollows) are present; ▪ A suitably qualified and trained fauna handler will be present during hollow-bearing tree clearing to rescue and relocate displaced fauna. ▪ Appropriate exclusion fencing around any trees and woodland that are to be retained within and immediately surrounding the development site should be erected, considering allowance for Tree Protection Zones in accordance with AS4970 (Standards Australia, 2009).	Construction site manager and suitably qualified/trained fauna handler	Prior to and during tree clearing	**High Efficacy** – risk of failure is low if proposed mitigation measures and those detailed within the site-specific BMP are followed. A detailed Vegetation Clearing procedure is provided in the BMP.
Impacts to surface water quality and quantity due to sediment run-off and/or contaminant runoff into adjacent watercourses	▪ Source controls such as sediment fences, mulching and jute matting will be utilised where appropriate. ▪ Site-based vehicles will carry spill kits. ▪ Erosion and sediment control will be required for the development in accordance with Managing Urban Stormwater: Soils and Construction (Landcom, 2004) prior to commencement of construction. ▪ Limit the use of pesticides in the project footprint where possible to avoid contamination of nearby watercourses/wetland areas.	Construction site manager	During vegetation clearing, construction and operation	**High Efficacy** – risk of failure is low if proposed mitigation measures, requirements of relevant guidelines, and those detailed within the site-specific BMP are followed. In the event of failure, the Construction Site Manager is responsible for implementing sufficient remedial risk management works.
Vehicle collision with fauna	▪ Speed limits within the Development Site should be limited to 40 km/hr. ▪ This limit should be clearly signed at all entry points to site. ▪ The Development Site should be separated from vegetated areas throughout the construction and operational phases of the development. This separation should be achieved through physical barriers including fencing and appropriate signage. Further details on the management of this reserve will be detailed within the site-specific Biodiversity Management Plan (BMP).	Construction site manager	During construction and operation	**High Efficacy** – risk of failure is low if proposed mitigation measures and those detailed within the site-specific BMP are followed.

Impact	Mitigation Measure	Responsibility	Timing	Efficacy
Indirect Impact				
Transfer of weeds and pathogens to and from site	▪ The fungal pathogens *Phytophora cinnamomi* and Myrtle Rust (*Puccinia psidii*) are known to occur in the Central Coast LGA, however, it is unknown if they occur within the Development Site. These pathogens can have devastating impacts on native plant communities and inhabiting fauna if not properly managed. ▪ Appropriate wash down facilities will be available to clean vehicles and equipment prior to arrival on-site and prior to departure. ▪ Ensure soil and seed material is not transferred in accordance with measures outlined in the Vegetation Management Plan. ▪ Weed infestations within the Development Site and broader Study Area are to be identified and mapped within the Biodiversity Management Plan (BMP).. ▪ The Biodiversity Management Plan (BMP) must detail requirements for the control of weeds within areas of retained vegetation.	Construction site manager	During vegetation clearing, constructio n, and operation	**High Efficacy** – risk of failure is low if proposed mitigation measures and those detailed within the site-specific BMP are followed. In the event of failure of weed mitigation measures appropriate weed management will be implemented in accordance with the Adaptive Management Programme detailed within the site-specific BMP
Noise, vibration, lighting, waste and air pollution impacts to adjacent sensitive habitat areas	▪ Increased human activity (from workers and traffic levels) directly adjacent to sensitive habitat areas may cause disturbance to flora and fauna species in adjoining habitat. ▪ Impacts from construction and operational activities, such as disturbance to an animal's normal behaviour patterns due to noise, vibration, lighting or dust may cause areas of previously suitable habitat to become sub-optimal and may cause fauna species to vacate areas of previously suitable habitat. ▪ Measures to mitigate impacts on flora and fauna from noise, vibration, waste, light and air pollution such as: ▪ Enforce 'carry-in, carry-out' policy regarding rubbish and waste materials generated on-site during construction to avoid waste materials entering adjacent vegetation. ▪ Restriction of public access and associated impacts from domestic pets, waste dumping and damage to adjoining vegetation must be enforced pre, during and post construction. ▪ Fence sensitive areas to delineate 'no go' zones. ▪ Levels of lighting associated with the proposed development (during construction and operation) will be reduced to a minimal level and directed away from retained vegetation areas to reduce any adverse effects upon the essential behavioural patterns of light-sensitive fauna. Lighting design and utilisation during construction and operational phases of the	Construction site manager	During constructio n and operation	**High Efficacy** – risk of failure is low if proposed mitigation measures and those detailed within the site-specific BMP are followed.

Impact	Mitigation Measure	Responsibility	Timing	Efficacy
	development should be based on principles detailed in Appendix A of the National Light Pollution Guidelines for Wildlife (DEE 2020). This includes consideration of adaptive controls, and measures to reduce light intensity and inappropriate light spill into retained vegetation and fauna habitat. ▪ Lighting should also comply with Australian Standard AS4282 (INT) 1997 – Control of Obtrusive Effects of Outdoor Lighting. ▪ Noise minimisation practices in accordance with DPIE recommendations. ▪ Dust control measures such as covering loads where required; amending operations under excessive wind conditions including ceasing operations if required; use of water tankers as required, to control dust; rehabilitation through vegetation of surfaces to be left unsealed; and, truck wheel washes or other dust removal measures.			
Monitoring and risk of failure	▪ Monitoring and mitigation measures detailed within the site-specific Biodiversity Management Plan (BMP) will be implemented throughout the construction and operational phases of the project. ▪ The management plan will provide an adaptive management strategy so as to address any failure of mitigation measures or address impacts that are	Landowner	Post Approval	
Ongoing Management				
Maintenance of Conservation Areas	• The boundary of each Conservation Area should be delineated and protected through the installation of fencing until a time in which an appropriated management plan is implemented. The delineation of the boundary of the Conservation Areas will allow for greater success in restoration, the management of exotic species incursion, the prevention of encroachment into the Conservation Areas through human traffic, mowing, collection of firewood, and rubbish dumping. • Weed incursion is recognised as a key threat to the Conservation Areas. It is recommended that management of weeds within the Conservation Areas prioritise weeds listed in **Table 23**, in accordance with the site-specific Biodiversity Management Plan (BMP).	Landowner	Operation	**High Efficacy** – risk of failure is low if proposed mitigation measures and those detailed within the site-specific BMP are followed. In the event of failure of weed mitigation measures appropriate weed management will be implemented in accordance with the Adaptive Management Programme detailed within the site-specific BMP

Impact	Mitigation Measure	Responsibility	Timing	Efficacy
Restoration of Conservation Areas	• The proponent proposes the restoration of vegetation within both Conservation Areas. The restoration of these two areas are detailed within a site specific Biodiversity Management Plan (BMP) which was prepared by a suitably qualified ecologist, outlining a clear strategy for the following: ▪ Management of weeds identified in **Table 23.** ▪ Retention of existing fauna habitat values including hollow-bearing trees and dead stag located within the Conservation Areas. ▪ Completion of a revegetation programmed within both Conservation Areas including the following: o **North- Western Conservation Area –** Plantings within this area should include supplementary plantings of native shrub and midstorey species representative of the vegetation community; *PCT 1638 - Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast*. The groundcover is largely native, however supplementary planting of groundcover species may be required. The need for such plantings should be informed by monitoring of the Conservation Areas as detailed in a site-specific Vegetation Management Plan (VMP). o **Eastern Conservation Area – O**wing to the location of this Conservation Area within low lying areas of the Study Area, forested wetland species are proposed for the restoration of this zone. Plantings should include key canopy, midstorey, and groundcover species representative of *PCT 1649 - Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands.* o **Constructed Wetlands –** One proposed detention basins is located within the Eastern Conservation Area and will be subject to revegetation following construction so as to provide water quality and quantity protection of local wetlands, and supplementary habitat for local fauna. Plantings within these two constructed wetlands will need to take into account engineering and stormwater management requirements. Species selection should be based of wetlands within the Study Area i.e. *PCT 1737 - Typha rushland.* ▪ Enhancement of existing fauna habitat values including but not limited to the suitable placement of salvaged habitat features (i.e. logs from cleared trees), and plantings of suitable species within the constructed	Landowner	Operation	**High Efficacy** – risk of failure is low if proposed mitigation measures and those detailed within the site-specific BMP are followed. The site-specific BMP will implement an adaptive management programme to manage medium to long term risks of failure. Short term risks of failure such as failure of vegetation clearing, stormwater, and weed incursion management is detailed in the rows above.

Impact	Mitigation Measure	Responsibility	Timing	Efficacy
	wetlands to provide habitat for frogs (following heavy rain). ▪ A plan for ongoing monitoring of management measures detailed within the BDAR. This plan will be incorporated into the management plan provided post-approval.			
Street Trees and Urban Design	• It is recommended that native species consistent with PCT 1638 and PCT 1649, and locally occurring Swift Parrot feed trees (*Corymbia gummifera*, *Eucalyptus robusta*, selected (where suitable) for additional plantings and landscaping within the Development Site. A total of approximately **1,290 Swift Parrot feed trees** will be planted as street trees and additional plantings within the 5m vegetated buffer along the southern boundary • Street trees along the road corridor adjacent to the western boundary of the Study Area should be used to supplement existing vegetation to the west in the provision of fauna connectivity.	Landowner	Operation	

5.3.1 Residual Impact Risks and Consequences

Key residual impacts, an evaluation of associated risks and consequences, and remedial measures to be implemented in the event that listed mitigation measures provided in **Table 19** fail are provided in **Table 20** below. Provided that the mitigation measures provided in **Table 19** and the site-specific BMP, the risk of failure is largely considered low-moderate, the consequences and remedial/response actions are detailed in **Table 20** below.

Table 20: Residual Impacts and Risks and Consequences of Mitigation Measure Failure

Residual Impact / Risk of Mitigation Measure Failure	Residual Risk of Occurrence	Timing / extent	Consequences	Remedial Measure	Responsibility
Failure to prevent vegetation clearing impacts on vegetation outside of the Development Site	Low-Moderate	Throughout the construction period	Depending on the extent of failure this would lead to impacts to native vegetation outside that approved. This may also result in impacts to threatened flora, threatened fauna habitat or key habitat features (i.e. hollow-bearing trees).	Inspections will occur as detailed within the site-specific BMP. Any unintentional impacts to native vegetation will be assessed and addressed through consultation with Central Coast Council and the BCD. This may require the retirement of additional biodiversity credits, installation of additional nest-boxes, or additional revegetation.	Proponent / Landowner
Failure to follow vegetation clearing and	Low-Moderate	Throughout the	This can result in fauna injury and mortalities,	A suitably qualified ecologist / fauna spotter catcher is	Proponent / Landowner

Residual Impact / Risk of Mitigation Measure Failure	Residual Risk of Occurrence	Timing / extent	Consequences	Remedial Measure	Responsibility
fauna management requirements detailed within the BCAR and Vegetation Clearing procedure provided in the BMP.		construction period	including to threatened fauna.	required to conduct a pre-clearance survey prior to clearing and identify all fauna habitat features that may be inhabited. The ecologist is required to supervise all clearing of habitat trees within the Development Site. Local wildlife carers are to be notified of works prior to clearing works being undertaken. Any failure of this procedure will require the following: ▪ Immediate Action – Stop Work to ensure the safety of any animal at risk of injury. ▪ Recovery – the animal will be safely removed from risk and assessed for injury by the ecologist and wildlife carer. ▪ Treatment – the most appropriate treatment for the animal will be determined. The costs for the treatment and care of any injured/orphaned fauna are to be covered by the developer. ▪ Notification – any injury or mortality occurring within the Development Site during clearing or construction will be recorded and	

Residual Impact / Risk of Mitigation Measure Failure	Residual Risk of Occurrence	Timing / extent	Consequences	Remedial Measure	Responsibility
				discussed within monitoring reports required by the site-specific BMP. The NSW Department of Planning and Environment will be notified accordingly.	
Failure of erosion and sedimentation mitigation measures.	Low-Moderate	Throughout the construction period	Failure of these measures can result in impacts to sensitive habitat adjacent to the Development Site (conservation areas and wetlands).	Regular inspection of erosion and sediment control measures are required (see **Table 19** and the site-specific BMP), particularly following rainfall events, to ensure their ongoing functionality. These measures will be maintained throughout the construction and operation phases (where applicable). In the event of failure, the Construction Site Manager is responsible for implementing sufficient remedial risk management works. Any failures and associated impacts will be reported to DPE and Central Coast Council.	Proponent / Landowner
Failure of weed management requirements.	Low-Moderate	Throughout the construction and operational periods.	Introduction and spread of introduced species including Priority Weeds and High Threat Weeds that pose a risk to the condition of sensitive environmental areas within and adjacent to the Study Area (i.e. conservation areas and wetlands).	Regular inspections are required in accordance with the measures listed in **Table 19** and the site-specific BMP. In the event of failure of weed mitigation measures appropriate weed management will be implemented in accordance with the Adaptive Management	Proponent / Landowner

Residual Impact / Risk of Mitigation Measure Failure	Residual Risk of Occurrence	Timing / extent	Consequences	Remedial Measure	Responsibility
				Programme detailed within the site-specific BMP	
Failure of waste management measures	Low-Moderate	Throughout the construction and operational periods.	The movement of rubbish and/or building waste into environmentally sensitive areas can impact vegetation condition and habitat suitability.	Any breach of waste management measures will be remedied immediately, with the removal of waste to be coordinated by the Construction Site Manager. Removal of waste will need to avoid any further impacts to native vegetation.	Proponent / Landowner
Failure of Street Tree plantings	Moderate	Throughout the construction and operational periods.	Tree mortality during establishment.	All street trees or native trees/shrubs/groundcover species planted as part of proposed revegetation plans will need to be replaced like-for-like in accordance with the BMP.	Proponent / Landowner

6 IMPACT SUMMARY

6.1 SERIOUS AND IRREVERSIBLE IMPACTS

Two (2) threatened species at risk of Serious and Irreversible Impacts (SAIIs) were found to contain habitat within the Study Area, the Little Bent-winged Bat (*Miniopterus australis*), and the Swift Parrot (*Lathamus discolor*). These two (2) species are identified as SAII entities according to the 'Guidance to assist a decision-maker to determine a serious and irreversible impact' (DPIE 2019). These determinations are based on Principle four (4) as set out in clause 6.7 of the *Biodiversity Conservation Regulation 2017* – "The impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity, and therefore its members are not replaceable", and Principle 1: "it will cause a further decline of a species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline" for the Little Bent-winged Bat and Swift Parrot respectively.

The Little Bent-winged Bat is associated with SAII only with reference to impacts to breeding habitat (caves and other roosting habitat). Suitable breeding habitat for the Little Bent-winged Bat is absent from the Study Area and immediate surrounds, as such the Disturbance Footprint provides foraging habitat only for the species. No further assessment of potential SAIIs to Little Bent-winged Bat was undertaken as part of this assessment.

A total of 6.09 ha important habitat for the Swift Parrot is mapped within the Disturbance Footprint (**Figure 14**).

An assessment of the potential for the development to result in serious and irreversible impacts on the Swift Parrot was undertaken using the assessment criteria for threatened species or populations set out in subsection 9.1 of the BAM (DPIE 2020a), is provided in **Appendix E**. In summary, this assessment determined the following:

- Swift Parrots breed in Tasmania and are present in NSW only during the non-breeding season (May to August) where important areas for the species constitute foraging habitat only. While on the mainland, the species has a wide foraging range extending from southern and central Victoria to south-east Queensland.
- The Swift Parrot is listed as Critically Endangered because modelling suggests that its population is declining by >80% within three generations (12–18 years) as a result of just one of many factors impacting the species: predation by introduced Sugar Gliders during breeding (Hingston 2019).
- Given the highly mobile, nomadic nature of the species, it is difficult to estimate population size. Only relatively small numbers of Swift Parrots have been reported from the Central Coast and Lake Macquarie in recent years (Birdlife Australia, 2009- 2020). As such, estimates of the size of the local population are unavailable.
- A total of 76 records of the species occur within 5 km of the Study Area with the majority being concentrated within mapped Forested Wetland vegetation further to the north of the Study Area.
- A total of 6.09 ha of Swift Parrot important habitat is mapped within the Disturbance Footprint, of which 5.79 ha was included in the species polygon as an impact to suitable habitat.
- The results of the Swift Parrot Habitat Assessment indicate that the highest value Swift Parrot habitat occurs within Vegetation Zones 1, 2, and 5 owing to their good condition, and canopy species mix, including the occurrence of two (2) preferred Swift Parrot feed tree species (*Eucalyptus robusta* and *Corymbia gummifera*).
- The highest concentration of preferred feed trees occur within the north western corner of the Study Area, with known nectar feed trees (*Eucalyptus robusta*) occurring in a high density within the creek corridor and

known lerp feed trees (*Corymbia gummifera*) occurring in the open woodland area. These areas are predominantly reserved within the proposed Conservation Areas.

- The Conservation Areas will preserve 2.53 ha of mapped Swift Parrot habitat, 2.35 ha of which contains suitable foraging habitat. This conservation area will therefore retain 35% of suitable and mapped Swift Parrot habitat within the Study Area (Total mapped = 8.61 ha, total mapped and suitable = 7.00 ha).
- The proposed development is expected to have limited impacts on the movement of Swift Parrot in the locality. While a small area of native vegetation would be removed, movement corridors within the local area would largely be maintained with the availability of a large areas of highly connected and suitable foraging habitat surrounding the site, and retention of multiple feed trees within the Study Area.

Impact mitigation measures are detailed in **Section 5.3**.

6.2 Impacts Requiring Offsets

6.2.1 Impacts on Native Vegetation

This section provides an assessment of the direct impacts to native vegetation requiring offsetting, and those not requiring offsets in accordance with Section 10.1 of the BAM (DPIE 2020a).

In accordance with the BAM (Section 9.2.1 [DPIE 2020a]) assessors must determine an offset for all impacts of proposals on PCTs that are associated with a vegetation zone that has a vegetation integrity (VI) score of:

- ≥15, where the PCT is representative of an EEC or a CEEC.
- ≥17, where the PCT is associated with threatened species habitat (as represented by Ecosystem Credits) or represents a vulnerable ecological community.
- ≥20, where the PCT does not represent a TEC and is not associated with threatened species habitat.

The proposed development will result in the clearing of approximately 21.51 ha of native vegetation (including 10.30 ha of low condition/cleared PCT 1638 – Vegetation Zone 6) identified within the Disturbance Footprint. The current vegetation integrity score (VI Score) for Vegetation Zone 6 is below thresholds (VI Score of 5.5). As such, no credit obligation is generated as a result of impacts to this vegetation zone.

A summary of the impacts on native vegetation and the required Ecosystem Credits is provided in **Table 21**.

Table 21: Summary of Ecosystem Credit requirements

Vegetation Zone Name	Impact Area (ha)	Current VI Score	Future VI Score	Credits Required
Vegetation Zone 1: PCT 1649 - Good (EEC)	0.25	70.2	0	9
Vegetation Zone 2: PCT 1649 - Low- Moderate (EEC)	0.59	46.3	0	14
Vegetation Zone 3: PCT 1649 - Low	0.57	31	0	7
Vegetation Zone 4: PCT 1638 - Moderate	2.88	52.0	0	66
Vegetation Zone 5: PCT 1638 – Low-Moderate	6.66	36	0	105
Vegetation Zone 6: PCT 1638 - Cleared	10.30	5.5	0	0
Vegetation Zone 7: PCT 1737 – Moderate (EEC)	0.26	64.9	0	8
Total Credits				**209**

* Areas of impact are rounded in the BAM-C. Rounded Impact Area (Area of Vegetation Zone)

The like-for-like Biodiversity Credit Report and the Variations Options are provided in **Appendix G.**

6.2.2 *Impacts on Species Credit species*

A summary of the impacts on species credit species and the required species credits is provided in **Table 22**.

Table 22: Summary of species credit requirements

Vegetation Zone Name	Area (ha)/Count (no. individuals)	Biodiversity Risk Weighting	Sensitivity to gain	Credits Required
***Angophora inopina* (Charmhaven Apple)**				
Vegetation Zone 4: PCT 1638 - Moderate	2.9	2	High	75
Vegetation Zone 5: PCT 1638 – Low-Moderate	6.7	2	High	120
Vegetation Zone 6: PCT 1638 - Cleared	10.3	2	High	29
Total	**19.9**	-		**224**
***Lathamus discolor* (Swift Parrot)**				
Vegetation Zone 1: PCT 1649 - Good (EEC)	0.21	3	Moderate	11
Vegetation Zone 2: PCT 1649 - Low- Moderate (EEC)	0.17	3	Moderate	6
Vegetation Zone 3: PCT 1649 - Low	0.1	3	Moderate	2
Vegetation Zone 4: PCT 1638 - Moderate	1.9	3	Moderate	75
Vegetation Zone 5: PCT 1638 – Low-Moderate	2.2	3	Moderate	61
Vegetation Zone 6: PCT 1638 - Cleared	1.2	3	Moderate	5
Total	**5.79**	-		**160**
***Myotis macropus* (Southern Myotis)**				
Vegetation Zone 2: PCT 1649 - Low- Moderate (EEC)	0.39	2	High	9
Vegetation Zone 3: PCT 1649 - Low	0.21	2	High	3
Vegetation Zone 4: PCT 1638 - Moderate	2.58	2	High	67
Vegetation Zone 5: PCT 1638 – Low-Moderate	4.46	2	High	80
Vegetation Zone 6: PCT 1638 - Cleared	9.02	2	High	25
Vegetation Zone 7: PCT 1737 – Moderate (EEC)	0.26	2	High	8
Total	**16.92**	**-**		**192**

6.3 IMPACTS NOT REQUIRING OFFSETS

Due to the low condition of Vegetation Zone 6, impacts to this area does not generate a credit obligation. Additionally, impacts to non-native vegetation or cleared areas does not require offsets (i.e. Vegetation Zone 7 and Vegetation Zone 8).

7 ASSESSMENT OF BIODIVERSITY LEGISLATION

7.1 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

7.1.1 Assessment Requirements

The EPBC Act requires that developments or undertakings that are likely to have a significant impact on MNES be referred for a determination as to whether they are a controlled action which requires approval under the EPBC Act (Section 1.5.1). Of the nine MNES listed under the Act, those considered relevant to the Study Area are potential impacts on listed threatened species or communities and potential impacts on migratory species listed under international agreements. The results of a search of the relevant threatened species database and an assessment of the likelihood of occurrence of threatened and migratory species is provided in **Appendix A**. An assessment of significance for MNES considered relevant to the Study Area are detailed in **Appendix G**. A referral to the Commonwealth's Department of Agriculture, Water and Environment (DAWE) will be completed for the proposed development.

7.2 BIOSECURITY ACT 2015

Species which require control prior to and post construction of the Project to ensure they are not spread due to works, include the high threat species listed in **Table 23**.

Table 23: Weed species requiring control within the Study Area

Scientific Name	Common Name	Weeds of National Significance (WONS)	Priority weeds of the Greater Sydney LLS (Biosecurity Act)	High Threat Weeds (BAM)
Andropogon virginicus	Whiskey Grass			✓
Asparagus aethiopicus	Asparagus Fern		✓	✓
Axonopus fissifolius	Narrow-leaved Carpet Grass			✓
Cenchrus clandestinum	Kikuyu			✓
Cinnamomum camphora	Camphor Laurel			✓
Ehrharta erecta	Panic Veldt Grass			✓
Hyparrhenia hirta	Coolatai Grass			✓
Lantana camara	Lantana	✓	✓	✓
Paspalum dilatatum	Paspalum			✓
Rubus anglocandicans	Blackberry	✓	✓	✓
Senecio madagascariensis	Fire Weed	✓	✓	✓

7.3 KOALA HABITAT PROTECTION STATE ENVIRONMENTAL PLANNING POLICY (SEPP 2021)

The Study Area is is located within Central Coast Council LGA, which is listed within Schedule 1 of the Koala SEPP 2021. The Koala SEPP 2021 was, therefore, deemed applicable for the Study Area. As such, an assessment of Koala habitat suitability was conducted in accordance with the SEPP and the definitions of koala habitat provided therein. These are defined as the following:

- **Highly Suitable Koala Habitat** – Where 15% or greater of the total number of trees within any PCT are the regionally relevant species of those listed in Schedule 2 of the Koala SEPP 2021, the site meets the definition of highly suitable koala habitat.
- **Core Koala Habitat –** is defined as:
  a) *an area of land which has been assessed by a suitably qualified and experienced person as being highly suitable koala habitat and where koalas are recorded as being present at the time of assessment of the land as highly suitable Koala habitat, or*
  b) *an area of land which has been assessed by a suitably qualified and experienced person as being highly suitable koala habitat and where koalas have been recorded as being present in the previous 18 years. Historical koala occupation of the site area is determined by considering koala records within the last 18 years, within the following maximum distances from the external boundary of the site area:*

     i. *2.5 kilometres of the site (for North Coast, Central Coast, Central Southern Tablelands, South Coast KMAs).*
     ii. *5 kilometres of the site (for Darling Riverine Plains, Far West, North West Slopes, Riverina, Northern Tablelands KMAs).*

As such, the presence of 'highly suitable koala habitat' and 'Core Koala Habitat' under the Koala SEPP 2021 is detailed below.

Presence of Highly Suitable Koala Habitat

Ten (10) Koala use tree species listed under Schedule 2 of the Koala SEPP were identified: *Allocasuarina littoralis* (Black She-oak), *Angophora costata* (Smooth-barked Apple), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus capitellata* (Brown Stringybark), *Eucalyptus haemastoma* (Broad-leaved Scribbly Gum),), *Eucalyptus racemosa* (Broad-leaved Scribbly Gum), *Angophora floribunda* (Rough-barked Apple), *Eucalyptus robusta* (Swamp Mahogany), *Eucalyptus resinifera* (Red Mahogany), and *Melaleuca quinquenervia* (Broad-leaved Paperbark). These species constitute over 15% of the total number of trees within areas of the Study Area where woodland vegetation occurs. As such, these areas constitute "highly suitable habitat" for the Koala under the SEPP.

Records of Koala Habitation

No Koalas were recorded within the Study Area during the assessment. Furthermore, no historical records (<18 years old) occur within 2.5 km of the Study Area (DPIE 2021a). The nearest record of a Koala is approximately 2 km from the Study Area, however, this record is dated 1996 (25 years ago).

As such, the vegetation within the Study Area does not constitute 'Core Koala Habitat' and no further assessment is required under the Koala SEPP 2021.

8 SUMMARY

The proposed development will result in impacts to approximately 22.88 ha of native vegetation. This includes:

- **0.25 ha of impacts to Vegetation Zone 1**: *PCT 1649 – Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Moderate).* The vegetation within this zone meets the definition for Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (EEC) under the BC Act.
- **0.59 ha of impacts to Vegetation Zone 2**: *PCT 1649 – Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands Low- Moderate (EEC)*. The vegetation within this zone meets the definition for Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (EEC) under the BC Act.
- **0.57 ha of impacts to Vegetation Zone 3**: *PCT 1649 – Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands – Low.*
- **2.88 ha of impacts to Vegetation Zone 4**: *PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast – Moderate.*
- **6.66 ha of impacts to Vegetation Zone 5**: *PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast – Low-Moderate.*
- **10.30 ha of impacts to Vegetation Zone 6**: PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast - Cleared
- **0.26 ha of impacts to Vegetation Zone 7**: PCT 1737 – Typha rushland- Good (EEC) – Moderate (EEC). The vegetation within this zone meets the definition for *Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* (EEC) under the BC Act.

One (1) threatened flora species (*Angophora inopina*) was recorded within the Study Area. This species is listed as vulnerable under both the NSW BC Act and Commonwealth's EPBC Act. A total of 10 individuals within 19.9 ha of habitat will be impacted under the proposed development. A total of 28 *Angophora inopina* individuals will be retained within the Conservation Areas, a 5m wide vegetation buffer and along the site boundaries. Therefore, a total of 74% of *Angophora inopina* plants will be retained under the proposed development.

A total of six (6) threatened fauna species were detected within the Study Area. Presence was also assumed for the Swift Parrot due to areas of the site being mapped as important habitat for this species. These are listed as follows:

- *Lathamus discolor* (Swift Parrot) – Assumed present within areas mapped as important habitat. An offset obligation was generated for impacts to this species. The species polygon for this species was assessed as 5.79 ha.
- *Miniopterus australis* (Little Bent-winged Bat) –The occurrence of this species within the Disturbance Footprint was assessed as an Ecosystem Credit species only due to the absence of breeding habitat (caves)
- *Micronomus norfolkensis* (Eastern Coastal Free-tailed Bat) – This species was assessed as an Ecosystem Credit species.
- *Myotis Macropus* (Southern Myotis) - An offset obligation was generated for impacts to this species The species polygon for this species was assessed as 16.91 ha.

- *Scoteanax rueppelli* (Greater Broad-nosed Bat) - This species was assessed as an Ecosystem Credit species.
- *Calyptorhynchus lathami* (Glossy Black-Cockatoo) - No evidence of breeding was detected within the Study Area during targeted surveys. The species is assessed as an Ecosystem Credit species.
- *Pandion cristatus* (Eastern Osprey) – While the species was observed to be nesting atop a 30m high telecommunication tower with the Study Area, development impacts are not considered to impact the species breeding habitat. The species is assessed as an Ecosystem Credit species.

The proposed Conservation Areas (total area 3.78 ha inclusive of constructed wetlands) aim to retain threatened species habitat and maintain connectivity within the landscape for locally occurring fauna species as envisaged by the *North Wyong Shire Structure Plan 2012* detailed within the Gateway Determination Report (DPIE 2020) and the *Greater Lake Munmorah Structure Plan*. The proposed Conservation Areas preserve the following key biodiversity values identified within the Study Area:

- **Retention of higher quality, suitable Swift Parrot habitat** within the Study Area (35% of suitable and mapped Swift Parrot habitat within the Study Area, noting that much of this mapping occurs within open grassland and therefore the proportion conserved is likely higher). The North-western Conservation Area is also characterised by a relative high number of mature, hollow-bearing trees, and comprise of a high proportion of preferred Swift Parrot feed trees (i.e. *Corymbia gummifera* and to a lesser preference *Eucalyptus capitellata*).
- **Retention of large, medium and small hollows** within the Study Area. The proposed Conservation Areas will retain 16 hollow-bearing trees (eight [8] of which contain large hollows [>30cm diameter] – a total of 24% of all large hollow bearing trees within the Study Area). Further hollow-bearing trees will be retained throughout the proposed development, where they can be incorporated into road reserves (i.e. along the northern and southern Study Area boundaries in particular).
- **Retention of vegetation with greatest opportunities for restoration**, vegetation within the North-western Conservation Area contains a high proportion of mature trees, with a absent midstorey and highly managed native groundcover and low weed cover. This is a good base for restoration including the cessation of management, and supplementary plantings of shrub species. The placement of this Conservation Area within the north-western corner allows greater protection from edge effects (e.g. lighting and noise) that would be more pronounced if surrounded by urban development.
- **Retention of mapped watercourse** within the Study Area.

Restoration works are proposed within both Conservation Areas. Offset are required for impacts to native vegetation and threatened species (and/or their habitat) in accordance with the Biodiversity Offset Scheme. These are detailed in **Section 6**. Impacts not requiring offsets include the clearing of low condition vegetation (Vegetation Zone 6) and exotic vegetation.

Potential direct and indirect impacts associated with the proposed development would be further avoided and/or minimised through the implementation of mitigation and management measures outlined in **Section 5.3.**

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APPENDIX A – THREATENED SPECIES DATABASE SEARCH

THREATENED SPECIES DATABASE SEARCH

A list of threatened species, populations and ecological communities that have been reported or modelled to occur from within a five-kilometre radius of the Study Area was obtained from the following databases:

- NSW DPIE BioNet Atlas: (http://www.bionet.nsw.gov.au/); and
- Commonwealth DAWE Protected Matters search tool: (https://www.environment.govSPRAT.au/epbc/protected-matters-search-tool).

Further resources used to inform the threatened species database search included:

- The BAM – Calculator (BAM Calculator (nsw.gov.au)), and
- NSW DPIE BioNet Threatened Biodiversity Profiles: (NSW BioNet Quick Guides and Manuals | NSW Environment, Energy and Science/).
- DAWE (2022b). *Species Profile and Threats Database (SPRAT)*. Available at: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

An assessment was then made of the likelihood of the threatened species, populations, and ecological communities reported or modelled to occur in the locality occurring within the Development Site or using the habitat within the Development Site as an essential part of a foraging range.

The table below summarises the likelihood of threatened species and EPBC Act listed migratory species occurring within the Development Site based on the habitat requirements of each species.

A brief definition of the likelihood of occurrence criteria is provided below:

- Known – species identified within the site during surveys;
- High – species known from the area (DPIE BioNet Atlas records), suitable habitat (such as roosting and foraging habitat) present within the site;
- Moderate – species may be known from the area, potential habitat is present within the site;
- Low – species not known from the area and/or marginal habitat is present within the site; and
- Nil – habitat requirements not met for this species within the site

Table A1 'Likelihood of Occurrence' Table

	Species	Status		Records	Source	Habitat	LoO	Summary
		BC	EPBC					
Flora								
1.	***Acacia bynoeana*** Bynoe's Wattle	E	V	3	BioNet, PMST	Bynoe's wattle is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches.	Low	Broadly suitable habitat within the Study Area. Records within the locality. **Not recorded during site assessment.**
2.	***Angophora inopina*** Charmhaven Apple	V	V	75	BioNet, PMST	Endemic to the Central Coast region of NSW. The known northern limit is near Karuah where a disjunct population occurs; to the south populations extend from Toronto to Charmhaven with the main population occurring between Charmhaven and Morisset.	Present	Suitable habitat within the Study Area. Records within the Study Area and the locality. **Recorded during site assessment.**
3.	***Callistemon linearifolius*** Netted Bottle Brush	V	-	3	BioNet	Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Grows in dry sclerophyll forest on the coast and adjacent ranges.	Low	No suitable habitat within the Study Area. Records within the locality. **Not recorded during site assessment.**
4.	***Caladenia tessellata*** Thick-lipped Spider-orchid	E	V	P	PMST	The Thick Lip Spider Orchid is known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil.	Nil	Broadly suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
5.	***Chamaesyce psammogeton*** Sand Spurge	E	-	1	BioNet	Sand Spurge is found sparsely along the coast from south of Jervis Bay (at Currarong, Culburra and Seven Mile Beach National Park) to Queensland (and Lord Howe Island). Grows on fore-dunes, pebbly strandlines and exposed headlands, often with Spinifex (*Spinifex sericeus*) and Prickly Couch (*Zoysia macrantha*).	Nil	No suitable habitat within the Study Area. Only one record within the locality. **Not recorded during site assessment.**

	Species	Status		Records	Source	Habitat	LoO	Summary
		BC	EPBC					
6.	***Corunastylis sp.*** Charmhaven	CE	CE	3	BioNet	*Corunastylis* sp. Charmhaven (NSW896673) is currently only known from the Wyong Shire of NSW where it is restricted to a few locations in the Charmhaven, Warnervale and Tooheys Road (Bushells Ridge) areas. It occurs within low woodland to heathland with a shrubby understorey and ground layer.	Low	Broadly suitable habitat within the Study Area. Few records within the locality. **Not recorded during site assessment.**
7.	***Corunastylis insignis*** Wyong Midge Orchid	CE	CE	P	PMST	Recorded from four localities between Chain Valley Bay and Wyong in Wyong local government area. A small population also occurs within Lake Macquarie LGA. Appears to be associated with *PCT 1636 Scribbly Gum – Red Bloodwood – Angophora inopina (not always present) heathy woodland on lowlands of the Central Coast* and variations containing Angophora costata.	Low	Suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
8.	***Cryptostylis hunteriana*** Leafless Tongue Orchid	V	V	19	BioNet PMST	Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*E. sieberi*), Red Bloodwood (*Corymbia gummifera*) and Black Sheoak (*Allocasuarina littoralis*); appears to prefer open areas in the understorey of this community.	Moderate	Broadly suitable habitat within the Study Area. Records within the locality. **Not recorded during site assessment.**
9.	***Cynanchum elegans*** White-flowered Wax Plant		E	P	PMST	Restricted to eastern NSW where it is distributed from Brunswick Heads on the north coast to Gerroa in the Illawarra region. The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation.	Nil	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
10.	***Diuris praecox*** Rough Doubletail	V	V	212	BioNet, PMST	Occurs between Ourimbah and Nelson Bay on the NSW north coast. This species has also been identified on the Wallarah Peninsula, near Lake Macquarie in NSW. Grows on hills and slopes of near-coastal districts, in open heathy forests which have a grassy to fairly dense understorey.	Moderate	Suitable habitat within the Study Area. Records within the locality. **Not recorded during site assessment.**

	Species	Status		Records	Source	Habitat	LoO	Summary
		BC	EPBC					
11.	***Eucalyptus camfieldii*** Camfield's Stringybark	V	V	2	BioNet, PMST	Restricted distribution in a narrow band with the most northerly records in the Raymond Terrace area south to Waterfall. Poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges.	Nil	No suitable habitat within the Study Area. Only two records within the locality. **Not recorded during site assessment.**
12.	***Eucalyptus parramattensis subsp. Decadens***	V	V	P	PMST	The Kurri Kurri meta-population is bordered by Cessnock—Kurri Kurri in the north and Mulbring—Abedare in the south. Generally occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high.	Nil	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
13.	***Eucalyptus parramattensis subsp. parramattensis***	E	-	2	BioNet	The species usually occurs from the Goulburn Valley on the Central West slopes to Hill Top on the Central Coast. This species is associated with low moist areas alongside drainage lines and adjacent to wetlands. It is often found in woodland on sandy soils.	Low	Broadly suitable habitat within the Study Area. Only two records within the locality. **Not recorded during site assessment.**
14.	***Euphrasia arguta***	CE	CE	P	PMST	Euphrasia arguta was rediscovered in the Nundle area of the NSW north western slopes and tablelands in 2008. Historic records of the species noted the following habitats: 'in the open forest country around Bathurst in sub humid places', 'on the grassy country near Bathurst', and 'in meadows near rivers'.	Nil	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
15.	***Genoplesium insigne*** Variable Midge Orchid	CE	CE	14	BioNet	Recorded from four localities between Chain Valley Bay and Wyong in Wyong local government area. A small population also occurs within Lake Macquarie LGA. Appears to be associated with PCT 1636 Scribbly Gum – Red Bloodwood – Angophora inopina (not always present) heathy woodland on lowlands of the Central Coast and variations containing Angophora costata.	Low	Broadly suitable habitat within the Study Area. Records within the locality. **Not recorded during site assessment.**

	Species	Status		Records	Source	Habitat	LoO	Summary
		BC	EPBC					
16.	***Grevillea parviflora subsp. parviflora*** Small-flowered Grevillea	V	V	1	BioNet, PMST	Grows in sandy or light clay soils usually over thin shales, often with lateritic ironstone gravels and nodules. Sydney region occurrences are usually on Tertiary sands and alluvium, and soils derived from the Mittagong Formation. Soil landscapes include Lucas Heights or Berkshire Park.	Nil	No suitable habitat within the Study Area. Only one record within the locality. **Not recorded during site assessment.**
17.	***Macadamia integrifolia*** Macadamia Nut		V	3	BioNet	The Macadamia Nut grows in remnant rainforest, preferring partially open areas such as rainforest edges. The Macadamia Nut prefers to grow in mild frost-free areas with a reasonably high rainfall.	Nil	No suitable habitat within the Study Area. Outside of species natural range, local records likely planted. **Not recorded during site assessment.**
18.	***Melaleuca biconvexa*** Biconvex Paperbark	V	V	P	PMST	Biconvex Paperbark is only found in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects	Nil	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
19.	***Persicaria elatior*** Tall Knotweed	V	V	P	PMST	Tall Knotweed has been recorded in south-eastern NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	Low	Broadly suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
20.	***Persoonia hirsute*** Hairy Geebung	E	E	6	BioNet	Persoonia hirsuta has a scattered distribution around Sydney. The species is distributed from Singleton in the north, along the east coast to Bargo in the south and the Blue Mountains to the west. The Hairy Geebung is found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone.	Nil	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**

	Species	Status		Records	Source	Habitat	LoO	Summary
		BC	EPBC					
21.	***Rhizanthella slateri*** Eastern Australian Underground Orchid	V	E	P	PMST	Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest. Highly cryptic given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. Therefore usually located only when the soil is disturbed. Flowers September to November.	Nil	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
22.	***Rhodamnia rubescens*** Scrub Turpentine	CE	-	P	PMST	Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils.	Nil	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
23.	***Rhodomyrtus psidioides*** Native Guava	CE	-	2	Bionet, PMST	Occurs from Broken Bay, approximately 90 km north of Sydney, New South Wales, to Maryborough in Queensland. Pioneer species found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest often near creeks and drainage lines.	Nil	No suitable habitat within the Study Area. Only two records within the locality. **Not recorded during site assessment.**
24.	***Rutidosis heterogama*** Heath Wrinklewort	V	V	118	BioNet, PMST	On the Central Coast it is located north from Wyong to Newcastle. Grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides.	Low	Broadly suitable habitat within the Study Area. Records within the locality. **Not recorded during site assessment.**
25.	***Syzgium paniculatum*** Magenta Lilly Pilly	CE	-	11	BioNet, PMST	Occurs from Broken Bay, approximately 90 km north of Sydney, New South Wales, to Maryborough in Queensland. Pioneer species found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest often near creeks and drainage lines	Nil	No suitable habitat within the Study Area. Records within the locality. **Not recorded during site assessment.**

	Species	Status		Records	Source	Habitat	LoO	Summary
		BC	EPBC					
26.	***Tetratheca juncea*** Black-eyed Susan	V	V	365	BioNet, PMST	Grows in sandy, occasionally swampy heath and in dry sclerophyll forest; chiefly in coastal districts from Bulahdelah to Lake Macquarie.	Low	Broadly suitable habitat within the Study Area. Records within the locality. **Not recorded during site assessment.**
27.	***Thesium australe*** Austral Toadflax	V	V	P	PMST	Austral Toad-flax is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast.	Nil	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
Birds								
1.	***Anthochaera phrygia*** Regent Honeyeater	CE	CE	7	BioNet, PMST	Mostly recorded in box-ironbark eucalypt associations. At times of food shortage, the species also uses other woodland types and wet lowland coastal forest dominated by Swamp Mahogany or Spotted Gum.	Low	No suitable habitat within the Study Area. Records within the locality. **Not recorded during site assessment.**
2.	***Artamus cyanopterus cyanopterus*** Dusky Woodswallow	V	-	2	BioNet	The species occurs throughout most of New South Wales, but is sparsely scattered in, or largely absent from, much of the upper western region. Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris.	Low	Broadly suitable aerial foraging habitat within the Study Area. Records within the locality. **Not recorded during site assessment.**
3.	***Botaurus poiciloptilus*** Australasian Bittern	E	E	P	PMST	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha spp.*) and spikerushes (*Eleocharis spp.*).	Low	Broadly suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**

	Species	Status		Records	Source	Habitat	LoO	Summary
		BC	EPBC					
4.	***Calyptorhynchus lathami*** Glossy Black-Cockatoo	V	-	14	BioNet	The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria. Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (*Allocasuarina littoralis*) and Forest Sheoak (A. torulosa) are important foods.	Present	Suitable foraging habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
5.	***Climacteris picumnus victoriae*** Brown Treecreeper (eastern subspecies)	V	-	1	BioNet	The Brown Treecreeper is endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range.	Nil	No suitable habitat within the Study Area. Only one record within the locality. **Not recorded during site assessment.**
6.	***Daphoenositta chrysoptera*** Varied Sittella	V	-	15	BioNet	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	Low	Broadly suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
7.	***Ephippiorhynchus asiaticus*** Black-necked Stork	E	-	1	BioNet	Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries.	Low	Broadly suitable habitat within the Study Area. Only one record within the locality. **Not recorded during site assessment.**
8.	***Epthianura albifrons*** White-fronted Chat	V	-	1	BioNet	The White-fronted Chat is found across the southern half of Australia, from southernmost Queensland to southern Tasmania. Gregarious species, usually found foraging on bare or grassy ground in wetland areas, singly or in pairs. They are insectivorous, feeding mainly on flies and beetles caught from or close to the ground.	Nil	No suitable habitat within the Study Area. Only one record within the locality. **Not recorded during site assessment.**

	Species	Status		Records	Source	Habitat	LoO	Summary
		BC	EPBC					
9.	***Falco hypoleucos*** Grey Falcon	E	V	P	PMST	Medium-sized, compact, pale falcon with a heavy, thick-set, deep-chested appearance. The species is sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast.	Nil	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
10.	***Glossopsitta pusilla*** Little Lorikeet	V	-	12	BioNet	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in *Angophora*, *Melaleuca* and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity.	Moderate	Suitable habitat within the Study Area. Records within the locality. **Not recorded during site assessment.**
11.	***Grantiella picta*** Painted Honeyeater	V	V	P	PMST	Inhabits *Acacia pendula*, *Acacia harpophylla*, Box-Gum Woodlands and Box-Ironbark Forests. Feeds on the fruits of mistletoes growing on woodland eucalyptus and acacia.	Nil	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
12.	***Haliaeetus leucogaster*** White-bellied Sea-Eagle	V	M	34	BioNet	Occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs and saltmarsh. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest).	Low	Marginal suitable habitat within the Study Area. Limited foraging habitat Records within the locality. **Not recorded during site assessment.**
13.	***Hirundapas caudacutus*** White-throated Needletail		M,V	14	BioNet, PMST	Most often seen in eastern Australia before storms, low pressure troughs and approaching cold fronts and occasionally bushfire. These conditions are often used by insects to swarm (eg termites and ants) or tend to lift insects away from the surface which favours sighting of White-throated Needletails as they feed.	Low	Broadly suitable aerial foraging habitat within the Study Area. Records within the locality. **Not recorded during site assessment.**

	Species	Status		Records	Source	Habitat	LoO	Summary
		BC	EPBC					
14.	***Lathamus discolor*** Swift Parrot	E	CE, M	76	BioNet, PMST	This migratory species has been recorded on the mainland from a variety of habitat types including dry and wet sclerophyll forest, forested wetlands, coastal swamp forests and heathlands. This species does not breed within mainland Australia. Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.	**Mapped Habitat Present**	Mapped Important habitat within the Study Area and preferred feed species including *Eucalyptus robusta* and *Corymbia gummifera*. Records within the locality. **Important habitat for the species is mapped within the Development Site.**
15.	***Lophoictinia isura*** Squared-tailed Kite	V		2	BioNet	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.	Low	Broadly suitable habitat within the Study Area. Records within the locality. **Not recorded during site assessment.**
16.	***Neophema pulchella*** Turquoise Parrot	V		1	BioNet	The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	Nil	No suitable habitat within the Study Area. Only one record within the locality. **Not recorded during site assessment.**

	Species	Status		Records	Source	Habitat	LoO	Summary
		BC	EPBC					
17.	***Ninox strenua*** Powerful Owl	V	-	21	BioNet	The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine, Black She-oak, Blackwood, Rough-barked Apple, Cherry Ballart and a number of eucalypt species. Powerful Owls nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old.	Moderate	Broadly suitable habitat within the Study Area. Suitable nesting hollows within the Study Area although very exposed (generally prefers hollows in dense vegetation). Records within the locality. **Not recorded during site assessment.**
18.	***Pandion cristatus*** Eastern Osprey	V	-	5	BioNet	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water.	Present	No foraging habitat within the Study Area. Records within the locality. Recorded nesting within the Study Area atop of a telecommunications tower. **Recorded during site assessment.**
19.	***Petroica boodang*** Scarlet Robin	V	-	1	BioNet	In NSW, it occurs from the coast to the inland slopes. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs.	Nil	Broadly suitable habitat within the Study Area. Only one record within the locality. **Not recorded during site assessment.**

	Species	Status		Records	Source	Habitat	LoO	Summary
		BC	EPBC					
20.	***Ptilinopus*** Superb Fruit-Dove	V	-	1	BioNet	The Superb Fruit-dove occurs principally from north-eastern in Queensland to north-eastern NSW. Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees.	Nil	Broadly suitable habitat within the Study Area. Only one record within the locality. **Not recorded during site assessment.**
21.	***Tyto novaehollandiae*** Masked Owl	V	-	6	BioNet	Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.	Low	Broadly suitable habitat within the Study Area. Records within the locality. **Not recorded during site assessment.**
Mammals								
1.	***Cercartetus nanus*** Eastern Pygmy-possum	V	-	2	BioNet	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Prefers dry forest close to sandstone ridgelines.	Low	Broadly suitable habitat within the Study Area and immediately surrounding Study Area. Only two records within the locality. **Not recorded during site assessment.**
2.	***Chalinolobus dwyeri*** Large-eared Pied Bat	V	V	1	BioNet, PMST	Found in well-timbered areas containing gullies. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features.	Nil	Broadly suitable foraging habitat within the Study Area, no roosting habitat present. Only one record within the locality. **Not recorded during site assessment.**

	Species	Status		Records	Source	Habitat	LoO	Summary
		BC	EPBC					
3.	***Dasyurus maculatus*** Spotted-tailed Quoll	V	E	5	BioNet, PMST	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	Low	Broadly suitable habitat within the Study Area. Record within the locality. **Not recorded during site assessment.**
4.	***Falsistrellus tasmaniensis*** Eastern False Pipistrelle	V	-	5	BioNet	Prefers moist habitats, with trees taller than 20 m. Generally, roosts in tree hollows but has also been found under loose bark on trees or in buildings.	Low	Broadly suitable habitat within the Study Area. Records within the locality. **Not recorded during site assessment.**
5.	***Micronomus norfolkensis*** Eastern Coastal Free-tailed Bat	V	-	25	BioNet	Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures.	Low	Broadly suitable habitat within the Study Area. Records within the locality. **Not recorded during site assessment.**
6.	***Miniopterus australis*** Little Bentwing-bat	V	-	36	BioNet	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. Roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings.	**Present**	Suitable foraging habitat within the Study Area. Records within the locality. **Species recorded within the Development Site**

	Species	Status		Records	Source	Habitat	LoO	Summary
		BC	EPBC					
7.	***Miniopterus orianae oceanensis*** Large Bent-winged Bat	V	-	19	BioNet	Forages in forested habitats. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings, and other man-made structures.	Low	No suitable roosting habitat. Broadly suitable foraging habitat within the Study Area. Records within the locality. **Not recorded during site assessment.**
8.	***Myotis macropus*** Southern Myotis	V	-	21	BioNet	Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage.	**Present**	Suitable foraging habitat within the Study Area. Records within the locality. **Species recorded within the Development Site**
9.	***Petauroides volans*** Greater Glider	-	V	P	PMST	Feeds exclusively on eucalypt leaves, buds, flowers and mistletoe. Shelters during the day in tree hollows.	Nil	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
10.	***Petaurus norfolcensis*** Squirrel Glider	V	-	42	BioNet	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas.	Moderate	Suitable habitat within the Study Area. Records within the locality. **Not recorded during site assessment.**
11.	***Phascolarctos cinereus*** Koala	V	E	7	BioNet, PMST	Found in a variety of forest types with suitable feed tree species.	Low	Broadly suitable habitat within the Study Area. Records within the locality. **Not recorded during site assessment.**

	Species	Status		Records	Source	Habitat	LoO	Summary
		BC	EPBC					
12.	***Potorous tridactylus tridactylus*** Long-nosed Potoroo	V	V	1	PMST	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature.	Low	Marginally suitable habitat within the Study Area. Only one record within the locality. **Not recorded during site assessment.**
13.	***Pseudomys novaehollandiae*** New Holland Mouse	-	V	110	BioNet, PMST	Inhabits open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes.	Low	Marginal habitat within the Study Area lacking understory. Records within the locality. **Not recorded during site assessment.**
14.	***Pteropus poliocephalus*** Grey-headed Flying-fox	V	V	33	BioNet, PMST	Occurs across a wide range of habitat types along the eastern seaboard of Australia, depending on food availability. Fruit from myrtaceous trees and rainforest trees form the major components of their diet.	Present	Suitable foraging habitat within the Study Area. Records within the locality. **Recorded during site assessment.**
15.	***Saccolaimus flaviventris*** Yellow-bellied Sheathtail-bat	V		2	BioNet	In the most southerly part of its range - most of Victoria, south-western NSW and adjacent South Australia - it is a rare visitor in late summer and autumn. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.	Low	Broadly suitable habitat within the Study Area. Only two records within the locality. **Not recorded during site assessment.**
16.	***Scoteanax rueppellii*** Greater Broad- nosed Bat	V	-	14	BioNet	This species occurs in a variety of habitats including rainforest, dry and wet sclerophyll forest and eucalypt woodland.	**Present**	Suitable foraging habitat within the Study Area. Records within the locality. **Species recorded within the Development Site**

	Species	Status		Records	Source	Habitat	LoO	Summary
		BC	EPBC					
17.	***Vespadelus troughtoni*** Eastern cave Bat	V		2	BioNet	The Eastern Cave Bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals	Nil	No suitable habitat within the Study Area. Only two records within the locality. **Not recorded during site assessment.**
Amphibians								
1.	***Crinia tinnula*** Wallum Froglet	V	-	66	BioNet	Wallum Froglets are found in a wide range of habitats, usually associated with acidic swamps on coastal sand plains. They typically occur in sedgelands and wet heathlands. They can also be found along drainage lines within other vegetation communities and disturbed areas, and occasionally in swamp sclerophyll forests.	Moderate	Broadly suitable habitat within the Study Area. Records within the locality. **Not recorded during site assessment.**
2.	***Heleioporus australiacus*** Giant Burrowing Frog	V	V	P	PMST	Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Breeding habitat of this species is generally soaks or pools within first or second order streams. They are also commonly recorded from 'hanging swamp' seepage lines and where small pools form from the collected water.	Nil	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**

	Species	Status		Records	Source	Habitat	LoO	Summary
		BC	EPBC					
3.	***Litoria aurea*** Green and Golden Bell Frog	E	V	4	BioNet, PMST	This species prefers open water bodies, fringed by reeds and other aquatic vegetation for breeding and foraging purposes. Needs fallen logs and debris for shelter and over-wintering purposes.	Low	Marginally suitable habitat within the Study Area, albeit degraded. Records within the locality. **Not recorded during site assessment.**
4.	***Mixophyes balbus*** Stuttering Frog	E	V	P	PMST	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range.	Nil	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
5.	***Uperoleia mahonyi*** Mahony's Toadlet	E	E	P	PMST	Mahony's Toadlet is endemic to the mid-north coast of New South Wales (NSW) and to date has been found between Kangy Angy and Seal Rocks. Mahony's Toadlet inhabits ephemeral and semi-permanent swamps and swales on the coastal fringe of its range.	Nil	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
Migratory Species								
1.	***Apus pacificus*** Pacific Swift	-	M	P	PMST	Almost entirely aerial and give spectacular displays of high-speed flying above any habitat, urban or rural. Swifts are most often seen in late summer, nearly always in flocks. They are typically associated with stormy weather when they feed on nuptial swarms of various insects.	Nil	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**

	Species	Status		Records	Source	Habitat	LoO	Summary
		BC	EPBC					
2.	***Cuculus optatus*** Oriental Cuckoo	-	M	P	PMST	Inhabits rainforest margins, monsoon forest, vine scrub, riverine thickets, wet densely canopied Eucalypt forests, paperbark swamp and mangroves.	Nil	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
3.	***Hirundapus caudacutus*** White-throated Needletail	-	M,V	14	BioNet PMST	Forages in high open spaces over varied habitat types. May aerially forage over the Development Site.	Low	Broadly suitable aerial foraging habitat within the Study Area. Records within the locality. **Not recorded during site assessment.**
4.	***Monarcha melanopsis*** Black-faced Monarch	-	M	P	PMST	Found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating.	Nil	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
5.	***Monarcha trivirgatus*** Spectacled Monarch	-	M	P	PMST	Prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves.	Nil	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
6.	***Motacilla flava*** Yellow Wagtail	-	M	P	PMST	Typically inhabits inundated fields, saltmarsh and wetlands and occasionally coastal areas.	Nil	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**

	Species	Status		Records	Source	Habitat	LoO	Summary
		BC	EPBC					
7.	***Myiagra cyanoleuca*** Satin Flycatcher	-	M	P	PMST	Found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests.	Nil	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
8.	***Rhipidura rufifrons*** Rufous Fantail	-	M	P	PMST	Found in rainforest, dense wet forests, swamp woodlands and mangroves, preferring deep shade, and is often seen close to the ground.	Nil	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
Threatened Ecological Communities								
1.	Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community.	-	E	P	PMST	The ecological community is found within the South Eastern Queensland (SEQ), NSW North Coast (NNC), Sydney Basin (SYB) and part of the South East Corner (SEC) IBRA7 bioregions. The canopy layer is dominated2 by Casuarina glauca (swamp oak, swamp she-oak).	Not present	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
2.	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	-	P	PMST	Known from along the majority of the NSW coast. Associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years.	**Present**	Vegetation within the Study Area consistent with EEC.

	Species	Status		Records	Source	Habitat	LoO	Summary
		BC	EPBC					
3.	River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	E	CE	P	PMST	Given its habitat, the community has an important role in maintaining river ecosystems and riverbank stability Associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Generally occurs below 50 m elevation, but may occur on localised river flats up to 250 m above sea level.	Not present	No suitable habitat within the Study Area. No records within the locality. **Not recorded during site assessment.**
4.	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	-	P	PMST	Associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Generally occurs below 20 m (though sometimes up to 50 m) elevation.	**Present**	Vegetation within the Study Area consistent with EEC.

APPENDIX B – FLORA SPECIES LIST

Table C1 - Flora Species List

Growth Form	Species	Q01		Q02		Q03		Q04		Q05		Q06		Q07		Q08		Q09		Q10		Q11		Q12		Q13		Q14	
		Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.
Exotic	*Agapanthus praecox*							0.1	10																				
Exotic	*Axonopus fissifolius*					1	20							45	1000	1	40					1	100			30	1000	5	100
Exotic	*Briza maxima*																	0.2	10									0.5	100
Exotic	*Bulbine bulbosa*																	0.1	30										
Exotic	*Cinnamomum camphora*																							5	1				
Exotic	*Conyza bonariensis*																	0.1	2										
Exotic	*Crassula multicalva*																					2	100						
Exotic	*Cyclospermum leptophyllum*																	0.1	15										
Exotic	*Cynodon dactylon*																					30	1000						
Exotic	*Cynodon incompletus*					40	10000																						
Exotic	*Cyperus polystachyos*							0.1	20	5	60	1	50	1	50							20	1000	5	100			0.5	20
Exotic	*Gamochaeta americana*					50	1000																						
Exotic	*Gomphocarpus fruticosus*																									0.1	5		
Exotic	*Hydrocotyle bonariensis*							0.1	10	0.1	80	0.1	20					0.1	2			0.2	100			5	1000		
Exotic	*Hypericum perforatum*																			0.1	10								
Exotic	*Hypochaeris radicata*			5	1000																								
Exotic	*Iris sp.*																									1	20		
Exotic	*Juncus cognatus*									2	60			0.1	40			0.1	50			1	50						
Exotic	*Juncus sp.*																											0.1	10
Exotic	*Lysimachia arvensis*													0.1	10														
Exotic	*Medicago lupulina*													0.1	10											0.1	40		
Exotic	*Megathyrsus maximus*									0.1	5																		
Exotic	*Pinus radiata*	10	5							0.1	1	2	15			20	8											2	5
Exotic	*Plantago lanceolata*					1	20					0.2	50	1	1000	0.1	10	0.1	40	0.5	50			0.5	100	0.1	50		
Exotic	*Poa annua*															1	40			10	500								
Exotic	*Richardia humistrata*			2	1000							0.1	20	0.5	300	0.1	20			0.1	20								
Exotic	*Securigera varia*													0.3	100														
Exotic	*Setaria pumila*							0.2	20			10	50											5	100			1	80
Exotic	*Sida rhombifolia*													0.1	5	0.1	1									0.2	10		
Exotic	*Sporobolus africanus*													5	500											5	500	5	500
Exotic	*Stachys arvensis*																			0.1	10								
Exotic	*Tagetes minuta*													0.1	10														
Exotic	*Taraxacum officinale*							0.1	40			0.2	100	0.5	100	0.1	20	0.1	30					0.2	30				
Exotic	*Trifolium repens*																					0.1	50						
Exotic	*Verbena bonariensis*											0.1	1	0.2	5											0.2	5		
Fern	*Gleichenia dicarpa*									1	300																		
Fern	*Lindsaea linearis*	0.5	20					0.1	20											0.1	10								
Fern	*Sellaginella uliginosa*									0.5	50											0.2	100						
Forb	*Caladenia catenata*			0.1	2													0.1	5										
Forb	*Commelina cyanea*																							0.1	20				
Forb	*Cryptostylis subulata*	0.5	10															0.1	30										

Growth Form	Species	Q01		Q02		Q03		Q04		Q05		Q06		Q07		Q08		Q09		Q10		Q11		Q12		Q13		Q14	
		Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.
Forb	*Damasonium minus*									0.1	10																		
Forb	*Dampiera stricta*																	0.1	10										
Forb	*Dianella caerulea*	1	20					0.3	30			0.2	20					0.1	3										
Forb	*Dichondra repens*							0.1	50			0.1	40							0.1	40			0.1	100			0.1	200
Forb	*Euphorbia drummondii*					1	20																						
Forb	*Geranium solanderi*																							0.5	100				
Forb	*Gonocarpus micranthus*									0.1	20											0.1	100						
Forb	*Gonocarpus teucrioides*	0.5	20	2	500							0.1	40					0.1	5									0.1	10
Forb	*Goodenia bellidifolia*									0.1	20																		
Forb	*Haemodorum planifolium*																	0.1	4										
Forb	*Lagenifera stipitata*											0.1	60			0.1	20	0.1	50										
Forb	*Lobelia purpurascens*	0.5	50					0.1	50			0.1	20			0.1	10	0.1	20					0.5	500			0.1	50
Forb	*Microtis sp.*																	0.1	5										
Forb	*Opercularia diphylla*																			0.1	20								
Forb	*Opercularia varia*							0.1	5																				
Forb	*Oxalis perennans*							0.1	10			0.1	20	0.5	100					0.1	50			0.1	40				
Forb	*Patersonia sericea*	0.5	20																										
Forb	*Philydrum lanuginosum*																					0.1	50						
Forb	*Portulaca oleracea*																					1	50						
Forb	*Ranunculus inundatus*									0.1	5											0.1	20						
Forb	*Stylidium gramineum*																	0.1	20										
Forb	*Thelymitra branwhitei*																	0.1	10										
Forb	*Thelymitra pauciflora*																	0.1	5										
Forb	*Trachymene incisa*	0.5	5																										
Forb	*Viola hederacea*																	0.1	40										
Forb	*Xyris gracilis*																					1	50						
Grass (Grass Like)	*Aristida vagans*	1	10																										
Grass (Grass Like)	*Baumea rubiginosa*									30	1000																		
Grass (Grass Like)	*Carex inversa*							0.1	30																				
Grass (Grass Like)	*Cyathochaeta diandra*							40	1000																				
Grass (Grass Like)	*Cyperus sanguinolentus*									2	50																		
Grass (Grass Like)	*Echinopogon caespitosus*																							5	1000	20	1000	2	50
Grass (Grass Like)	*Entolasia stricta*	20	1000	2	500			1	50			5	100					10	1000									0.5	100
Grass (Grass Like)	*Eragrostis brownii*																			5	500								
Grass (Grass Like)	*Eragrostis leptostachya*	0.5	100	2	1000							5	500	10	1000			2	500	10	1000							0.5	100
Grass (Grass Like)	*Fimbristylis dichotoma*							0.1	30	0.5	50							0.1	5	0.1	10	0.3	50						
Grass (Grass Like)	*Gahnia clarkei*									15	20																		
Grass (Grass Like)	*Imperata cylindrica*	5	1000	2	500							15	1000															50	1000
Grass (Grass Like)	*Juncus holoschoenus*									3	50																		
Grass (Grass Like)	*Juncus subsecundus*													0.2	50			0.1	10			0.5	100	0.1	50			0.5	20
Grass (Grass Like)	*Lepidosperma concavum*	2	20													0.1	1												
Grass (Grass Like)	*Lepidosperma laterale*	5	20					2	20			0.1	5					1	20										

Growth Form	Species	Q01		Q02		Q03		Q04		Q05		Q06		Q07		Q08		Q09		Q10		Q11		Q12		Q13		Q14	
		Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.
Grass (Grass Like)	*Lepidosperma neesii*							1	30					0.1	4			0.1	10	0.1	5								
Grass (Grass Like)	*Lepyrodia scariosa*	20	1000																			5	500						
Grass (Grass Like)	*Lomandra cylindrica*																	0.1	10										
Grass (Grass Like)	*Lomandra multiflora*																	0.1	20										
Grass (Grass Like)	*Lomandra obliqua*							0.1	30			0.1	10					0.5	20										
Grass (Grass Like)	*Microlaena stipoides var. stipoides*			2	1000											0.5	50	5	500	20	1000								
Grass (Grass Like)	*Ptilothrix deusta*							0.5	30									10	1000										
Grass (Grass Like)	*Schoenus apogon*									4	200			0.1	100	0.1	2	0.1	30			30	1000	5	1000			0.1	20
Grass (Grass Like)	*Schoenus brevifolius*	2	500																										
Grass (Grass Like)	*Sporobolus virginicus*							15	300			0.5	50									5	500	5	300				
Grass (Grass Like)	*Themeda australis*	10	1000					5	100			2	40					30	1000									1	100
High Threat Weed	*Andropogon virginicus*	5	1000					0.1	20	35	1000	30	1000	80	1000			2	100			2	500			5	500		
High Threat Weed	*Asparagus aethiopicus*																							0.1	4				
High Threat Weed	*Cenchrus clandestinum*											10	1000							5	500			65	1000				
High Threat Weed	*Ehrharta erecta*							10	200																				
High Threat Weed	*Hyparrhenia hirta*																									35	1000	15	500
High Threat Weed	*Lantana camara*																											1	5
High Threat Weed	*Paspalum dilatatum*																					10	500	5	100			10	100
High Threat Weed	*Rubus anglocandicans*																							5	20			5	50
High Threat Weed	*Senecio madagascariensis*											0.1	10	1	50	0.1	10	0.1	5							1	50		
Other	*Billardiera scandens*																	0.1	10										
Other	*Cassytha glabella*																	0.1	20										
Other	*Glycine tabacina*																	0.1	30										
Other	*Hardenbergia violacea*			1	200							0.1	2					0.1	30										
Other	*Parsonsia straminea*																	0.1	3										
Other	*Xanthorrhoea fulva*							3	7									0.5	5										
Other	*Xanthorrhoea latifolia*	2	20																										
Other	*Xanthorrhoea media*	10	20																										
Shrub	*Acacia fimbriata*																	0.5	5										
Shrub	*Acacia longifolia*	2	10					0.2	2																				
Shrub	*Acacia suaveolens*	2	20																										
Shrub	*Acacia ulicifolia*											0.2	3																
Shrub	*Banksia oblongifolia*	1	5													0.1	1												
Shrub	*Daviesia ulicifolia*	1	20																										
Shrub	*Dillwynia retorta*	5	20					0.1	5			6	10					5	20										
Shrub	*Dodonaea triquetra*															0.1	1												
Shrub	*Epacris pulchella*			1	200			0.1	10			0.3	20					1	50										
Shrub	*Gompholobium latifolium*	1	50																										
Shrub	*Hovea linearis*																	0.1	5										
Shrub	*Leptospermum polygalifolium*									0.1	1																		
Shrub	*Leptospermum trinervium*	2	10	1	50			0.5	4																				
Shrub	*Melaleuca sieberi*	20	30																			0.1	1	3	1			0.2	2

Growth Form	Species	Q01		Q02		Q03		Q04		Q05		Q06		Q07		Q08		Q09		Q10		Q11		Q12		Q13		Q14	
		Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.	Cov.	Abun.
Shrub	*Melaleuca thymifolia*	2	20																										
Shrub	*Mirbelia rubiifolia*	1	10									1	10					1	30	0.1	5								
Shrub	*Monotoca elliptica*																	2	10										
Shrub	*Pimelea linifolia*	1	50															0.1	2									0.1	2
Shrub	*Pittosporum undulatum*																	0.1	2										
Shrub	*Pultenaea sp.*																	0.1	10										
Shrub	*Pultenaea rosmarinifolia*			1	50																								
Shrub	*Pultenaea tuberculata*																	0.1	3										
Tree	*Allocasuarina littoralis*	5	10					45	40	0.1	1	0.1	1					0.1	1	10	13							0.2	10
Tree	*Angophora costata*			2	1	5	1	0.1	10	5	2	0.1	5	1	2	15	4	10	30	30	4					0.5	1	40	2
Tree	*Angophora floribunda*	15	5																										
Tree	*Archontophoenix cunninghamiana*							0.1	1																				
Tree	*Corymbia gummifera*			5	2							5	1			20	4												
Tree	*Eucalyptus acmenoides*															2	10												
Tree	*Eucalyptus capitellata*			5	2																							5	10
Tree	*Eucalyptus haemastoma*			40	5			15	3	0.1	10	25	3					35	6	5	1					10	2		
Tree	*Eucalyptus racemosa*	20	2																										
Tree	*Eucalyptus resinifera*																							15	2				
Tree	*Eucalyptus robusta*	5	1																										
Tree	*Glochidion ferdinandi*																							2	3	2	1		
Tree	*Livistona australis*																							3	1				
Tree	*Melaleuca quinquenervia*							2	4	5	10			0.1	1					5	1	0.1	5	30	6				

Table B2 Flora Species List – Exotic Vegetation Plots

No.	Family	Scientific Name	Common Name	Form	Q15		Q16	
					Cover	Abund	Cover	Abund
1.	**Apiaceae**	*Hydrocotyle bonariensis*		Exotic	3	1000		
2.	**Asparagaceae**	*Asparagus aethiopicus*	Asparagus Fern	HTW			0.1	3
3.	**Asteraceae**	*Bidens pilosa*	Cobbler's Pegs	Exotic	0.1	30	0.1	1
4.	**Asteraceae**	*Hypochaeris radicata*	Catsear	Exotic	0.1	20	0.1	10
5.	**Asteraceae**	*Senecio madagascariensis*	Fireweed	Exotic	0.5	20	0.1	4
6.	**Asteraceae**	*Tagetes minuta*	Stinking Roger	Exotic	0.5	10		
7.	**Commelinaceae**	*Tradescantia fluminensis*	Wandering Jew	HTW	0.1	10		
8.	**Fabaceae (Caesalpinioideae)**	*Senna pendula var. glabrata*		Exotic	0.5	1		
9.	**Fabaceae (Faboideae)**	*Medicago lupulina*	Black Medic	Exotic	0.2	100		
10.	**Fabaceae (Faboideae)**	*Medicago spp.*		Exotic	0.1	20		
11.	**Fabaceae (Faboideae)**	*Trifolium repens*	White Clover	Exotic	2	1000	0.1	20
12.	**Fabaceae (Faboideae)**	*Vicia spp.*	Vetch	Exotic	2	5		
13.	**Fabaceae (Mimosoideae)**	*Acacia falcata*		Shrub (SG)	0.2	1		
14.	**Juncaceae**	*Juncus cognatus*		Exotic	0.2	100		
15.	**Malvaceae**	*Modiola caroliniana*	Red-flowered Mallow	Exotic	0.1	20		
16.	**Myrtaceae**	*Angophora costata*	Sydney Red Gum	Tree (TG)			0.5	1
17.	**Nyctaginaceae**	*Bougainvillea glabra*		Exotic	1	1		
18.	**Pinaceae**	*Pinus radiata*	Radiata Pine	Exotic	1	3	65	14
19.	**Plantaginaceae**	*Plantago lanceolata*	Lamb's Tongues	Exotic	0.1	20	0.1	10

No.	Family	Scientific Name	Common Name	Form	Q15		Q16	
					Cover	Abund	Cover	Abund
20.	**Poaceae**	*Andropogon virginicus*	Whisky Grass	HTW	5	100		
21.	**Poaceae**	*Axonopus fissifolius*	Narrow-leafed Carpet Grass	HTW	80	1000	20	1000
22.	**Poaceae**	*Briza subaristata*		HTW	5	100	1	30
23.	**Poaceae**	*Cenchrus clandestinus*	Kikuyu Grass	Exotic			45	1000
24.	**Poaceae**	*Cynodon dactylon*	Common Couch	Grass & grasslike (GG)			1	50
25.	**Poaceae**	*Imperata cylindrica*	Blady Grass	Grass & grasslike (GG)	1	100		
26.	**Poaceae**	*Paspalum dilatatum*	Paspalum	HTW	10	1000		
27.	**Poaceae**	*Sporobolus africanus*	Parramatta Grass	Exotic	10	1000		

APPENDIX C – FAUNA SPECIES LIST

Table C1 Fauna Species List

Scientific Name	Common Name	Status		Observation Type
		BC	EPBC	
Crinia signifera	Common Froglet	N/A	N/A	Observed/Heard
Limnodynastes peronii	Brown-striped Frog	P	N/A	Observed/Heard
Litoria fallax	Eastern Dwarf Tree Frog	P	N/A	Observed/Heard
Litoria peronii	Peron's Tree Frog	P	N/A	Observed/Heard
Litoria tyleri	Tyler's Tree Frog	P	N/A	Observed/Heard
Uperoleia fusca	Dusky Toadlet	P	N/A	Observed/Heard
Acanthiza lineata	Striated Thornbill	P	N/A	Observed
Acanthiza pusilla	Brown Thornbill	P	N/A	Observed
Acanthorhynchus tenuirostris	Eastern Spinebill	P	N/A	Observed
Acridotheres tristis	Common Myna	P	N/A	Observed
Anthochaera carunculata	Red Wattlebird	P	N/A	Observed
Cacatua galerita	Sulphur-crested Cockatoo	P	N/A	Observed
Cacatua sanguinea	Little Corrella	P	N/A	Observed
Caligavis chrysops	Yellow-faced Honeyeater	P	N/A	Observed
Centropus phasianinus	Pheasant Coucal	P	N/A	Observed
Chenonetta jubata	Australian Wood Duck	P	N/A	Observed
Coracina novaehollandiae	Black-faced Cockoo-shrike	P	N/A	Observed
Corvus coronoides	Australian Raven	P	N/A	Observed
Cracticus nigrogularis	Pied Butcherbird	P	N/A	Observed
Cracticus torquatus	Grey Butcherbird	P	N/A	Observed
Dacelo novaeguineae	Laughing Kookaburra	P	N/A	Observed
Elanus axillaris	Black-shouldered Kite	P	N/A	Observed
Eolophus roseicapilla	Galah	P	N/A	Observed
Eopsaltria australis	Eastern Yellow Robin	P	N/A	Observed
Eudynamys orientalis	Eastern Koel	P	N/A	Observed
Eurystomus orientalis	Dollarbird	P	N/A	Observed
Glossopsitta concinna	Musk Lorikeet	P	N/A	Observed
Grallina cyanoleuca	Magpie Lark	P	N/A	Observed
Gymnorhina tibicen	Australian Magpie	P	N/A	Observed
Hirundapus cochinensis	White-throated Needle-tail	P	N/A	Observed
Hirundo neoxena	Welcome Swallow	P	N/A	Observed

Scientific Name	Common Name	Status		Observation Type
		BC	EPBC	
Malurus cyaneus	Superb Fairywren	P	N/A	Observed
Meliphaga lewinii	Lewin's Honeyeater	P	N/A	Observed
Melithreptus brevirostris	Brown-headed Honeyeater	P	N/A	Observed
Ocyphaps lophotes	Crested Pigeon	P	N/A	Observed
Pachycephala pectoralis	Australian Golden Whistler	P	N/A	Observed
Pardalotus punctatus	Spotted Pardalote	P	N/A	Observed
Phylidonyris niger	White-cheeked Honeyeater	P	N/A	Observed
Platycercus eximius	Eastern Rosella	P	N/A	Observed
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Observed
Rhipidura albiscapa	Grey Fantail	P	N/A	Observed
Rhipidura leucophrys	Willie Wagtail	P	N/A	Observed
Scythrops novaehollandiae	Channel-billed Cuckoo	P	N/A	Observed
Sericornis frontalis	White-browed Scrubwren	P	N/A	Observed
Sphecotheres vieilloti	Australian Figbird	P	N/A	Observed
Strepera graculina	Pied Currawong	P	N/A	Observed
Todiramphus sanctus	Sacred Kingfisher	P	N/A	Observed
Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet	P	N/A	Observed
Trichoglossus moluccanus	Rainbow Lorikeet	P	N/A	Observed
Vanellus miles	Masked Lapwing	P	N/A	Observed
Acrobates pygmaeus	Feathertail Glider	P	N/A	Observed
Chalinolobus gouldii	Gould's Wattled Bat	P	N/A	Anabat
Chalinolobus morio	Chocolate Wattled Bat	P	N/A	Anabat
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V,P	N/A	Anabat
Miniopterus australis	Little Bent-winged Bat	V,P	N/A	Anabat
Myotis macropus	Southern Myotis	V,P	N/A	Anabat
Nyctophilus sp.	long-eared bat	P	N/A	Anabat
Ozimops ridei	Eastern Free-tailed Bat	P	N/A	Anabat
Petaurus breviceps	Sugar Glider	P	N/A	Camera Detection
Pseudocheirus peregrinus	Common Ringtail Possum	P	N/A	Anabat
Rattus rattus	Black Rat	N/A	N/A	Camera Detection
Scoteanax rueppellii	Greater Broad-nosed Bat	V,P	N/A	Anabat

Scientific Name	Common Name	Status		Observation Type
		BC	EPBC	
Scotorepens orion	Eastern Broad-nosed Bat	P	N/A	Anabat
Trichosurus vulpecula	Common Brushtail Possum	P	N/A	Observed
Vespadelus darlingtoni	Large Forest Bat	P	N/A	Anabat
Vespadelus pumilus	Eastern Forest Bat	P	N/A	Anabat
Vespadelus vulturnus	Little Forest Bat	P	N/A	Anabat

APPENDIX D – THREATENED ECOLOGICAL COMMUNITY DETERMINATIONS

NSW Biodiversity Conservation Act 2016

Threatened Ecological Community Determination – BC Act *Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions - EEC*.

Vegetation Zone 1: PCT 1649 – Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Good Condition – EEC)

Decision Key Criteria	Answer	Justification
Occurs in the NSW North Coast, Sydney Basin and Southeast Corner IBRA7 Bioregions?	Yes	The Study Area is based within the Sydney Basin IBRA Bioregion.
Occurs within Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, Lake Macquarie, Wyong, Gosford, Hornsby, Pittwater, Warringah, Manly, Liverpool, Rockdale, Botany Bay, Randwick, Sutherland, Wollongong, Shellharbour, Kiama and Shoalhaven but may occur elsewhere in these bioregions.	Yes	The Study Area occurs within the Wyong LGA
Is the ecological community associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains – which are generally below 20m elevation, and no more than 50m elevation.	Yes	Soil profiles on the same landscape position and adjacent to the site (obtained from DPIE (eSPADE)) identifies the soil landscape within the Study Area as being Doyalson (do) associated with sand loams. Elevation is approximately 18 m.

Decision Key Criteria	Answer	Justification
Does the community have an open or dense tree layer of eucalypts and paperbarks, which may exceed 25 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality?	Yes	Canopy cover is consistent with an open forest. Canopy is dominated by *Eucalyptus robusta* (Swamp Mahogany), *Angophora floribunda* (Rough-barked Apple) with *Melaleuca quinquenervia* (Broad-leaved Paperbark).
Is the groundcover of the community composed of abundant sedges, ferns, forbs, and grasses?	Yes	The groundcover is a mix of native grasses and sedges including *Entolasia stricta* (Wiry Panic), *Themeda triandra* (Kangaroo Grass), *Xanthorrhoea media*, *Lepyrodia scariosa*, and *Lepidosperma laterale* (Variable Sword-sedge).
Does this community have a relatively dense tree canopy dominated by *Eucalyptus robusta, Melaleuca quinquenervia* or *E. botryoides*? Does this community also contain the relatively infrequent occurrence of other eucalypts, *Casuarina glauca* or *Lophostemon suaveolens*; the occasional presence of rainforest elements as scattered trees or understorey plants; and the prominence of large sedges and ferns in the groundcover?	Yes	Canopy is dominated by *Eucalyptus robusta* (Swamp Mahogany) and some areas *Melaleuca quinquenervia*. No *Casuarina glauca* or *Lophostemon* occurs within this Vegetation Zone. As stated above, ground cover varies, but is generally dominated by grasses and sedges.
Are the soils are usually waterlogged, stained black or dark grey with humus, and show little influence of saline ground water?	Yes	The soils are light-dark brown. Most of this community had very waterlogged soil. There is no signs of saline water influence which can be seen from the absence of saline tolerant vegetation, i.e. *Phragmites australis* and *Casuarina glauca*.
Determination	This Vegetation Zone meets the definition of the Endangered Ecological Community *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* as listed under the NSW Biodiversity Conservation Act 2016.	

Vegetation Zone 2 – *PCT 1649 – Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands* (Low-Moderate Condition – EEC)

Decision Key Criteria	Answer	Justification
Occurs in the NSW North Coast, Sydney Basin and Southeast Corner IBRA7 Bioregions?	Yes	The Study Area is based within the Sydney Basin IBRA Bioregion.
Occurs within Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, Lake Macquarie, Wyong, Gosford, Hornsby, Pittwater, Warringah, Manly, Liverpool, Rockdale, Botany Bay, Randwick, Sutherland, Wollongong, Shellharbour, Kiama and Shoalhaven but may occur elsewhere in these bioregions.	Yes	The Study Area occurs within the Wyong LGA
Is the ecological community associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains – which are generally below 20m elevation, and no more than 50m elevation.	Yes	Soil profiles on the same landscape position and adjacent to the site (obtained from DPIE (eSPADE)) identifies the soil landscape within the Study Area as being Doyalson (do) associated with sand loams. Elevation is approximately 18 m.
Does the community have an open to dense tree layer of eucalypts and paperbarks, which may exceed 25 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality?	Yes	Canopy cover varies across the Vegetation Zone but is generally consistent with an open forest. Canopy is dominated by *Melaleuca quinquenervia* (Broad-leaved Paperbark), *Eucalyptus robusta* (Swamp Mahogany), with occasional mature *Angophora costata* (Smooth barked Apple).

Decision Key Criteria	Answer	Justification
Is the groundcover of the community composed of abundant sedges, ferns, forbs, and grasses?	Yes	The groundcover is dominated by a mix of native and exotic grasses including *Andropogon virginicus*, *Themeda triandra*, *Sporobolus virginicus, and Eragrostis leptostachya*. Low lying areas had a greater abundance of species such as *Baumea rubiginosa, Cyperus polystachyos*, *Schoenus apogon*, and *Juncus holoschoenus*.
Does this community have a relatively dense tree canopy dominated by *Eucalyptus robusta, Melaleuca quinquenervia* or *E. botryoides*? Does this community also contain the relatively infrequent occurrence of other eucalypts, *Casuarina glauca* or *Lophostemon suaveolens*; the occasional presence of rainforest elements as scattered trees or understorey plants; and the prominence of large sedges and ferns in the groundcover?	Yes	Canopy is dominated by *Eucalyptus robusta* (Swamp Mahogany) *Melaleuca quinquenervia* (Broad-leaved Paperbark). No *Casuarina glauca* or *Lophostemon* occurs within this Vegetation Zone. As stated above, ground cover varies, but is generally dominated by grasses and sedges.
Are the soils are usually waterlogged, stained black or dark grey with humus, and show little influence of saline ground water?	Yes	The soils are light-dark brown. Most of this community had very waterlogged soil. There is minimal signs of saline water influence which can be seen from the absence of saline tolerant vegetation across most of the vegetation zone, i.e. *Phragmites australis* and *Casuarina glauca*.
Determination	This Vegetation Zone meets the definition of the Endangered Ecological Community *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* as listed under the BC Act.	

Vegetation Zone 3 - *PCT 1649 – Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Cleared)*

Decision Key Criteria	Answer	Justification
Occurs in the NSW North Coast, Sydney Basin and Southeast Corner IBRA7 Bioregions?	Yes	The Study Area is based within the Sydney Basin IBRA Bioregion.
Occurs within Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, Lake Macquarie, Wyong, Gosford, Hornsby, Pittwater, Warringah, Manly, Liverpool, Rockdale, Botany Bay, Randwick, Sutherland, Wollongong, Shellharbour, Kiama and Shoalhaven but may occur elsewhere in these bioregions.	Yes	The Study Area occurs within the Wyong LGA
Is the ecological community associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains – which are generally below 20m elevation, and no more than 50m elevation.	Yes	Soil profiles on the same landscape position and adjacent to the site (obtained from DPIE (eSPADE)) identifies the soil landscape within the Study Area as being Doyalson (do) associated with sand loams. Elevation is approximately 18 m.
Does the community have an open or dense tree layer of eucalypts and paperbarks, which may exceed 25 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality?	No	The vegetation zone does not have an intact canopy

Decision Key Criteria	Answer	Justification
Is the groundcover of the community composed of abundant sedges, ferns, forbs, and grasses?	Yes	The groundcover is a mix of native grasses and sedges including *Entolasia stricta* (Wiry Panic), *Themeda triandra* (Kangaroo Grass), *Xanthorrhoea media*, *Lepyrodia scariosa*, and *Lepidosperma laterale* (Variable Sword-sedge).
Does this community have a relatively dense tree canopy dominated by *Eucalyptus robusta, Melaleuca quinquenervia* or *E. botryoides*? Does this community also contain the relatively infrequent occurrence of other eucalypts, *Casuarina glauca* or *Lophostemon suaveolens*; the occasional presence of rainforest elements as scattered trees or understorey plants; and the prominence of large sedges and ferns in the groundcover?	No	The vegetation zone does not have an intact canopy
Are the soils are usually waterlogged, stained black or dark grey with humus, and show little influence of saline ground water?	Yes	The soils are light-dark brown. Most of this community had very waterlogged soil. There is no signs of saline water influence which can be seen from the absence of saline tolerant vegetation, i.e. *Phragmites australis* and *Casuarina glauca*.
Determination	This Vegetation Zone **does not meet** the definition of the Endangered Ecological Community *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* as listed under the NSW Biodiversity Conservation Act 2016.	

Threatened Ecological Community Determination – BC Act *Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions - EEC*.

Vegetation Zone 7: *PCT 1736 - Typha Rushland (EEC)*

Decision Key Criteria	Answer	Justification
Occurs on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is known from parts of the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes, Port Stephens, Maitland, Newcastle, Cessnock, Lake Macquarie, Wyong, Gosford, Hawkesbury, Baulkham Hills, Blacktown, Penrith, Fairfield, Liverpool, Wollondilly, Camden, Campbelltown, Wollongong, Shellharbour, Kiama, Shoalhaven, Eurobodalla and Bega Valley but may occur elsewhere in these bioregions.	Yes	The Study Area is based within the Sydney Basin IBRA Bioregion. The Study Area is within a coastal floodplain and within the Central Coast LGA.
Occurs on silts, muds or humic loams in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains. Occurs below 20 m elevation.	Yes	The Vegetation Zone is located in a drainage depression in a low-lying area near the coast.

Decision Key Criteria	Answer	Justification
Vegetation is dominated by herbaceous plants and have very few woody species as listed in the determination.	Yes	The vegetation within this zone is characterised by a dense layer of emergent aquatic plants such as sedges and rushes. Characteristic species include *Typha orientalis* (Broad-leaved Cumbungi), *Machaerina rubiginosa, Gahnia clarkei* (Tall Saw-sedge) and *Carex appressa* (Tall Sedge).
Artificial wetlands created on previously dry land specifically for purposes such as sewerage treatment, stormwater management and farm production, are not regarded as part of this community. Does the Vegetation occur as a result of the above-mentioned land management practices?	Yes	Whilst the wetland appears to be associated with the construction of the fire trail along the northern boundary of the Study Area. However, the continuation of similar wetland vegetation to the north of the site suggests the wetland is naturally occurring.
Determination	This Vegetation Zone meets the definition of the Endangered Ecological Community *Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* as listed under the BC Act.	

Commonwealth's Environment Protection Biodiversity Conservation Act 1999

Threatened Ecological Community Determination – EPBC Act *Coastal Swamp Sclerophyll Forest of New South Wales North Coast and South-east Queensland*– EEC.

Vegetation Zone 1 - PCT 1649 – *Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands* (Good Condition – EEC)

The key diagnostic characteristics are designed to allow identification of the ecological community irrespective of the season. Areas of vegetation that do not meet the key diagnostics do not support the nationally listed ecological community. The ecological community is defined as patches of native vegetation meeting the description in Section 1 of the Conservation Advice that meet the following key diagnostic characteristics (see table below).

Decision Key Criteria	Answer	Justification
Occurs on the mainland and islands near to the coast (within 20 km) from South East Queensland to south-eastern NSW specifically within these IBRA Bioregions: South Eastern Queensland (SEQ); NSW North Coast (NNC); Sydney Basin (SYB) and the Bateman sub-region of the South East Corner (SEC).	**Yes**	The Study Area Is based within the **Sydney Basin** IBRA Bioregion.
Occurs in coastal catchments typically below 20m ASL, but occasionally up to 220m ASL	**Yes**	The Vegetation within the Study Area occurred at an elevation of approximately 18m ASL.

Decision Key Criteria	Answer	Justification
Occurs on hydric soils with inundation patterns ranging from intermittent to episodic.	**Yes**	Soil profiles on the same landscape position and adjacent to the site (obtained from DPIE (eSPADE)) identifies the soil landscape within the Study Area as being Doyalson (do) associated with sand loams. Elevation is approximately 18 m.
The vegetation structure varies from tall closed to open forest to woodland, to dense (closed) shrubland or scrub forest. Minimum crown cover (see footnote 5, p. 4) is at least 10%, but it is more typically in the range 50% to 70%.	**Yes**	Canopy cover is consistent with an open forest.
From South East Queensland to the Sydney Basin Bioregion, the canopy[9] is typically dominated or co-dominated by *Melaleuca quinquenervia* and/or *Eucalyptus robusta*. In some areas, the canopy may be locally dominated by other melaleuca species including *M. dealbata* (SEQ bioregion) (rarely); *M. biconvexa* (mid-NSW coast to south of Sydney); *M. decora* (north of Shoalhaven), frequently with *Parsonsia straminea* climbing on the trunks of canopy species. In the SEC bioregion, *M. ericifolia* may occur as a dominant canopy or sub-canopy species.	**Yes**	Canopy is dominated by *Melaleuca quinquenervia* (Broad-leaved Paperbark) and *Eucalyptus robusta* (Swamp Mahogany).
Other tree species may occur in the canopy (or sub-canopy) in some areas, but they are not dominant across a patch, including *Casuarina glauca*, *Banksia* spp., *Callistemon salignus*, *Corymbia intermedia* (Pink Bloodwood), *E. tereticornis*, (Forest Red Gum/Queensland Blue Gum), *E. longifolia* (Woollybutt), *E. botryoides* (Southern Mahogany/Bangalay), *E. ovata* (Swamp Gum), *Livistona australis* and/or *Lophostemon* spp.	**Yes**	Canopy is dominated by *Eucalyptus robusta* (Swamp Mahogany) *Melaleuca quinquenervia* (Broad-leaved Paperbark). No *Casuarina glauca* or *Lophostemon* occurs within this Vegetation Zone. As stated above, ground cover varies, but is generally dominated by grasses and sedges.
The understorey typically includes a variable ground layer, depending on the canopy cover and inundation rate/period. Tall sedges (typically *Gahnia* spp.) and/or ferns often dominate the ground layer, mixed with graminoids and other herbs, especially *Imperata cylindrica* (Blady Grass).	**Yes**	The groundcover is a mix of native grasses and sedges including *Entolasia stricta* (Wiry Panic), *Themeda triandra* (Kangaroo Grass), *Xanthorrhoea media*, *Lepyrodia scariosa*, and *Lepidosperma laterale* (Variable Sword-sedge).
While they can occur regularly in the ground layer, the ecological community is not present if halophytic species, more typically associated with estuarine/saltmarsh areas, dominate the ground layer of a patch, for example, *Appium prostratum*, *Atriplex cineria*, *Chenopodium glaucum*, *Rhagodia candolleaus* and *Samolus repens*.	**N/A**	Not Applicable

Decision Key Criteria	Answer	Justification
Note: Revegetated or replanted sites, or areas of vegetation regeneration (regrowth), are included in the nationally listed ecological community if they meet the key diagnostic characteristics. The inclusion of patches of natural and managed regeneration reflects the ecological community's ability to regenerate.	**N/A**	Not Applicable – This vegetation zone contains an intact native canopy, midstorey and groundcover.
Determination	This Vegetation Zone **meets** the definition of the Endangered Ecological Community *Coastal Swamp Sclerophyll Forest of New South Wales North Coast and South-east Queensland* as listed under the Commonwealth's Environment Protection Biodiversity Conservation Act 1999.	

Notes

9 The uppermost layers of a vegetation type, formed by plant crowns. In a woodland or forest, the canopy is formed by the crowns of trees and sometimes large shrubs. The canopy can be further divided into upper, mid, and lower canopy layers. The tallest plants of a vegetation type form the upper canopy layer.

Identifying a patch – A patch is a discrete and mostly continuous area of the ecological community[10], as defined by the key diagnostic characteristics, but can include small-scale (<30m) variations, gaps, and disturbances within this area. The smallest patch size that can be identified is 0.25 ha. Where a larger forest or woodland area has been classified as a different vegetation type (e.g. by state vegetation mapping), localised areas of the ecological community greater than 0.25 ha may be present within this larger area.

10 Note that NSW vegetation assessment tools/methodologies define a patch as including all intact native vegetation, which may include one or more ecological communities that have a gap of less than 100 m from the next area of moderate to good condition native vegetation.

Breaks in a patch - When it comes to defining a patch of the ecological community, allowances are made for "breaks" up to 30 m between areas that meet the key diagnostics. Such breaks may be the result of watercourses, tracks, paths, roads, gaps made by exposed areas of soil, leaf litter or cryptogams, and areas of localised variation in vegetation that do not meet the key diagnostics. Such breaks do not significantly alter the overall functionality of the ecological community and thus form a part of the patch. Small breaks (< 30m across) should be included in the calculation of the size of the patch but be taken into account when determining the overall condition of the patch by excluding them from the calculation of patch condition. Where there is a break in the ecological community of 30 m or more (e.g. due to permanent artificial structures, wide roads or other barriers, water bodies or other types of vegetation) then the gap indicates that separate patches are present.

Vegetation Zone 2 - PCT 1649 – Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Low – Moderate Condition – EEC)

The key diagnostic characteristics are designed to allow identification of the ecological community irrespective of the season. Areas of vegetation that do not meet the key diagnostics do not support the nationally listed ecological community. The ecological community is defined as patches of native vegetation meeting the description in Section 1 of the Conservation Advice that meet the following key diagnostic characteristics (see table below).

Decision Key Criteria	Answer	Justification
Occurs on the mainland and islands near to the coast (within 20 km) from South East Queensland to south-eastern NSW specifically within these IBRA Bioregions: South Eastern Queensland (SEQ); NSW North Coast (NNC); Sydney Basin (SYB) and the Bateman sub-region of the South East Corner (SEC).	**Yes**	The Study Area Is based within the **Sydney Basin** IBRA Bioregion.
Occurs in coastal catchments typically below 20m ASL, but occasionally up to 220m ASL	**Yes**	The Vegetation within the Study Area occurred at an elevation of approximately 18m ASL.
Occurs on hydric soils with inundation patterns ranging from intermittent to episodic.	**Yes**	Soil profiles on the same landscape position and adjacent to the site (obtained from DPIE (eSPADE)) identifies the soil landscape within the Study Area as being Doyalson (do) associated with sand loams. Elevation is approximately 18 m.
The vegetation structure varies from tall closed to open forest to woodland, to dense (closed) shrubland or scrub forest. Minimum crown cover (see footnote 5, p. 4) is at least 10%, but it is more typically in the range 50% to 70%.	**Yes**	Canopy cover is consistent with an open forest, although impacted by historic clearing and management of the groundlayer.

Decision Key Criteria	Answer	Justification
From South East Queensland to the Sydney Basin Bioregion, the canopy[9] is typically dominated or co-dominated by *Melaleuca quinquenervia* and/or *Eucalyptus robusta*. In some areas, the canopy may be locally dominated by other melaleuca species including *M. dealbata* (SEQ bioregion) (rarely); *M. biconvexa* (mid-NSW coast to south of Sydney); *M. decora* (north of Shoalhaven), frequently with *Parsonsia straminea* climbing on the trunks of canopy species. In the SEC bioregion, *M. ericifolia* may occur as a dominant canopy or sub-canopy species.	**Yes**	Canopy is dominated by scattered *Melaleuca quinquenervia* (Broad-leaved Paperbark) and *Eucalyptus robusta* (Swamp Mahogany) with occasional *Angophora costata*.
Other tree species may occur in the canopy (or sub-canopy) in some areas, but they are not dominant across a patch, including *Casuarina glauca*, *Banksia* spp., *Callistemon salignus*, *Corymbia intermedia* (Pink Bloodwood), *E. tereticornis*, (Forest Red Gum/Queensland Blue Gum), *E. longifolia* (Woollybutt), *E. botryoides* (Southern Mahogany/Bangalay), *E. ovata* (Swamp Gum), *Livistona australis* and/or *Lophostemon* spp.	**Yes**	Canopy is dominated by *Eucalyptus robusta* (Swamp Mahogany) *Melaleuca quinquenervia* (Broad-leaved Paperbark). No *Casuarina glauca* or *Lophostemon* occurs within this Vegetation Zone. As stated above, ground cover varies, but is generally dominated by grasses and sedges.
The understorey typically includes a variable ground layer, depending on the canopy cover and inundation rate/period. Tall sedges (typically *Gahnia* spp.) and/or ferns often dominate the ground layer, mixed with graminoids and other herbs, especially *Imperata cylindrica* (Blady Grass).	**Yes**	The groundcover is a mix of native grasses and sedges including *Entolasia stricta* (Wiry Panic), *Themeda triandra* (Kangaroo Grass), *Xanthorrhoea media*, *Lepyrodia scariosa*, and *Lepidosperma laterale* (Variable Sword-sedge).
While they can occur regularly in the ground layer, the ecological community is not present if halophytic species, more typically associated with estuarine/saltmarsh areas, dominate the ground layer of a patch, for example, *Appium prostratum*, *Atriplex cineria*, *Chenopodium glaucum*, *Rhagodia candolleaus* and *Samolus repens*.	**N/A**	Not Applicable
Note: Revegetated or replanted sites, or areas of vegetation regeneration (regrowth), are included in the nationally listed ecological community if they meet the key diagnostic characteristics. The inclusion of patches of natural and managed regeneration reflects the ecological community's ability to regenerate.	**Yes**	This vegetation zone has a partially intact canopy and signs of regeneration in the groundlayer.
Determination	This Vegetation Zone **meets** the definition of the Endangered Ecological Community *Coastal Swamp Sclerophyll Forest of New South Wales North Coast and South-east Queensland* as listed under the Commonwealth's Environment Protection Biodiversity Conservation Act 1999.	
Notes		

Decision Key Criteria	Answer	Justification
9 The uppermost layers of a vegetation type, formed by plant crowns. In a woodland or forest, the canopy is formed by the crowns of trees and sometimes large shrubs. The canopy can be further divided into upper, mid, and lower canopy layers. The tallest plants of a vegetation type form the upper canopy layer. *Identifying a patch* – A patch is a discrete and mostly continuous area of the ecological community[10], as defined by the key diagnostic characteristics, but can include small-scale (<30m) variations, gaps, and disturbances within this area. The smallest patch size that can be identified is 0.25 ha. Where a larger forest or woodland area has been classified as a different vegetation type (e.g. by state vegetation mapping), localised areas of the ecological community greater than 0.25 ha may be present within this larger area. 10 Note that NSW vegetation assessment tools/methodologies define a patch as including all intact native vegetation, which may include one or more ecological communities that have a gap of less than 100 m from the next area of moderate to good condition native vegetation. *Breaks in a patch* - When it comes to defining a patch of the ecological community, allowances are made for "breaks" up to 30 m between areas that meet the key diagnostics. Such breaks may be the result of watercourses, tracks, paths, roads, gaps made by exposed areas of soil, leaf litter or cryptogams, and areas of localised variation in vegetation that do not meet the key diagnostics. Such breaks do not significantly alter the overall functionality of the ecological community and thus form a part of the patch. Small breaks (< 30m across) should be included in the calculation of the size of the patch but be taken into account when determining the overall condition of the patch by excluding them from the calculation of patch condition. Where there is a break in the ecological community of 30 m or more (e.g. due to permanent artificial structures, wide roads or other barriers, water bodies or other types of vegetation) then the gap indicates that separate patches are present.		

Vegetation Zone 3 - *PCT 1649 – Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Cleared)*

The key diagnostic characteristics are designed to allow identification of the ecological community irrespective of the season. Areas of vegetation that do not meet the key diagnostics do not support the nationally listed ecological community. The ecological community is defined as patches of native vegetation meeting the description in Section 1 of the Conservation Advice that meet the following key diagnostic characteristics (see table below).

Decision Key Criteria	Answer	Justification
Occurs on the mainland and islands near to the coast (within 20 km) from South East Queensland to south-eastern NSW specifically within these IBRA Bioregions: South Eastern Queensland (SEQ); NSW North Coast (NNC); Sydney Basin (SYB) and the Bateman sub-region of the South East Corner (SEC).	**Yes**	The Study Area Is based within the **Sydney Basin** IBRA Bioregion.
Occurs in coastal catchments typically below 20m ASL, but occasionally up to 220m ASL	**Yes**	The Vegetation within the Study Area occurred at an elevation of approximately 18m ASL.
Occurs on hydric soils with inundation patterns ranging from intermittent to episodic.	**Yes**	Soil profiles on the same landscape position and adjacent to the site (obtained from DPIE (eSPADE)) identifies the soil landscape within the Study Area as being Doyalson (do) associated with sand loams. Elevation is approximately 18 m.
The vegetation structure varies from tall closed to open forest to woodland, to dense (closed) shrubland or scrub forest. Minimum crown cover (see footnote 5, p. 4) is at least 10%, but it is more typically in the range 50% to 70%.	**No**	The vegetation zone does not have an intact canopy

Decision Key Criteria	Answer	Justification
From South East Queensland to the Sydney Basin Bioregion, the canopy[9] is typically dominated or co-dominated by *Melaleuca quinquenervia* and/or *Eucalyptus robusta*. In some areas, the canopy may be locally dominated by other melaleuca species including *M. dealbata* (SEQ bioregion) (rarely); *M. biconvexa* (mid-NSW coast to south of Sydney); *M. decora* (north of Shoalhaven), frequently with *Parsonsia straminea* climbing on the trunks of canopy species. In the SEC bioregion, *M. ericifolia* may occur as a dominant canopy or sub-canopy species.	**No**	The vegetation zone does not have an intact canopy
Other tree species may occur in the canopy (or sub-canopy) in some areas, but they are not dominant across a patch, including *Casuarina glauca*, *Banksia* spp., *Callistemon salignus*, *Corymbia intermedia* (Pink Bloodwood), *E. tereticornis*, (Forest Red Gum/Queensland Blue Gum), *E. longifolia* (Woollybutt), *E. botryoides* (Southern Mahogany/Bangalay), *E. ovata* (Swamp Gum), *Livistona australis* and/or *Lophostemon* spp.	**No**	The vegetation zone does not have an intact canopy
The understorey typically includes a variable ground layer, depending on the canopy cover and inundation rate/period. Tall sedges (typically *Gahnia* spp.) and/or ferns often dominate the ground layer, mixed with graminoids and other herbs, especially *Imperata cylindrica* (Blady Grass).	**Yes**	The groundcover is a mix of native grasses and sedges including *Entolasia stricta* (Wiry Panic), *Themeda triandra* (Kangaroo Grass), *Xanthorrhoea media*, *Lepyrodia scariosa*, and *Lepidosperma laterale* (Variable Sword-sedge).
While they can occur regularly in the ground layer, the ecological community is not present if halophytic species, more typically associated with estuarine/saltmarsh areas, dominate the ground layer of a patch, for example, *Appium prostratum*, *Atriplex cineria*, *Chenopodium glaucum*, *Rhagodia candolleaus* and *Samolus repens*.	**N/A**	Not Applicable
Note: Revegetated or replanted sites, or areas of vegetation regeneration (regrowth), are included in the nationally listed ecological community if they meet the key diagnostic characteristics. The inclusion of patches of natural and managed regeneration reflects the ecological community's ability to regenerate.	**Yes**	This vegetation zone has no intact canopy and no signs of regeneration of this canopy in the groundlayer.
Determination	This Vegetation Zone **does not meet** the definition of the Endangered Ecological Community *Coastal Swamp Sclerophyll Forest of New South Wales North Coast and South-east Queensland* as listed under the Commonwealth's Environment Protection Biodiversity Conservation Act 1999.	
Notes		

Decision Key Criteria	Answer	Justification
9 The uppermost layers of a vegetation type, formed by plant crowns. In a woodland or forest, the canopy is formed by the crowns of trees and sometimes large shrubs. The canopy can be further divided into upper, mid, and lower canopy layers. The tallest plants of a vegetation type form the upper canopy layer. *Identifying a patch* – A patch is a discrete and mostly continuous area of the ecological community[10], as defined by the key diagnostic characteristics, but can include small-scale (<30m) variations, gaps, and disturbances within this area. The smallest patch size that can be identified is 0.25 ha. Where a larger forest or woodland area has been classified as a different vegetation type (e.g. by state vegetation mapping), localised areas of the ecological community greater than 0.25 ha may be present within this larger area. 10 Note that NSW vegetation assessment tools/methodologies define a patch as including all intact native vegetation, which may include one or more ecological communities that have a gap of less than 100 m from the next area of moderate to good condition native vegetation. *Breaks in a patch* - When it comes to defining a patch of the ecological community, allowances are made for "breaks" up to 30 m between areas that meet the key diagnostics. Such breaks may be the result of watercourses, tracks, paths, roads, gaps made by exposed areas of soil, leaf litter or cryptogams, and areas of localised variation in vegetation that do not meet the key diagnostics. Such breaks do not significantly alter the overall functionality of the ecological community and thus form a part of the patch. Small breaks (< 30m across) should be included in the calculation of the size of the patch but be taken into account when determining the overall condition of the patch by excluding them from the calculation of patch condition. Where there is a break in the ecological community of 30 m or more (e.g. due to permanent artificial structures, wide roads or other barriers, water bodies or other types of vegetation) then the gap indicates that separate patches are present.		

APPENDIX E – SAII ASSESSMENT

SAII Assessment

Introduction

The Swift Parrot (*Lathamus discolor*) is identified as a Serious and Irreversible Impact (SAII) entity according to the 'Guidance to assist a decision-maker to determine a serious and irreversible impact' (DPIE 2019). This is based on principle 1 as set out in clause 6.7 of the *Biodiversity Conservation Regulation 2017 (BC Regulation)* – an impact that may cause a further decline of a species or ecological community currently in a rapid state of decline.

Assessment Requirements

The following assessment addresses impacts to species at risk of SAII resulting from the proposed development through the application of the four principles set out above.

Habitat for one (1) species at risk of Serious and Irreversible Impacts (SAII) was confirmed within the Development Site;

- *Lathamus discolor* (Swift Parrot)

Swift Parrot (Lathamus discolor)

The Swift Parrot is small parrot about 25 cm long. It is bright green with red around the bill, throat and forehead. It breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south-west slopes. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations (DPIE, 2022d). Habitat for the Swift Parrot is mapped under the BAM Important Areas Mapping.

The species was not recorded during targeted bird surveys undertaken within the Study Area. However, the site is mapped as important habitat for the species, owing to records occurring one (1) kilometre to the north of the Study Area (predominately recorded at Joshua Porter reserve, Chain Valley Bay in 2011 and 2019). The mapped important habitat of the Swift Parrot within the Study Area is based off a 2km polygon placed around the Chain Valley Bay records to the north. The proposed development is therefore considered to impact mapped Swift Parrot Habitat requiring an SAII Assessment (see below).

Table E-2: Impact Assessment for SAII species - Swift Parrot (*Lathamus discolor*)

Criteria	Comments
1. Impact Avoidance	
What actions and measures were taken to avoid direct and indirect impacts on the species at risk of an SAII? Consistent with ***Criteria A*** within the Guidance Document (DPIE 2019): *"The action and measures taken to avoid the direct and indirect impact on the potential entity for a SAII".*	The design of the proposed development considers existing biodiversity values within the Study Area (see **Section 5.1.1**). The Conservation Areas will preserve 2.53 ha of mapped Swift Parrot habitat within the Study Area, of which 2.35 ha contains suitable foraging habitat (including key Swift Parrot foraging species (i.e. *Corymbia gummifera*)). The Conservation Areas will therefore retain 35% of suitable Swift Parrot habitat within the Study Area. The design of the proposed Conservation Areas, along with the establishment of pocket parks and incorporation of local Swift Parrot foraging trees into urban design, have the intent to largely preserve and further enhance foraging habitat within the site. The location of the proposed Collector Road from the western boundary and Chisholm Avenue is a requirement of Central Coast Council and Bushfire safety, with the added limitation of no access from the Pacific Highway. Alternatives including the location of the access road further to the north would result in direct impacts to a mapped coastal wetland, and fragment the proposed north-west Conservation Area. As such, an alternative access road location was not appropriate. The size of the proposed conservation areas have been increased since first proposed. The current extent considers the preservation of high quality habitat and the feasibility of the project. The North-western Conservation Area is also characterised by a relative high number of mature, hollow-bearing trees, and comprise of a high proportion of preferred Swift Parrot feed trees (i.e. *Corymbia gummifera* and to a lesser preference *Eucalyptus capitellata*). Appropriate mitigation measures have been detailed in **Section 5.3** to further minimise any indirect impacts to biodiversity values within the site and the environment. These include: Clearly delineate the boundaries of the project footprint to prevent any unnecessary clearing beyond its extent. This includes the installation of appropriate fencing along the eastern extent of the Development Site. Fencing should prohibit entry into the retained vegetation area and the minimise indirect impacts during construction such as the movement of dust and rubbish into the forest and wetland. • Appropriate signage such as 'no go zone' or 'environmental protection area' should be installed surrounding the area of retained native vegetation and wetlands. • Clearly identify and communicate the location of any 'no go zones' in site inductions. • Tree protection measures will be implemented to protect retained trees surrounding the development site. Tree protection measures should consider allowances for Tree Protection Zones in accordance with AS4970 (Standards Australia, 2009).A pre-clearing protocol will be implemented during clearing works, as follows: • Pre-clearance surveys will be undertaken to determine if any inhabiting fauna, or habitat features (i.e. nests or hollows) are present; • A suitably qualified and trained fauna handler will be present during hollow-bearing tree clearing to rescue and relocate displaced fauna. • Appropriate exclusion fencing around any trees and woodland that are to be retained within and immediately surrounding the development site should be erected, considering allowance for Tree Protection Zones in accordance with AS4970 (Standards Australia, 2009).
2. Current Population	

Criteria	Comments
Evidence of rapid decline *i. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer)* *ii. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer) as indicated by: an index of abundance appropriate to the species; decline in geographic distribution and/or habitat quality; exploitation; effect of introduced species, hybridisation, pathogens, pollutants, competitors or parasite*	The Swift Parrot is listed as Critically Endangered because modelling suggests that its population is declining by >80% within three generations (12–18 years) as a result of just one of many factors impacting the species: predation by introduced Sugar Gliders during breeding (Heinsohn et al.2019). A recent assessment of Australia's threatened birds concluded that there is a 31% chance of the Swift Parrot becoming extinct in the next 20 years, making it the seventh most likely species in Australia to do so (Geyle et al. 2018).
Evidence of small population size *i. an estimate of the species' current population size in NSW, and* *ii. an estimate of the decline in the species' population size in NSW in three years or one generation (whichever is longer), and* *iii. where such data is available, an estimate of the number of mature individuals in each subpopulation, or the percentage of mature individuals in each subpopulation, or whether the species is likely to undergo extreme fluctuations* Consistent with ***Criteria B*** within the Guidance Document (DPIE 2019): *"The size of the local population directly and indirectly impacted by the development, clearing or biodiversity certification".*	BirdLife Australia estimated the population as between 1000 and 2500 in 2020 based on census methods, however Olah *et al.* (2020) estimates that the population could be as low as 300 individuals. The NSW population is estimated at between 300-2000 (Ross Crates per comms. 2022) Given the highly mobile, nomadic nature of the species, it is difficult to estimate population size. In a summary of recorded parrots in the Lake Macquarie LGA to the north between 1995-2014 (Roderick & Ingwersen 2014) only in two years were up to (and maybe over) 100 birds were recorded visiting (however this estimate only includes detections, a number of Swift Parrots may have been undetected during this period). Only relatively small numbers of Swift Parrots have been reported from the Central Coast and Lake Macquarie in recent years (Birdlife Australia, 2009- 2020) and, as such, estimates of the size of the sub-population are unavailable. Most recent records on the Central Coast have been near Tuggerawong (generally less than 10 but up to about 100 individuals in 2011) although a number of sightings have also been recorded at Chain Valley Bay (Joshua Porter Reserve and surrounds) about 1km to the north of the Study Area (up to about 30 individuals). Given the lack of recent sightings from the Lake Munmorah area, it is anticipated that the population using the local area does not exceed that of more favoured habitats within the wider locality and current utilisation of the habitat is sporadic. It does appear that utilisation of habitat is cyclical and/or dependent upon foraging resources in a particular region during winter foraging. A total of 4.65 ha of mapped Swift Parrot habitat (with canopy trees) will be impacted as part of the proposed development. If the clearing of native vegetation occurs outside of the period in which the Swift Parrot occurs on the mainland, there will not be any direct impacts to Swift Parrot, only indirect impacts of mapped Swift Parrot Habitat.
Evidence of limited geographic range *i. extent of occurrence* *ii. area of occupancy* *iii. number of threat-defined locations (geographically or ecologically distinct areas in which a single threatening event may rapidly affect all species occurrences), and* *iv. whether the species' population is likely to undergo extreme fluctuations*	The species is highly mobile and has a wide foraging range extending from southern and central Victoria to south-east Queensland. Foraging habitats may be used on a cyclic basis depending on the availability of food resources such as flowering eucalypts and lerp infestations (DPIE, 2022d). These food resources are linked to variable climatic conditions and rainfall (Saunders and Heinsohn 2008). The local area of occupancy primarily comprises Joshua Porter Reserve and surrounds about 1km to the north of the Study Area (up to about 30 individuals) within Swamp Mahogany-dominated forested wetland vegetation. No individuals of the species have been recorded within the Study Area or its immediate vicinity, despite the areas surrounding the Study Area being characterised by similar feed trees and mapped Swift Parrot Important Habitat and access to the public (e.g. public roads, fire trail, reserve and shopping centre. As such the current occupancy of the Study Area by the Swift Parrot as part of its foraging range is not known.

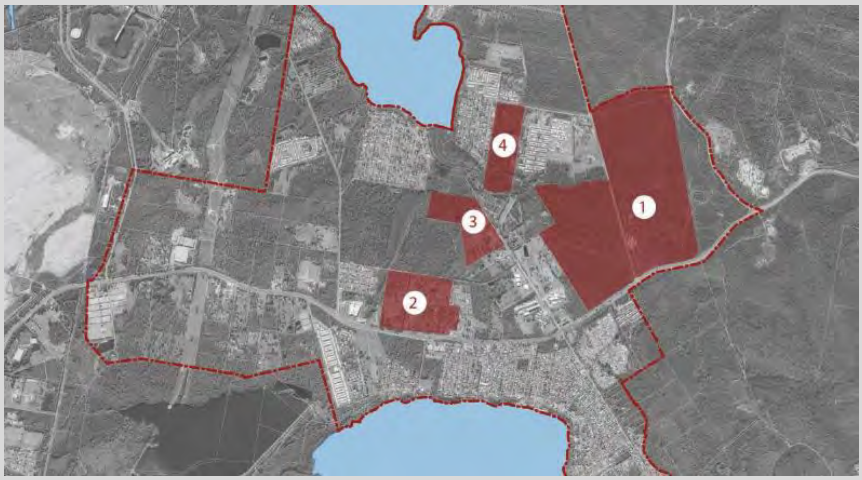
Criteria	Comments
Consistent with ***Criteria B*** within the Guidance Document (DPIE 2019): *"The size of the local population directly and indirectly impacted by the development, clearing or biodiversity certification".*	While the assessment of serious and irreversible impacts includes consideration of Swift Parrot "breeding" habitat, the species is only present in NSW during the non-breeding season (the species breeds exclusively in Tasmania). As such, important areas for the Swift Parrot within NSW constitute foraging habitat and is likely mapped on vegetation community type. The Swift Parrot is highly mobile, widespread, not breeding, the number of threat defined locations is difficult to quantify but the number of places where a single threatening event might affecting all species' occurrences is likely to be small. The species' local/regional population does undergo extreme fluctuations across years contingent upon environmental/climatic conditions throughout the rest of the species' range.
Evidence that the species is unlikely to respond to management *i. known reproductive characteristics severely limit the ability to increase the existing population on, or occupy new habitat (e.g. species is clonal) on, a biodiversity stewardship site.* *ii. the species is reliant on abiotic habitats which cannot be restored or replaced (e.g. karst systems) on a biodiversity stewardship site, or* *iii. life history traits and/or ecology is known but the ability to control key threatening processes at a biodiversity stewardship site is currently negligible (e.g. frogs severely impacted by chytrid fungus).*	The Swift Parrot is listed as an entity at risk of SAII due to Principle 1 (Species or ecological community currently in a rapid decline) as the species has experienced a population reduction of >80% in 10 years or three (3) generations. The species did not meet **Principle 4** (species or ecological community that is unlikely to respond to management and is therefore irreplaceable). Key threatening processes for the species within its mainland foraging range include habitat loss and alteration, collision mortality (i.e. with wire netting, windows and cars), and competition (i.e. with large aggressive birds). The following addresses three threatening processes most relevant to the proposed development. ***Habitat loss and alteration*** Important foraging habitat in coastal New South Wales (NSW) is characterised by the presence of key nectar feed tree species, including Swamp Mahogany (*Eucalyptus robusta*), Forest Red Gum (*Eucalyptus tereticornis*), Blackbutt (*Eucalyptus pilularis*), and Spotted Gum (*Corymbia maculata*). Saunders and Heinsohn (2008) found that each of the abovementioned tree species were also relied on for lerps, with the addition of three (3) key lerp (only) feed trees (for coastal NSW) including Red Bloodwood (*Corymbia gummifera*), Coastal Grey Box (*Eucalyptus mollucana*), and Rough-barked Apple (*Angophora subvelutina*). Within these habitats, Swift Parrots have been found to preferentially forage in large, mature trees (Kennedy 2000; Kennedy and Overs 2001; Kennedy and Tzaros 2005) that provide more reliable foraging resources than younger trees (Wilson and Bennett 1999; Law et al. 2000). The species has been known to occur within a wider range of habitats than those mentioned above (including planted vegetation), however these are largely opportunistic or as supplementary foraging habitat, rather than providing a reliable quantity and quality resource for which the species can depend on (Saunders and Tzaros 2011). Therefore, it is recognised that the species is likely to respond to management of this key threatening process (habitat clearing and degradation) through the following: • Conservation of preferred feed trees • Conservation of mature trees • Plantings can provide supplementary food resources but not a replacement for mature remnant feed trees. A Swift Parrot Habitat Assessment (**Appendix I**) provides an assessment of the suitability of Swift Parrot Habitat throughout the Study Area, including discussion on the areas proposed for conservation and those to be developed. Management of highly suitable Swift Parrot foraging habitat within the conservation areas is detailed further in the site specific Biodiversity Management Plan (BMP).

Criteria	Comments
	Habitat loss and alteration Collision with wire netting, mesh fences, windows and cars cause mortality to swift parrots in urban areas throughout their range (Pfennigwerth 2008). Continuing urban encroachment into foraging habitat is likely to worsen this problem. Collisions are of particular concern in the greater Hobart and Melbourne areas and the New South Wales central and north coast regions, where injuries and fatalities have been recorded (Tzaros 2002). The species is likely to respond to improved residential development design and consideration of collision threats for the Swift Parrot. Management of these threats are detailed further in the site specific Biodiversity Management Plan (BMP). ***Competition*** Habitat suitability for the species is impacted through competition for food and nesting resources from large, aggressive honeyeaters within altered habitats (Ford et al. 1993; Grey et al. 1998; Saunders and Heinsohn 2008) and introduced birds and bees (Brown 1989; Paton 1993; Hingston et al. 2004) (Saunders and Tzaros 2011). Swift Parrots are less likely to occur at known foraging sites as the abundance of large, aggressive nectar feeders such as Noisy Miner (*Manorina melanocephala*) and Rainbow Lorikeet (*Trichoglossus haematodus*) increase (Saunders and Heinsohn 2008). Impacts by Noisy Miner and Rainbow Lorikeet are likely to increase with further habitat loss and fragmentation that promote suitable conditions for these species to thrive. The Swift Parrot is likely to respond to management of competitive species, however direct intervention and management of these species can be challenging within an urban landscape. A more passive management of this threat through retention of vegetation adjacent to good condition habitat, and the restoration of retained areas (increased habitat complexity) is likely to improve foraging habitat for the species within the site and broader locality. At a species-wide scale Swift Parrots are unlikely to respond to management because of: 1. rate of population decline 2. highly nomadic life-history making it impossible to manage the species at the site-level (in contrast to sedentary species e.g. green and golden bell frog or cumberland snail).
3. Impacts of the proposal on the SAII species	
Impact on the species' population *i) Estimate of the number of individuals present in the subpopulation on the subject land and as a percentage of the total NSW population* *ii) an estimate of the number of individuals (mature and immature) to be impacted by the proposal and as a percentage of the total NSW population,* Consistent with **Criteria B** within the Guidance Document (DPIE 2019): *"The size of the local population*	Targeted surveys for the Swift Parrot were not conducted as they are not required under the BAM (species assumed present within mapped areas). As such the current occupancy of the Study Area by the Swift Parrot as part of its foraging range is not known. For the purposes of this assessment, Swift Parrot foraging habitat was presumed present within the Study Area based on the occurrence of important habitat mapping and the presence of key Swift Parrot feed trees including *Eucalyptus robusta* and *Corymbia gummifera*. Given the highly mobile, nomadic nature of the species, it is difficult to estimate population size. Only relatively small numbers of Swift Parrots have been reported from the Central Coast and Lake Macquarie in recent years (Birdlife Australia, 2009- 2020) and, as such, estimates of the size of the local population are unavailable. Most recent records on the Central Coast have been near Tuggerawong about 18 km south of the Study Area (generally less than 10 but up to about 100 individuals in 2011). There are also two (2) identified known important areas within the locality of the Study Area; Joshua Porter and Karignan Creek Reserves approximately 1 km to the north of the site. With Swift

Criteria	Comments
directly and indirectly impacted by the development, clearing or biodiversity certification" in Guidance Document (DPIE 2019. *iii) if the species' unit of measure is area, provide data on the number of individuals on the site, and the estimated number that will be impacted, along with the area of habitat to be impacted by the proposal.* Consistent with ***Criteria D*** in the Guidance Document (DPIE 2019); *"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:* *i. an estimate of the change in habitat available to the local population as a result of the proposed development* *ii. the proposed loss, modification, destruction or isolation of the available habitat used by the local population* *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."* Consistent with ***Criteria E*** in the Guidance Document (DPIE 2019); *"The likely impact on the ecology of the local population. At a minimum, address the following for fauna:* • *breeding* • *foraging* • *roosting, and* • *dispersal or movement pathways"*	Parrot numbers within the Central Coast estimated as between 10 and 100 (although likely higher considering number of undetected Swift Parrots, we've estimated that 1/5 are detected) (seasonally variable), and a total Swift Parrot population of between 1000 and 2500 individuals, the region is likely to provide foraging habitat for between 2 and 50% of the total population for the species. The Study Area is located within 1 km of one of foraging sites on the Central Coast (Joshua Porter and Karignan Creek Reserves) where individuals were recorded in 2011 and 2019. The species was not recorded within the Study Area during site assessments, there are also no records of the species within the Study Area. A total of 76 records of the species occur within 5 km of the Study Area with the majority being concentrated within mapped Forested Wetland vegetation to the north of the Study Area. It is understood that important habitat in the Lake Macquarie / Central Coast region is considered to consist of the following vegetation types (in order) (pers comm., M Roderick, Birdlife Australia; refer also Roderick and Ingwersen, 2014): • Swamp Mahogany-dominated associations. • Forest Red Gum-dominated associations. • Spotted Gum-Ironbark dominated associations. • Red Bloodwood/Blackbutt dominated associations. A total of 8.61 ha of mapped Swift Parrot important habitat exists within the Disturbance Footprint. Impact areas of mapped Swift Parrot habitat with existing foraging resources (feed trees) are detailed below: **Zone** / **PCT** / **Conservation Area (ha and %) No impacts** / **Total area of Disturbance (ha and %)** / **Total Area within Study Area (ha)** 1 / 1649 Good (EEC) / 0.11 (33%) / 0.22 (64%) / 0.33 2 / 1649 Low-Moderate (EEC) / 0.32 (56%) / 0.25 (44%) / 0.57 3 / 1649 Low / NA / NA / NA 4 / 1638 Moderate / 0.04 (2%) / 1.93 (98%) / 1.96 5 / 1638 Low-Moderate / 1.88 (45%) / 2.25 (54%) / 4.14 6 / 1638 Cleared / NA / NA / NA 7 / 1737 Moderate (EEC) / NA / NA / NA **Total** / 2.35 ha (35%) / 4.65 ha (65%) / 7 ha The Conservation Areas will preserve 2.53 ha of mapped Swift Parrot habitat, 2.35 ha of which contains suitable foraging habitat. This conservation area will therefore retain 35% of suitable and mapped Swift Parrot habitat within the Study Area. The North-western Conservation Area is also characterised by a relative high number of mature, hollow-bearing trees, and comprise of a high proportion of preferred Swift Parrot feed trees (i.e. *Corymbia gummifera* and *Eucalyptus robusta*). Areas determined to be unsuitable for foraging habitat include cleared grassland variants of PCT 1649 and PCT 1638 (Vegetation Zones 3 and 6 respectively). The North-western Conservation Area, where the

Criteria	Comments
	majority of retained Swift Parrot habitat occurs, is also characterised by a relative high number of mature, hollow-bearing trees, and comprise of a high proportion of preferred Swift Parrot feed trees (i.e. *Corymbia gummifera*). Roost site characteristics, and the importance of such sites for the Swift Parrot, are relatively unknown (Saunders and Tzaros, 2011). However, vegetation structure and proximity to foraging sites are likely to be important for roost site selection and they may therefore be likely equated to those areas providing suitable foraging resources. Given the likely opportunistic nature of the use of the Study Area, the development is not expected to impact on roosting opportunities. Movement pathways used by Swift Parrots throughout their range are also not well understood (Saunders and Tzaros, 2011). However, the aforementioned North Wyong Shire Structure Plan 2012 indicates a local conservation link associated with the Swamp Mahogany dominated forest to the immediate west of the Study Area. This vegetation community (PCT 1649) likely provides the primary foraging habitat for species in the vicinity of the Study Area. Only small areas of intact PCT 1649 with suitable foraging habitat (canopy) occur within the Study Area (0.9 ha), of which 53% is to be retained within the proposed Conservation Areas. The proposed development also intends to incorporate Swift Parrot foraging tree species as part of the residential subdivision landscaping plan, further providing for Swift Parrot foraging habitat within the locality. Swift parrots are highly mobile and therefore risk of the proposed development jeopardising dispersal/movement is considered low. In summary: • The proposed development occurs within 1 km of a known, yet infrequently used, Swift Parrot foraging site on the Central Coast. • The Central Coast is likely to provide foraging habitat for between 10 and 50% of the total population for the species during any one season. • No individuals were recorded within the Subject Site during the site assessments. However, targeted surveys were not completed within the period in which the species is on the mainland. Opportunistic surveys were completed throughout the assessment period, including the period in which the species was on the mainland. • Impacts to 7 ha of mapped and suitable Swift Parrot foraging habitat (with intact canopy) within the Study Area. However, a total of 2.35 ha (35%) of this habitat will be retained within the proposed Conservation Areas. • The North-western Conservation Area will retain a large portion of preferred foraging habitat (PCT 1649 and PCT 1638) whilst also providing for a vegetated buffer between the residential subdivision and areas of preferred foraging habitat immediately west of the Study Area. • The vegetation within the Study Area may also represent temporary roosting habitat and supports local movement pathways for the highly mobile species. • The proposed residential development will incorporate Swift Parrot foraging species within landscaping and urban design plans.
Impact on geographic range *i) the area of the species' geographic range to be impacted by the proposal in hectares, and a percentage of the total AOO, or EOO within NSW* *ii) the impact on the subpopulation as either: all individuals will be impacted (subpopulation eliminated); OR*	The species breeds exclusively in Tasmania, with winter foraging habitat spanning from Victoria to Queensland. Impacts to mapped Swift Parrot habitat is minimal, with a total of 6.09 ha of mapped habitat (approximately 4.65 ha of mapped foraging habitat with foraging resources) to be impacted by the proposed development. The proposed development would have limited impacts on the movement of Swift Parrot in the local area. While a small area of native vegetation would be removed, the Conservation Areas will preserve 2.56 ha of mapped Swift Parrot

Criteria	Comments
impact will affect some individuals and habitat; OR impact will affect some habitat, but no individuals of the species will be directly impacted. *ii) to determine if the persisting subpopulation that is fragmented will remain viable, estimate (based on published and unpublished sources such as scientific publications, technical reports, databases or documented field observations) the habitat area required to support the remaining population, and habitat available within dispersal distance, and distance over which genetic exchange can occur (e.g. seed dispersal) and pollination distance for the species* *iv) to determine changes in threats affecting remaining subpopulations and habitat if the proposed impact proceeds, estimate changes in environmental factors including changes to fire regimes (frequency, severity); hydrology, pollutants; species interactions (increased competition and effects on pollinators or dispersal); fragmentation, increased edge effects, likelihood of disturbance; and disease, pathogens and parasites. Where these factors have been considered elsewhere in relation to the target species, the assessor may refer to the relevant sections of the BDAR or BCAR.* Consistent with ***Criteria F*** in the Guidance Document (DPIE 2019); *"A description of the extent to which the local population will become fragmented or isolated as a result of the proposed development."* Consistent with ***Criteria G*** in the Guidance Document (DPIE 2019); *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.* Consistent with ***Criteria H*** in the Guidance Document (DPIE 2019);	habitat, 2.35 ha of which contains suitable foraging habitat. This conservation area will therefore retain 35% of suitable and mapped Swift Parrot habitat within the Study Area. The North-western Conservation Area is also characterised by a relative high number of mature, hollow-bearing trees, and comprise of a high proportion of preferred Swift Parrot feed trees (i.e. *Corymbia gummifera* and *Eucalyptus robusta*) Furthermore, movement corridors within the local area would largely be maintained with the retention of a large areas of highly connected and suitable foraging habitat surrounding the site, and retention of multiple feed trees within the Study Area. The proposed development also intends on incorporating Swift Parrot foraging tree species as part of the residential subdivision landscaping plan, further providing for Swift Parrot foraging habitat within the locality. The proposed development will likely result in a small increase in edge effects, however, much of the Study Area is already heavily managed. Mitigation measures have been detailed within this report to minimise indirect impacts to vegetation outside of the Development Site. These include: • Weed incursion is recognised as a key threat to the Conservation Areas. It is recommended that management of weeds within the Conservation Areas prioritise weeds listed in **Table 23**, until a time in which an appropriate management plan is implemented for the Study Area. • The proposed development is unlikely to result in an increase in disease or pathogen risk to the species. • The proponent proposes the restoration of vegetation within both Conservation Areas. The restoration of these two areas should be detailed within a site specific Vegetation Management Plan (VMP) and be prepared by a suitably qualified ecologist or bush regeneration specialist, and outline a clear strategy for the following: ▪ Management of weeds identified in **Table 23.** ▪ Completion of a revegetation programme within both Conservation Areas including the following: o **North- Western Conservation Area –** Plantings within this area should include supplementary plantings of native shrub and midstorey species representative of the vegetation community; *PCT 1638 - Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast*. The groundcover is largely native, however supplementary planting of groundcover species may be required. The need for such plantings should be informed by monitoring of the Conservation Areas as detailed in a site-specific Vegetation Management Plan (VMP) o **Eastern Conservation Area –** Owing to the location of this Conservation Area within low lying areas of the Study Area, forested wetland species are proposed for the restoration of this zone. Plantings should include key canopy, midstorey, and groundcover species representative of *PCT 1649 - Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands.* o **Constructed Wetlands –** The two proposed detention basins are located within the Conservation Areas and will be subject to revegetation following construction so as to provide water quality and quantity protection of local wetlands, and supplementary habitat for local fauna. Plantings within these two constructed wetlands will need to take into account engineering and stormwater management requirements. Species selection should be based of wetlands within the Study Area i.e. *PCT 1737 - Typha rushland* **Habitat Fragmentation and Cumulative Impacts** The proposed development will impact Swift Parrot foraging habitat.

Criteria	Comments
"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."	Also, the Swift Parrot Habitat Assessment (Appendix I) has shown that the proposed conservation areas will retain the highest quality foraging habitat within the Study Area, where possible (i.e. unable to avoid location of western collector road location), and areas most connected to larger areas of suitable habitat to the north of the site. Therefore, the proposed development will impact foraging habitat, however appropriate impact avoidance and minimisation measures have been implemented to reduce impacts and prioritise quality of habitat within conservation areas. Any impact to foraging habitat for this Critically Endangered species is a threat to the population, and the proposed development is one of a number of larger proposed developments within the locality (see below excerpt from the Draft Greater Lake Munmorah Structure Plan 2021). However, through sensible development design and prioritisation of habitat quality, areas of mapped Swift Parrot Habitat within the Study Area will be retained and restored through active management as detailed within the site specific Biodiveristy Management Plan (BMP). The proposed development will therefore have a minor contribution to cumulative impacts to the mapped habitat within the locality. Larger developments to the Study Area's north and north-east will impact larger and more intact areas of mapped Important Areas of habitat for the species. If these would go ahead, it would increase the importance of retaining vegetation within the two large conservation areas proposed as part of this development.  **Excerpt 1:** Proposed Developments being considered by Central Coast Council (Greater Lake Munmorah Structure Plan)

Criteria	Comments
	 **Excerpt 2:** Swift Parrot Important Area Mapping within the locality
Criteria I in the Guidance Document (DPIE 2019);*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.*	Estimated area of Swift Parrot Habitat within the Study Area, locality (10 km radius of the Study Area), IBRA subregion (Wyong), and state of New South Wales (NSW) is provided below. The area of mapped important habitat, and mapped habitat with foraging resources (i.e. feed trees) are outlined for the overall disturbance footprint (including detention basins) and Conservation Areas. The size of these areas are then compared as a proportion of mapped habitat lost/retained within the locality (10km radius), IBRA subregion and State. In summary the proposed development will result in the removal of 0.5% of mapped Swift Parrot habitat within the locality, and will retain 35% of suitable Swift Parrot habitat within the Study Area.

Swift Parrot Habitat (Hectares)	Conservation Area	Disturbance Footprint	Study Area	10 km radius	Wyong IBRA Subregion	State of NSW
Mapped Swift Parrot Habitat	2.53	6.09	8.61	2358.25	11906.44	121,000
Mapped Swift Parrot Habitat (with foraging habitat)	2.35	4.65	7	-	-	-
Total Area	2.95	24.62	27.58	31,416	211,494	80115000
Impact/Retained Mapped Areas as a % of Areas above						

Criteria	Comments
	Mapped Swift Parrot Habitat / **Study Area** / **10 km radius** / **Wyong IBRA Subregion** / **State of NSW** Disturbance Footprint: 70% / <0.01% / <0.01% / <0.01% Retained: 30% / <0.01% / <0.01% / <0.01% *Impact/Retained Mapped Areas (with foraging habitat) as a % of Areas above* **Mapped Swift Parrot Habitat (with foraging habitat)** / **Study Area** / **10 km radius** / **Wyong IBRA Subregion** / **State of NSW** Disturbance Footprint: 65% / <0.01%* / <0.01%* / <0.01%* Retained: 35% / <0.01%* / <0.01%* / <0.01%* *Percentage based on the area of mapped habitat with resources within the Study Area divided by just the Swift Parrot Important Habitat Mapping – as area of Important Mapping occurring within suitable vegetation is not available for locality (10km radius), IBRA subregion, or State scales.
4. New Information	
The assessor may also provide new information that can be used to demonstrate that the principle identifying the species as at risk of an SAII, is inaccurate.	Not Applicable

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APPENDIX F – EPBC ASSESSMENTS OF SIGNIFICANCE

Species Assessed under the EPBC Act Significant Impact Guidelines

The following pertains to Assessments of Significance for direct or indirect impacts to EBPC Act listed threatened species, populations and communities.

The following species have been assessed under the EPBC Act *Matters of National Environmental Significance Significant impact guidelines 1.1* (Department of the Environment [DotE], 2013) (Significant Impact Guidelines):

- Critically Endangered Species
  - Swift Parrot (*Lathamus discolor*)
- Endangered Species
  - None
- Vulnerable Species
  - *Angophora inopina* (Charmhaven Apple)
  - *Cryptostylis hunteriana* (Leafless Tongue Orchid)
  - *Diuris praecox*. (Rough Doubletail)
  - Grey-headed Flying-fox (*Pteropus poliocephalus*)
- Migratory Species
  - White-throated Needletail (*Hirundapus caudacutus*)

Critically Endangered and Endangered Species – EPBC Act Assessment of Significance

The EPBC Act Significant Impact Guidelines (DOE 2013) state:

- An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:
  - lead to a long-term decrease in the size of a population
  - reduce the area of occupancy of the species
  - fragment an existing population into two or more populations
  - adversely affect habitat critical to the survival of a species
  - disrupt the breeding cycle of a population
  - modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
  - result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat
  - introduce disease that may cause the species to decline, or
  - interfere with the recovery of the species.
- A 'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:
  - *a geographically distinct regional population, or collection of local populations, or*
  - a population, or collection of local populations, that occurs within a particular bioregion.
- An 'invasive species' is an introduced species, including an introduced (translocated) native species, which out-competes native species for space and resources or which is a predator of native species. Introducing an invasive species into an area may result in that species becoming established. An invasive species may harm listed threatened species or ecological communities by direct competition, modification of habitat or predation.
  - 'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:
  - for activities such as foraging, breeding, roosting, or dispersal
  - for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
  - to maintain genetic diversity and long term evolutionary development, or
  - for the reintroduction of populations or recovery of the species or ecological community.
- Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act.

Swift Parrot (*Lathamus discolor*) - Critically Endangered

Assessment of Significance

1. ***Is the action likely to lead to a long-term decrease in the size of an important population of a species?***

An 'important population' is defined as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity, and/or
- Populations that are near the limit of the species range.

Swift Parrot 'important area' mapping occurs within the Study Area therefore the site is considered to represent foraging habitat for the species.

Impacts to feed trees including *Eucalyptus species* have been minimised through the positioning of the proposed wildlife corridor.

Whilst a total of 76 records of the species occur within 5 km of the Study Area, the species was not recorded within the Study Area during site assessments, there are also no records of the species within the Study Area. Previous records of the species are concentrated around Joshua Porter Reserve, Chain Valley Bay in 2011 and 2019.

As such, the proposed development will only impact potential foraging habitat for the species. The proposed development is therefore considered unlikely to lead to a long-term decrease in the size of an important population of the Swift Parrot.

2. ***Will the action reduce the area of occupancy of an important population of the species?***

The proposed development will involve impacts to 0.84 ha of PCT 1649 which contain Swamp Mahogany and 9.54 ha of PCT 1638 (with canopy) which contains *Corymbia gummifera*. The majority of the suitable habitat for the species within the locality will remain available to the seasonally migratory species.

As such, due to the large area of suitable foraging habitat in the surrounding area, the proposed Action will not significantly reduce the area of occupancy of an important population of the species.

3. ***Will the action fragment an existing important population into two or more populations?***

Given the mobility of the species, the proposed action 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?***

Under the Significant Impact Guidelines (Commonwealth of Australia 2013), habitat critical to the survival of a species is defined as areas that are necessary: for breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity, or for the recovery of the species.

The results of the Swift Parrot Habitat Assessment indicate that the highest value Swift Parrot habitat occurs within Vegetation Zones 1, 2, and 5 owing to their good condition, and canopy species mix, including the occurrence of two (2) preferred Swift Parrot feed tree species (*Eucalyptus robusta* and *Corymbia gummifera*). These vegetation zones also contained the majority of the preferred feed trees occurring within the Study Area (221 trees of 234), the remaining 13 trees occur as scattered paddock trees within Vegetation Zone 6 and the

exotic vegetation zone. The highest concentration of preferred feed trees occur within the north western corner of the Study Area, with known nectar feed trees (*Eucalyptus robusta*) occurring in a high density within the creek corridor and known lerp feed trees (*Corymbia gummifera*) occurring in the open woodland area. These areas largely follow existing Important Area Mapping for the Swift Parrot (DPIE 2022). Large areas of mapped Important Habitat within the eastern half of the Study Area have a low occurrence of feed trees in comparison. Swift Parrot foraging resources within the rest of the Study Area is comparatively sparse.

5. ***Will the action disrupt the breeding cycle of an important population?***

The proposed action will not impact on the breeding cycle of the Swift Parrot with all breeding for the species occurring in Tasmania and not on the mainland of Australia.

6. ***Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?***

The loss of potential marginal foraging habitat within the Study Area is not considered critical to the survival of the species. Extensive areas of similar vegetation representative of the region occur to the north of the Study Area will continue to provide habitat in the locality and will provide a buffer in between the Study Area and areas of Chain Valley Bay where the species has been detected previously.

The proposed action is unlikely to destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

7. ***Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?***

Mitigation measures detailed in **Section 5.3** will prevent construction activities from introducing or spreading new or existing environmental and noxious weeds or invasive fauna species into the Study Area.

8. ***Will the action introduce disease that may cause the species to decline?***

Mitigation measures detailed in **Section 5.3** will prevent construction activities from introducing or spreading plant and animal pathogens into the Study Area.

9. ***Will the action interfere substantially with the recovery of the species?***

The proposed development is unlikely to interfere within the below objectives of the National Recovery Plan of the Swift Parrot. The removal of potential foraging habitat for the species is in contrast to the aim of Objective 2, however, proposed Conservation Areas will ensure areas of 'important habitat' for the species are conserved and enhanced through active management.

Objective 1: To identify and prioritise habitats and sites used by the species across its range, on all land tenures.
Objective 2: To implement management strategies to protect and improve habitats and sites on all land tenures
Objective 3: To monitor and manage the incidence of collisions, competition and Beak and Feather Disease (BFD).

Objective 4: To monitor population trends and distribution throughout the range.

Conclusion

Based on the above assessment it is considered unlikely that this Commonwealth-listed species will be significantly impacted by the proposal.

F2 Vulnerable Species – EPBC Act Assessment of Significance

The EPBC Act Significant Impact Guidelines (DotE 2013) state:

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- *lead to a long-term decrease in the size of an important population of a species*
- *reduce the area of occupancy of an important population*
- *fragment an existing important population into two or more populations*
- *adversely affect habitat critical to the survival of a species*
- *disrupt the breeding cycle of an important population*
- *modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*
- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*
- *introduce disease that may cause the species to decline, or*
- *interfere substantially with the recovery of the species.*

An 'important population' is a population that is necessary for a species' long-term survival and recovery.

This may include populations identified as such in recovery plans, and/or that are:

- *key source populations either for breeding or dispersal*
- *populations that are necessary for maintaining genetic diversity, and/or*
- *populations that are near the limit of the species range.*

***Angophora inopina* (Charmhaven Apple)**

Assessment of Significance

1. ***Is the action likely to lead to a long-term decrease in the size of an important population of a species?***

An 'important population' is defined as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity, and/or
- Populations that are near the limit of the species range.

A total of 38 individuals of *Angophora inopina* (Charmhaven Apple) were recorded within Vegetation Zones 4, 5 and 6. No individuals of the species were recorded within Vegetation Zones 1, 2, 3 or 7. These individuals are likely to be part of larger population of the species within the locality. Therefore, the Study Area is unlikely to contain a key source population for breeding, or one that is necessary for maintaining genetic diversity.

As such, it is unlikely the Study Area comprises an important population of *Angophora inopina*.

2. ***Will the action reduce the area of occupancy of an important population of the species?***

The proposed action will not impact an important population of this vulnerable species.

A total of 28 *Angophora inopina* individuals will be retained within the Conservation Areas, the 5m wide vegetation buffer and along the site boundaries. Therefore, a total of 74% of *Angophora inopina* plants will be retained under the proposed development.

3. ***Will the action fragment an existing important population into two or more populations?***

The proposed action will not impact an important population of this vulnerable species.

4. ***Will the action adversely affect habitat critical to the survival of a species?***

The proposed development will not impact habitat critical to the survival of this vulnerable species.

5. ***Will the action disrupt the breeding cycle of an important population?***

The proposed action will not impact an important population of this vulnerable species.

6. ***Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?***

The action will impact native vegetation representative of habitat for the species (19.9 ha). However, the species is mainly restricted to fragmented patches of woodland vegetation. As such, the majority of the habitat is unsuitable for maintaining a viable population of the species.

7. ***Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?***

Mitigation measures detailed in **Section 5.3** will prevent construction activities from introducing or spreading new or existing environmental and noxious weeds or invasive fauna species into the Study Area.

8. ***Will the action introduce disease that may cause the species to decline?***

No, the action will not result in the introduction of disease that may cause the species to decline locally.

9. ***Will the action interfere substantially with the recovery of the species?***

No, the proposed action will not interfere substantially with the recovery of the species.

Conclusion

Based on the above assessment it is considered unlikely that this Commonwealth-listed species will be significantly impacted by the proposal.

Grey-headed Flying-fox (*Pteropus poliocephalus*)

Assessment of Significance

1. **Is the action likely to lead to a long-term decrease in the size of an important population of a species?**

An 'important population' is defined as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity, and/or
- Populations that are near the limit of the species range.

The Study Area contains a number of myrtaceous tree species which may provide foraging habitat for the species. However, no breeding habitat (camps) were identified within the Study Area. Therefore, the Study Area is unlikely to contain a key source population for breeding, or one that is necessary for maintaining genetic diversity. The Study Area is also highly connected to large areas of suitable foraging habitat within remnant vegetation to the north, south and west of the site.

As such, it is unlikely the Study Area comprises an important population of Grey-headed Flying-fox.

2. **Will the action reduce the area of occupancy of an important population of the species?**

The proposed action will not impact an important population of this vulnerable species.

3. **Will the action fragment an existing important population into two or more populations?**

The proposed action will not impact an important population of this vulnerable species.

4. **Will the action adversely affect habitat critical to the survival of a species?**

No the proposed development will not impact habitat critical to the survival of this vulnerable species.

5. **Will the action disrupt the breeding cycle of an important population?**

The proposed action will not impact an important population of this vulnerable species.

6. **Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?**

The action will impact native vegetation representative of marginal foraging habitat for the species. This includes 0.79 ha of PCT 1649 – *Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands* (Vegetation Zones 1 and 2) known to have foraging tree species including *Eucalyptus robusta* (Swamp Mahogany) and *Eucalyptus resinifera* (Red Mahogany). The proposed development aims to restore this community within the proposed Eastern Conservation Area. As such, whilst the proposed development will remove marginal foraging habitat for the species, these areas will be largely replaced through

active restoration works within the Conservation Area. The proposed development is therefore not expected to modify, destroy, remove or isolate availability of quality habitat within the locality.

7. **Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?**

Mitigation measures detailed in **Section 5.3** will prevent construction activities from introducing or spreading new or existing environmental and noxious weeds or invasive fauna species into the Study Area.

8. **Will the action introduce disease that may cause the species to decline?**

No, the action will not result in the introduction of disease that may cause the species to decline locally.

9. **Will the action interfere substantially with the recovery of the species?**

No, the proposed action will not interfere substantially with the recovery of the species.

Conclusion

Based on the above assessment it is considered unlikely that this Commonwealth-listed species will be significantly impacted by the proposal.

Cryptostylis hunteriana (Leafless Tongue Orchid)

Assessment of Significance

1. **Is the action likely to lead to a long-term decrease in the size of an important population of a species?**

An 'important population' is defined as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity, and/or
- Populations that are near the limit of the species range.

The Study Area contains areas of remnant woodland vegetation with intact native groundcover, likely constituting suitable habitat for the species. However, targeted surveys for the species were conducted during the flowering of a locally occurring reference population (Lake Munmorah State Conservation Area population), and the species was not detected within the Study Area. Therefore, the Study Area is unlikely to contain a key source population for breeding, or one that is necessary for maintaining genetic diversity.

As such, it is unlikely the Study Area comprises an important population of *Cryptostylis hunteriana*.

2. **Will the action reduce the area of occupancy of an important population of the species?**

The proposed action will not impact an important population of this vulnerable species.

3. **Will the action fragment an existing important population into two or more populations?**

The proposed action will not impact an important population of this vulnerable species.

4. **Will the action adversely affect habitat critical to the survival of a species?**

No the proposed development will not impact habitat critical to the survival of this vulnerable species.

5. **Will the action disrupt the breeding cycle of an important population?**

The proposed action will not impact an important population of this vulnerable species.

6. **Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?**

The action will impact native vegetation representative of marginal habitat for the species. This includes 10.54 ha of *PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast* (Vegetation Zones 4 and 5) characterised by intact canopy and native groundcover, albeit in variable condition. As the species was not detected within the Subject Site the proposed development is not expected to modify, destroy, remove or isolate availability of quality habitat within the locality.

7. **Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?**

Mitigation measures detailed in **Section 5.3** will prevent construction activities from introducing or spreading new or existing environmental and noxious weeds or invasive fauna species into the Study Area.

8. **Will the action introduce disease that may cause the species to decline?**

No, the action will not result in the introduction of disease that may cause the species to decline locally.

9. **Will the action interfere substantially with the recovery of the species?**

No, the proposed action will not interfere substantially with the recovery of the species.

Conclusion

Based on the above assessment it is considered unlikely that this Commonwealth-listed species will be significantly impacted by the proposal.

Diuris praecox. (Rough Doubletail)

Assessment of Significance

1. **Is the action likely to lead to a long-term decrease in the size of an important population of a species?**

An 'important population' is defined as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity, and/or
- Populations that are near the limit of the species range.

The Study Area contains areas of remnant woodland vegetation with intact native groundcover, likely constituting suitable habitat for the species. However, targeted surveys for the species were conducted during the flowering of a locally occurring reference population (Kanangra Drive, Lake Munmorah), and the species was not detected within the Study Area. Therefore, the Study Area is unlikely to contain a key source population for breeding, or one that is necessary for maintaining genetic diversity.

As such, it is unlikely the Study Area comprises an important population of *Diuris praecox*.

2. **Will the action reduce the area of occupancy of an important population of the species?**

The proposed action will not impact an important population of this vulnerable species.

3. **Will the action fragment an existing important population into two or more populations?**

The proposed action will not impact an important population of this vulnerable species.

4. **Will the action adversely affect habitat critical to the survival of a species?**

No the proposed development will not impact habitat critical to the survival of this vulnerable species.

5. **Will the action disrupt the breeding cycle of an important population?**

The proposed action will not impact an important population of this vulnerable species.

6. **Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?**

The action will impact native vegetation representative of marginal habitat for the species. This includes 9.54ha of *PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast* (Vegetation Zones 4 and 5) characterised by intact canopy and native groundcover, albeit in variable condition. As the species was not detected within the Subject Site the proposed development is not expected to modify, destroy, remove or isolate availability of quality habitat within the locality.

7. **Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?**

Mitigation measures detailed in **Section 5.3** will prevent construction activities from introducing or spreading new or existing environmental and noxious weeds or invasive fauna species into the Study Area.

8. **Will the action introduce disease that may cause the species to decline?**

No, the action will not result in the introduction of disease that may cause the species to decline locally.

9. **Will the action interfere substantially with the recovery of the species?**

No, the proposed action will not interfere substantially with the recovery of the species.

Conclusion

Based on the above assessment it is considered unlikely that this Commonwealth-listed species will be significantly impacted by the proposal.

F2 Migratory Species – EPBC Act Assessment of Significance

The EPBC Act Significant Impact Guidelines state:

> *An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:*
>
> - *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*
> - *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*
> - *seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.*
>
> *An area of 'important habitat' for a migratory species is:*
>
> *(a) habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or*
>
> *(b) habitat that is of critical importance to the species at particular life-cycle stages, and/or*
>
> *(c) habitat utilised by a migratory species which is at the limit of the species range, and/or*
>
> *(d) habitat within an area where the species is declining.*

White-throated Needletail (*Hirundapus caudacutus*)

1. Is the action likely to 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

Important habitat for a migratory species is: habitat that supports an ecologically significant proportion of a species population, habitat that is of critical importance to a species at a particular life cycle stage, habitat that is at the limit of a species range and/or habitat within an area where the species is declining.

Potential foraging habitat for these species has been identified within the Study Area, however, is not considered to be important habitat for the species.

2. Will the action 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

It is unlikely that the proposed action will result in invasive species becoming established in an area of important habitat for migratory species

3. Will the action seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species

The Study Area forms part of a foraging range for these species, as such it is unlikely that an ecologically significant proportion of the population of these species occur within the Development Site and/or the Study Area.

APPENDIX G – BIODIVERSITY CREDIT REPORTS

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id
00029825/BAAS21021/21/00029826

Proposal Name
285 to 335 Pacific Highway Lake Munmorah

BAM data last updated *
14/10/2022

Assessor Name
Gilbert Whyte

Assessor Number
BAAS18041

BAM Data version *
55

Proponent Names
Ian Stewart

Report Created
09/12/2022

BAM Case Status
Finalised

Assessment Revision
7

Assessment Type
Biocertification

Date Finalised
09/12/2022

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

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Nil		

Species
Lathamus discolor / Swift Parrot

Additional Information for Approval

PCT Outside Ibra Added

None added

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
No Changes

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

BAM Biodiversity Credit Report (Like for like)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
1649-Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands	Not a TEC	0.6	0	7	7
1638-Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast	Not a TEC	19.8	171	0	171
1737-Typha rushland	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.3	0	8	8
1649-Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.8	0	23	23

1638-Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region
Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1138, 1253, 1625, 1636, 1638, 1776, 1778, 1782, 1786	Sydney Coastal Dry Sclerophyll Forests >=50% and <70%	1638_VZ4	Yes	66	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1138, 1253, 1625, 1636, 1638, 1776, 1778, 1782, 1786	Sydney Coastal Dry Sclerophyll Forests >=50% and <70%	1638_VZ5	Yes	105	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1138, 1253, 1625, 1636, 1638, 1776, 1778, 1782, 1786	Sydney Coastal Dry Sclerophyll Forests >=50% and <70%	1638_VZ6	Yes	0	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1649-Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Coastal Swamp Forests This includes PCT's: 839, 923, 1064, 1227, 1230, 1231, 1232, 1649, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1726, 1729, 1730, 1731, 1794, 1795, 1798	Coastal Swamp Forests <50%	1649_VZ3	No	7	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

1649-Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands

1649-Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands

Like-for-like credit retirement options

Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 837, 839, 926, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798	-	1649_VZ1	No	9	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 837, 839, 926, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798	-	1649_VZ2	No	14	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1737-Typha rushland	**Like-for-like credit retirement options**					
	Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region

	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 780, 781, 782, 828, 1071, 1735, 1736, 1737, 1738, 1739, 1740, 1741, 1742, 1911	-	1737_VZ7	No	8	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Angophora inopina / Charmhaven Apple	**1638_VZ4, 1638_VZ5, 1638_VZ6**	19.8	224.00
Lathamus discolor / Swift Parrot	**1638_VZ4, 1638_VZ5, 1638_VZ6, 1649_VZ1, 1649_VZ2, 1649_VZ3**	5.8	160.00
Myotis macropus / Southern Myotis	**1638_VZ4, 1638_VZ5, 1638_VZ6, 1649_VZ2, 1649_VZ3, 1737_VZ7**	16.9	192.00

BAM Biodiversity Credit Report (Like for like)

Credit Retirement Options

Like-for-like credit retirement options

Angophora inopina / Charmhaven Apple	Spp	IBRA subregion
	Angophora inopina / Charmhaven Apple	Any in NSW
Lathamus discolor / Swift Parrot	Spp	IBRA subregion
	Lathamus discolor / Swift Parrot	Any in NSW
Myotis macropus / Southern Myotis	Spp	IBRA subregion
	Myotis macropus / Southern Myotis	Any in NSW

BAM Biodiversity Credit Report (Variations)

Proposal Details

Assessment Id
00029825/BAAS21021/21/00029826

Proposal Name
285 to 335 Pacific Highway Lake Munmorah

BAM data last updated *
14/10/2022

Assessor Name
Gilbert Whyte

Assessor Number
BAAS18041

BAM Data version *
55

Proponent Name(s)
Ian Stewart

Report Created
09/12/2022

BAM Case Status
Finalised

Assessment Revision
7

Assessment Type
Biocertification

Date Finalised
09/12/2022

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

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Nil		

Species
Lathamus discolor / Swift Parrot

Additional Information for Approval

PCT Outside Ibra Added

None added

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
No Changes

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
1649-Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands	Not a TEC	0.6	0	7	7.00
1638-Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast	Not a TEC	19.8	171	0	171.00
1737-Typha rushland	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.3	0	8	8.00
1649-Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.8	0	23	23.00

1638-Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region

Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1138, 1253, 1625, 1636, 1638, 1776, 1778, 1782, 1786	Sydney Coastal Dry Sclerophyll Forests >=50% and <70%	1638_VZ4	Yes	66	Wyong,Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1138, 1253, 1625, 1636, 1638, 1776, 1778, 1782, 1786	Sydney Coastal Dry Sclerophyll Forests >=50% and <70%	1638_VZ5	Yes	105	Wyong,Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1138, 1253, 1625, 1636, 1638, 1776, 1778, 1782, 1786	Sydney Coastal Dry Sclerophyll Forests >=50% and <70%	1638_VZ6	Yes	0	Wyong,Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Variation options

Formation	Trading group	Zone	HBT	Credits	IBRA region
Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 3 or higher threat status	1638_VZ4	Yes (including artificial)	66	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 3 or higher threat status	1638_VZ5	Yes (including artificial)	105	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 3 or higher threat status	1638_VZ6	Yes (including artificial)	0	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1649-Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Coastal Swamp Forests This includes PCT's: 839, 923, 1064, 1227, 1230, 1231, 1232, 1649, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1726, 1729, 1730, 1731, 1794, 1795, 1798	Coastal Swamp Forests <50%	1649_VZ3	No	7	Wyong,Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					
	Formation	Trading group	Zone	HBT	Credits	IBRA region
	Forested Wetlands	Tier 4 or higher threat status	1649_VZ3	No	7	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

1649-Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands	Like-for-like credit retirement options					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 837, 839, 926, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798	-	1649_VZ1	No	9	Wyong,Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 837, 839, 926, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798	-	1649_VZ2	No	14	Wyong,Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					

	Formation	Trading group	Zone	HBT	Credits	IBRA region
	Forested Wetlands	Tier 3 or higher threat status	1649_VZ1	No	9	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Forested Wetlands	Tier 3 or higher threat status	1649_VZ2	No	14	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1737-Typha rushland	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 780, 781, 782, 828, 1071, 1735, 1736, 1737, 1738, 1739, 1740, 1741, 1742, 1911	-	1737_VZ7	No	8	Wyong,Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					
	Formation	Trading group	Zone	HBT	Credits	IBRA region

	Freshwater Wetlands	Tier 3 or higher threat status	1737_VZ7	No	8	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Angophora inopina / Charmhaven Apple	**1638_VZ4, 1638_VZ5, 1638_VZ6**	19.8	224.00
Lathamus discolor / Swift Parrot	**1638_VZ4, 1638_VZ5, 1638_VZ6, 1649_VZ1, 1649_VZ2, 1649_VZ3**	5.8	160.00
Myotis macropus / Southern Myotis	**1638_VZ4, 1638_VZ5, 1638_VZ6, 1649_VZ2, 1649_VZ3, 1737_VZ7**	16.9	192.00

Credit Retirement Options

Like-for-like options

Angophora inopina/ Charmhaven Apple	Spp		IBRA region
	Angophora inopina/Charmhaven Apple		Any in NSW
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Flora	Vulnerable	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Lathamus discolor/ Swift Parrot	Spp		IBRA region
	Lathamus discolor/Swift Parrot		Any in NSW
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Endangered	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Myotis macropus/ Southern Myotis	Spp		IBRA region
	Myotis macropus/Southern Myotis		Any in NSW
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Vulnerable	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

APPENDIX H – PREDICTED AND CANDIDATE SPECIES REPORTS

BAM Candidate Species Report

Proposal Details

Assessment Id 00029825/BAAS21021/21/00029826	Proposal Name 285 to 335 Pacific Highway Lake Munmorah	BAM data last updated * 14/10/2022
Assessor Name Gilbert Whyte	Report Created 09/12/2022	BAM Data version * 55
Assessor Number BAAS18041	Assessment Type Biocertification	BAM Case Status Finalised
Assessment Revision 7	Date Finalised 09/12/2022	

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

List of Species Requiring Survey

Name	Presence	Survey Months
Acacia bynoeana Bynoe's Wattle	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Angophora inopina Charmhaven Apple	Yes (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Anthochaera phrygia Regent Honeyeater	No (surveyed) *Survey months are outside of the months specified in Bionet.	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☑ Survey month outside the specified months?

Asperula asthenes Trailing Woodruff	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Burhinus grallarius Bush Stone-curlew	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Callistemon linearifolius Netted Bottle Brush	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Calyptorhynchus lathami Glossy Black-Cockatoo	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Corunastylis sp. Charmhaven (NSW896673) Corunastylis sp. Charmhaven (NSW896673)	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Crinia tinnula Wallum Froglet	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☑ Dec ☐ Survey month outside the specified months?

Cryptostylis hunteriana Leafless Tongue Orchid	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Diuris praecox Rough Doubletail	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Eucalyptus camfieldii Camfield's Stringybark	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Genoplesium insigne Variable Midge Orchid	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Grevillea parviflora subsp. parviflora Small-flower Grevillea	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Haliaeetus leucogaster White-bellied Sea-Eagle	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?

Hieraaetus morphnoides Little Eagle	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Lathamus discolor Swift Parrot	Yes (assumed present)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Litoria aurea Green and Golden Bell Frog	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Litoria brevipalmata Green-thighed Frog	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Maundia triglochinoides Maundia triglochinoides	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☑ Dec ☐ Survey month outside the specified months?
Melaleuca biconvexa Biconvex Paperbark	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?

Myotis macropus Southern Myotis	Yes (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Nettapus coromandelianus Cotton Pygmy-Goose	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Ninox connivens Barking Owl	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Pandion cristatus Eastern Osprey	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Persicaria elatior Tall Knotweed	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☑ Dec ☐ Survey month outside the specified months?
Petalura gigantea Giant Dragonfly	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☑ Dec ☐ Survey month outside the specified months?

Petaurus norfolcensis Squirrel Glider	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Phascolarctos cinereus Koala	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☑ Jul ☑ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Rhizanthella slateri Eastern Australian Underground Orchid	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Rutidosis heterogama Heath Wrinklewort	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Thelymitra adorata Wyong Sun Orchid	No (surveyed) *Survey months are outside of the months specified in Bionet.	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☑ Survey month outside the specified months?
Turnix maculosus Red-backed Button-quail	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?

Uperoleia mahonyi Mahony's Toadlet	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☑ Dec ☐ Survey month outside the specified months?
Zannichellia palustris Zannichellia palustris	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☑ Dec ☐ Survey month outside the specified months?

Threatened species Manually Added

None added

Threatened species assessed as not on site

Refer to BAR for detailed justification

Common name	Scientific name	Justification in the BAM-C
Black-tailed Godwit	Limosa limosa	Habitat degraded
Broad-billed Sandpiper	Limicola falcinellus	Habitat degraded
Curlew Sandpiper	Calidris ferruginea	Habitat degraded
Great Knot	Calidris tenuirostris	Habitat degraded Geographic limitations
Terek Sandpiper	Xenus cinereus	Habitat degraded

BAM Predicted Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00029825/BAAS21021/21/00029826	285 to 335 Pacific Highway Lake Munmorah	14/10/2022
Assessor Name	**Report Created**	**BAM Data version ***
Gilbert Whyte	09/12/2022	55
Assessor Number	**Assessment Type**	**BAM Case Status**
BAAS18041	Biocertification	Finalised
Assessment Revision		**Date Finalised**
7		09/12/2022

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

Threatened species reliably predicted to utilise the site. No surveys are required for these species. Ecosystem credits apply to these species.

Common Name	Scientific Name	Vegetation Types(s)
Australasian Bittern	Botaurus poiciloptilus	1737-Typha rushland
Australian Painted Snipe	Rostratula australis	1737-Typha rushland
Barking Owl	Ninox connivens	1649-Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands
		1638-Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast
Black Bittern	Ixobrychus flavicollis	1737-Typha rushland
Black Falcon	Falco subniger	1737-Typha rushland
Black-necked Stork	Ephippiorhynchus asiaticus	1737-Typha rushland
Black-tailed Godwit	Limosa limosa	1737-Typha rushland
Blue-billed Duck	Oxyura australis	1737-Typha rushland
Broad-billed Sandpiper	Limicola falcinellus	1737-Typha rushland
Brown Treecreeper (eastern subspecies)	Climacteris picumnus victoriae	1638-Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast

Comb-crested Jacana	Irediparra gallinacea	1737-Typha rushland
Curlew Sandpiper	Calidris ferruginea	1737-Typha rushland
Eastern Coastal Free-tailed Bat	Micronomus norfolkensis	1649-Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands
		1638-Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast
		1737-Typha rushland
Eastern Osprey	Pandion cristatus	1649-Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands
		1737-Typha rushland
Freckled Duck	Stictonetta naevosa	1737-Typha rushland
Glossy Black-Cockatoo	Calyptorhynchus lathami	1649-Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands
		1638-Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast
		1737-Typha rushland
Great Knot	Calidris tenuirostris	1737-Typha rushland
Greater Broad-nosed Bat	Scoteanax rueppellii	1649-Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands
		1638-Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast
		1737-Typha rushland
Little Bent-winged Bat	Miniopterus australis	1649-Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands
		1638-Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast
		1737-Typha rushland
Little Eagle	Hieraaetus morphnoides	1737-Typha rushland
Little Lorikeet	Glossopsitta pusilla	1649-Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands

Little Lorikeet	Glossopsitta pusilla	1638-Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast
Magpie Goose	Anseranas semipalmata	1737-Typha rushland
Regent Honeyeater	Anthochaera phrygia	1649-Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands
Speckled Warbler	Chthonicola sagittata	1638-Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast
Spotted Harrier	Circus assimilis	1737-Typha rushland
Spotted-tailed Quoll	Dasyurus maculatus	1649-Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands
		1638-Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast
Terek Sandpiper	Xenus cinereus	1737-Typha rushland
Turquoise Parrot	Neophema pulchella	1638-Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast
Varied Sittella	Daphoenositta chrysoptera	1649-Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands
		1638-Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast
White-bellied Sea-Eagle	Haliaeetus leucogaster	1649-Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands
		1638-Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast
		1737-Typha rushland
White-fronted Chat	Epthianura albifrons	1737-Typha rushland
White-throated Needletail	Hirundapus caudacutus	1649-Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands
		1638-Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast
		1737-Typha rushland

Threatened species Manually Added

None added

BAM Predicted Species Report

Threatened species assessed as not within the vegetation zone(s) for the PCT(s)

Refer to BAR for detailed justification

Common Name	Scientific Name	Justification in the BAM-C

APPENDIX I – SWIFT PARROT HABITAT ASSESSMENT (WEDGETAIL 2022)

WEDGETAIL
PROJECT CONSULTING

Swift Parrot Habitat Assessment

Lakes Ridge

285 – 335 Pacific Highway, Lake Munmorah, NSW 2259

Report prepared for:
Rose Living Pty Ltd c/- Barker Ryan Stewart

Version 2.0
11 August 2022

Swift Parrot Habitat Assessment

Lakes Ridge

285 – 335 Pacific Highway, Lake Munmorah, NSW 2259

Prepared for:
Rose Living Pty Ltd,
C/ Barker Ryan Stewart
Studio 5, 78 York Street.
East Gosford, NSW
Australia

Prepared by:

Wedgetail Project Consulting Pty Ltd

PO Box 234,
Cardiff NSW 2285
ABN: 93 640 388 683

Document Control:

Version	Description	Date
2.0	Final	11 August 2022
1.0	Draft for Species Expert Review	14 July 2022
Prepared	Reviewed	Endorsed
		
David Martin **Senior Ecologist**	Mark Dean **Ecologist**	David Martin **Senior Ecologist**

Contents

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1. INTRODUCTION

1.1 SCOPE

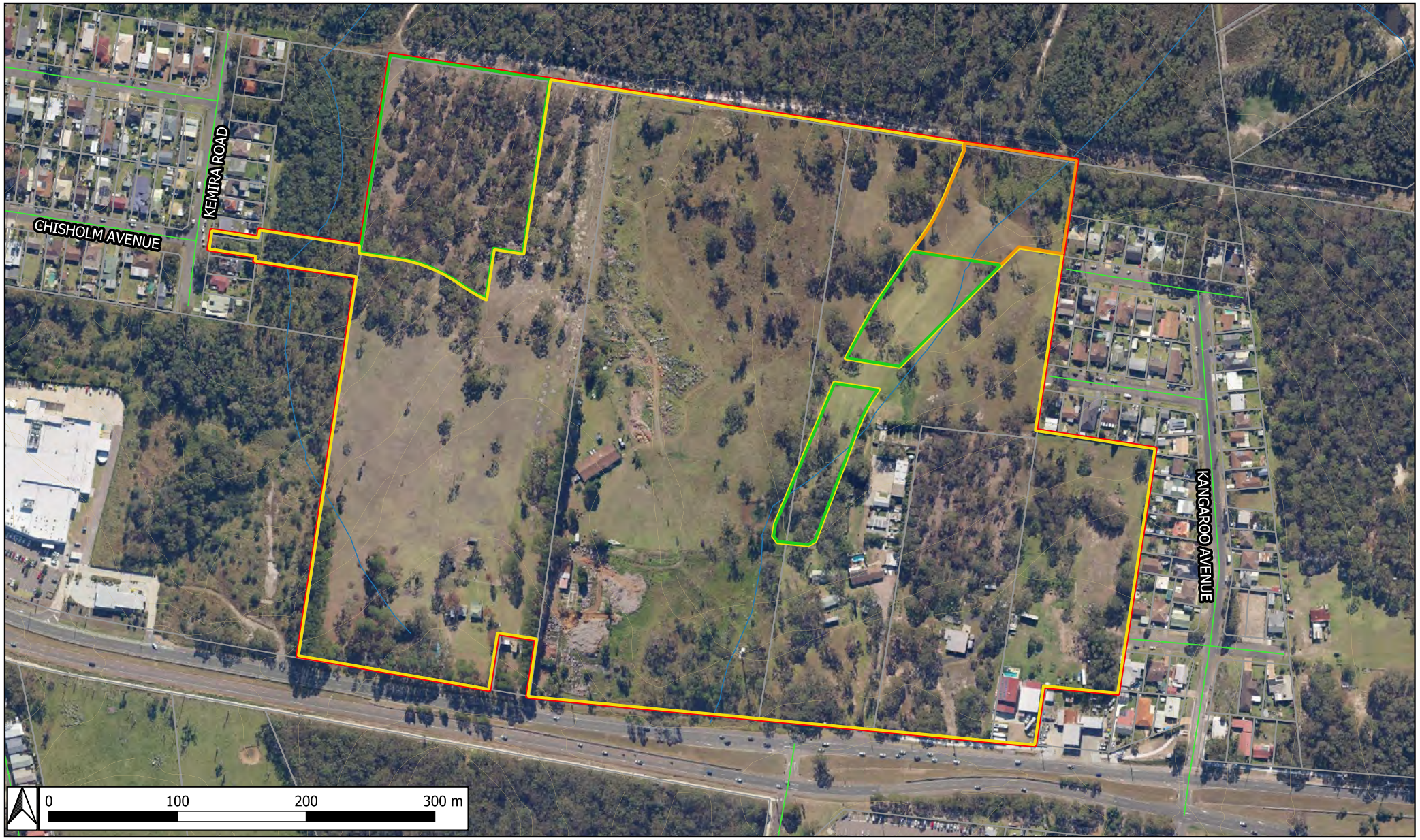
Wedgetail Project Consulting Pty Ltd (Wedgetail) was engaged by Barker Ryan Stewart (BRS), on behalf of the Rose Group Pty Ltd Group, to undertake a Habitat Assessment for the Swift Parrot (*Lathamus discolor*) to support the proposed Biocertification of land at 285, 295, 305, 315, 325 and 335 Pacific Highway Lake Munmorah, New South Wales (NSW) 2259 (inclusive of Lot 1 DP 626787, Lot 437 DP 755266, Lot 438 DP 755266, Lot 27 DP 755266, Lot 12 DP 771284, Lot 83 DP 650114) (hereafter referred to as the 'Study Area') (see **Figure 1**).

The following terms are used throughout this report to describe particular geographical areas:

- **Study Area** – 285 – 335 Pacific Highway, Lake Munmorah, NSW (inclusive of Lot 1 and 2 DP 626787, Lot 438 and 437 DP 755266, Lot 27 DP 755266, Lot 83 DP650114 and Lot 12 DP 771284) (**Figure 1**).
- **Development Site** - The area within the Study Area to be subject to the proposed residential subdivision (rezoning to *R2 Low Density Residential*) (**Figure 1**).
- **Conservation Area** – The area within the Study Area to be rezoned and maintained as a *C2 Environmental Conservation*, inclusive of areas of temporary impact and restoration associated with detention basins (constructed wetlands) (**Figure 1**).
- **Locality** - Land within a 5 kilometre (km) radius of the Study Area.

The Study Area is located within the Central Coast Council LGA and is currently zoned *RU6 Transition* and *RE1 Public Recreation* under the Wyong Local Environmental Plan (LEP) 2013. The Planning Proposal seeks to rezone the Study Area to *R2 Low Density Residential* and the construction of a residential subdivision. The proposal also seeks to provide the establishment of *C2 Environmental Conservation* zoned land within the Study Area (hereafter referred to as the "Conservation Area"), in accordance with the requirements of the Gateway Determination issued in September 2020 and the framework for strategic biodiversity certification.

The Swift Parrot Habitat Assessment was completed in response to recommendations by the Biodiversity Conservation Division (BCD) following a review of the BCAR in May 2022 "*an assessment of the quality of impacted areas should be undertaken to justify impacts, in consultation with a Biodiversity Assessment Method (BAM) approved species expert*" (Recommendation 2). The methods and key objectives of this habitat assessment are outlined in the following sections.



Created by: KBlundell
Date: 12/10/2022
Version: 2210051.3

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https://wedgetail.com.au/

Legend

- Study Area
- Development Site
- Conservation Area
- Conservation Area (temporary Impacts)
- Cadastre
- Minor creek
- Contour
- Local Road

Study Area

Figure: **1**

Rose Living Pty Ltd, C-/ Barker Ryan Stewart
Swift Parrot Habitat Assessment
Lakes Ridge, 285 - 335 Pacific Highway, Lake Munmorah NSW 2259

1.2 BACKGROUND

The Swift Parrot (*Lathamus discolor*) is listed as Endangered under the New South Wales (NSW) *Biodiversity Conservation Act 2016* (BC Act) and Critically Endangered under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (The EPBC Act). Whilst the species was not recorded within the Study Area, the site is mapped as habitat for the species under the NSW BAM Important Area Mapping. The Important Area Mapping within the Study Area is based on a 2km buffer of Swift Parrot records located approximately one (1) kilometre north of the Study Area (predominately within the Joshua Porter reserve, Chain Valley Bay in 2011 and 2019). As such, the proposed development is assumed to be impacting foraging habitat for the Swift Parrot.

The proposed development seeks to provide the establishment of *C2 Environmental Conservation* zoned land within the Study Area, prioritising the conservation of threatened species habitat including foraging habitat for the Swift Parrot. The key objective of this report is to assess the quality of Swift Parrot foraging habitat present within the proposed conservation areas and within the proposed development site and provide comment on the suitability of the proposed development layout in regards to the conservation of Swift Parrot habitat on site.

A discussion of Swift Parrot foraging habitat requirements is provided below. An outline of methods used during this assessment, results and discussion are provided in the following sections of this report.

Swift Parrot Habitat

The Swift Parrot breeds in Tasmania during summer, migrating north to South-eastern mainland Australia for winter. Breeding habitat for the species is largely restricted to Blue Gum (*Eucalyptus globulus*) and Black Gum (*Eucalyptus ovata*) (Webb *et al.* 2014) forests along the east and southeast coasts of Tasmania, with scarce and fragmented breeding habitat also likely to occur within the state's northwest.

The Swift Parrot is nomadic on the mainland, occurring within south eastern Australia during winter, and depending on a network of different foraging locations, of which they exploit at different times depending on environmental conditions. The Swift Parrot is known to forage on nectar and lerps in eucalypt forests and woodlands throughout coastal and western slopes regions. Coastal environments are considered to support larger numbers of birds, especially when inland habitats are subject to drought (Saunders and Tzaros 2011). Important foraging habitat in coastal New South Wales (NSW) is characterised by the presence of key nectar feed tree species, including Swamp Mahogany (*Eucalyptus robusta*), Forest Red Gum (*Eucalyptus tereticornis*), Blackbutt (*Eucalyptus pilularis*), and Spotted Gum (*Corymbia maculata*). Saunders and Heinsohn (2008) found

that each of the abovementioned tree species were also relied on for lerps, with the addition of three (3) key lerp (only) feed trees (for coastal NSW) including Red Bloodwood (*Corymbia gummifera*), Coastal Grey Box (*Eucalyptus mollucana*), and Rough-barked Apple (*Angophora subvelutina*). Within these habitats, Swift Parrots have been found to preferentially forage in large, mature trees (Kennedy 2000; Kennedy and Overs 2001;Kennedy and Tzaros 2005) that provide more reliable foraging resources than younger trees (Wilson and Bennett 1999; Law et al. 2000). The species has been known to occur within a wider range of habitats than those mentioned above (including planted vegetation), however these are largely opportunistic or as supplementary foraging habitat, rather than providing a reliable quantity and quality resource for which the species can depend on (Saunders and Tzaros 2011).

The ability of Swift Parrots to exploit suitable foraging habitat is impacted through competition for food and nesting resources from large, aggressive honeyeaters within human-modified, or fragmented, habitats (Ford et al. 1993; Grey et al. 1998; Saunders and Heinsohn 2008) and introduced birds and bees (Brown 1989; Paton 1993; Hingston et al. 2004) (Saunders and Tzaros 2011). Swift Parrots are less likely to occur at known foraging sites as the abundance of large, aggressive nectar feeders such as Noisy Miner (*Manorina melanocephala*) and Rainbow Lorikeet (*Trichoglossus haematodus*) increase (Saunders and Heinsohn 2008). Impacts by aggressive competitors on Swift Parrot foraging are likely to increase with further habitat loss and fragmentation that promote suitable conditions for these species to thrive. Piper and Catterall (2003) found that noisy miners occupy a zone of 20m from the forest edge, with frequent use occurring up to 100m from the edge, but little beyond 200m. in these areas the abundance and species richness of other birds was half of that recorded at other sites (Piper and Catterall 2003). Saunders and Heinsohn (2008) also found positive associations with three non-aggressive species (Little Lorikeet, Fuscous Honeyeater and Dusky Woodswallow) and two aggressive species (Noisy Friarbird and Red Wattlebird).

Other key threats to Swift Parrot include; habitat loss and fragmentation, habitat degradation (senescence of paddock trees and suppression of tree regeneration), frequent fire, competition with feral bees, and climate change (changes to eucalypt flowering frequency and timing, and drought-associated dieback of feed trees) (Saunders and Tzaros 2011).

Habitat features considered relevant for this assessment, and overall survey design, was developed in consultation with the NSW Biodiversity Conservation Division (BCD), Central Coast Council (CCC) and Ross Crates (Swift Parrot Species Expert). The following measures were considered for inclusion in the habitat assessment:

- Condition/age of feed trees including occurrence and quality of the favoured blossom feed trees outlined in the Swift Parrot Recovery Plan
- Diversity of Eucalypt species present
- Occurrence and quality of favoured lerp trees and mistletoe
- Presence of competitor species (e.g. rainbow lorikeets, noisy miners etc.)
- Connection to other areas of suitable Swift Parrot habitat within the locality and/or fragmentation
- Availability of water within the site
- Landscape productivity (soil types/fertility, slope, elevation)
- Any evidence of site fidelity (i.e. preference to use the site through the use of previous species records [BioNet])
- Cumulative impacts, particularly considered against the growth corridor outlined in the Central Coast Regional Plan.

Through further consultation with the Species Expert, the following key habitat features were considered to be the greatest influence on the quality of Swift Parrot habitat within the Subject Site were considered to fall into one of three (3) key measures of Swift Parrot habitat quality, including Foraging Resource Availability, Landscape Productivity, and Threats.

Foraging Resource Availability

- Occurrence of key nectar feed trees - Swamp Mahogany (*Eucalyptus robusta*), Forest Red Gum (*Eucalyptus tereticornis*), Blackbutt (*Eucalyptus pilularis*), and Spotted Gum (*Corymbia maculata*). Ironbarks, whilst generally summer flowering, were considered owing to variability in flowering timing.
- Occurrence of key lerp feed trees - Red Bloodwood (*Corymbia gummifera*), Coastal Grey Box (*Eucalyptus mollucana*), Rough-barked Apple (*Angophora subvelutina*), and *Eucalyptus punctata* (Grey Gum) (Ross Crates per comms. 2022).
- Maturity of Swift Parrot feed trees
- Occurrence of supplementary feed resources - including other winter flowering eucalypts and mistletoes.

Landscape Productivity

- Vegetation community condition and connectivity to other habitats
- Availability of water within the site

Threats

- Occurrence of resource competitors - large, aggressive nectar feeders and feral bees
- Land Management

The methods, results and discussion relating to this assessment are provided in the following sections.

2. METHODS

The methods used to inform this Swift Parrot Habitat Assessment within each of the three (3) key measures of Swift Parrot habitat quality (Foraging Resource Availability, Landscape Productivity, and Threats) are provided below. Data informing the habitat assessment were collected through the completion of a desktop assessment, the utilisation of previously collected site data (surveys completed to inform the BCAR), and the completion of a Swift Parrot Habitat site assessment.

2.1 FORAGING RESOURCE AVAILABILITY

2.1.1 Vegetation Community Mapping

Detailed vegetation surveys were conducted across the Study Area during August 2021. The boundaries of each of the identified vegetation communities within the Study Area were mapped using a combination of rapid data points (RDP) and walking transects, using the polygons produced through aerial photo interpretation (API) to assist in targeting survey effort. RDPs involved collecting waypoints over the Study Area using a handheld TrimbleTM GPS unit and recording dominant species, structure and condition. Walking transects involved verifying polygons where homogenous in floristic composition and condition, as well as walking vegetation ecotones and using the recorded tracks to define vegetation community boundaries. The RDPs and survey tracks were then overlaid on an aerial photograph and used to delineate and/or clarify vegetation boundaries.

Each vegetation community identified within the Study Area was assigned to the closest equivalent Plant Community Type (PCT) from those listed in the BioNet Vegetation Classification database (DPIE 2022b). Vegetation zones were identified and delineated in the Development Site in accordance with Section 4.3 of the BAM (DPIE 2020a). A vegetation zone is defined in the BAM as a relatively homogenous area that is the same vegetation type and broad condition.

Following stratification of the Study Area into vegetation zones, plots/transects were undertaken to collect site condition data for the composition, structure and function attributes in accordance with Section 4.3 of the BAM (DPIE 2020a). Vegetation Integrity plots were used to provide detail on;

- Floristic species mix (including supplementary feed species [winter flowering eucalypts and mistletoe])
- Tree maturity (collection of tree size classes [diameter at breast height – dbh])

2.1.2 Swift Parrot Feed Tree Surveys

A detailed Swift Parrot Habitat Assessment was completed on 20, 21, and 24 June 2022 by two (2) Wedgetail Ecologists. During the assessment the location of all recognised Swift Parrot feed trees (nectar and lerp feed tree species) were recorded using a handheld GPS. Species recorded are detailed in **Table 1**.

Table 1: Recognised Swift Parrot Feed Trees – Coastal NSW (Nectar and Lerp feed trees)

Common Name	Scientific Name	Resource*
Swamp Mahogany	*Eucalyptus robusta*	Nectar and Lerps
Forest Red Gum	*Eucalyptus tereticornis*	Nectar and Lerps
Blackbutt	*Eucalyptus pilularis*	Nectar and Lerps
Spotted Gum	*Corymbia maculata*	Nectar and Lerps
Red Ironbark	*Eucalyptus fibrosa*	Nectar and Lerps**
Caley's ironbark	*Eucalyptus caleyi*	Nectar and Lerps**
Red Bloodwood	*Corymbia gummifera*	Lerps
Coastal Grey Box	*Eucalyptus moluccana*	Lerps
Rough-barked Apple	*Angophora subvelutina*	Lerps
Grey Gum	*Eucalyptus punctata*	Lerps**

*As per Saunders and Heinsohn 2008. ** Ross Crates per comms.

2.2 LANDSCAPE PRODUCTIVITY

2.2.1 Desktop Assessment

A desktop assessment was completed to assess landscape productivity, including a review of the following:

- Lower Hunter and Central Coast Regional vegetation survey VIS_ID 2227 (DPIE 2018a) (NSW National Parks and Wildlife Service [NPWS] 2003) for existing vegetation community mapping within the Study Area and locality.
- Biodiversity Assessment Method (BAM) Important Area Mapping
- The NSW DPIE, BioNet Atlas (DPIE 2022a) for Swift Parrot records within 5 km radius of the Study Area.
- Wildlife Corridors proposed in the *North Wyong Shire Structure Plan 2012* and the *Greater Lake Munmorah Structure Plan 2020* (adopted by Council in April 2022)
- Existing aerial photography and watercourse mapping.

2.3 THREATS

2.3.1 Bird Surveys

Habitat Assessments (nest and hollow surveys) were conducted throughout the Study Area the survey period (August 2021 – January 2022). Three (3) half hour visual and auditory bird survey were conducted in separate portions of the Study Area on morning of 19 November 2021 (6am-7:30am). Species were identified visually with the aid of binoculars or aurally from call identification. Targeted bird surveys were conducted outside of the period when Swift Parrots may be present within the locality, however these surveys were able to discern the presence of competitor species within the Subject Site. Further opportunistic bird surveys were conducted throughout the survey period (August 2021, and December 2021). Key antagonistic/competitor species, positive influence species and neutral species were all recorded during the surveys.

3. RESULTS

3.1 VEGETATION COMMUNITIES

Three (3) Plant Community Types (PCTs) were identified within the Study Area:

- *PCT 1649 - Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands*.
- *PCT 1638 - Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast*.
- *PCT 1737 - Typha rushland*.

The above PCTs were further assigned to seven (7) vegetation zones based on floristics and vegetation condition as described in **Table 2**. The broad value of each vegetation zone as habitat for the Swift Parrot is outlined in **Table 2**.

The extent of each vegetation zone is illustrated on **Figure 2**.

Table 2: Description of Vegetation Zones within Study Area

Vegetation Zone	Vegetation Zone Description	Swift Parrot Habitat
Vegetation Zone 1 *PCT 1649 – Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal*	**Vegetation Class**: Forested Wetland (Coastal Swamp Forests) **Canopy**: *Eucalyptus robusta* (Swamp Mahogany) [Dominant] and *Angophora floribunda* (Rough-barked Apple), *Melaleuca quinquenervia* (Broad-leaved Paperbark), *Eucalyptus resinifera* (Red Mahogany). **Midstorey**: Dense. *Melaleuca quinquenervia* juveniles, and *Melaleuca sieberi, Allocasuarina littoralis* (Black She-oak) with occasional *Pinus radiata* (Radiata Pine).	**High Value** Key nectar feed species (*E.robusta*). Mature trees (1 tree with dbh > 50cm per 400 m^2) Tree regeneration (all stem classes present

Vegetation Zone	Vegetation Zone Description	Swift Parrot Habitat
lowlands - Good Condition (EEC) **Total impacted:** 0.20ha **Study Area:** 0.32 See Plate 2	**Shrub Layer:** Dense. *Melaleuca thymifolia* (Thyme Honey-myrtle), *Dillwynia retorta*, *Acacia suaveolens* (Sweet Wattle), *Pimelea latifolia* (Slender Rice-flower), *Mirbelia rubiifolia* (Heathy Mirbelia), and *Daviesia ulicifolia* (Gorse Bitter Pea). **Groundcover**: Dense. *Entolasia stricta* (Wiry Panic), *Themeda triandra* (Kangaroo Grass), *Xanthorrhoea media* (Cadigal), *Lepyrodia scariosa*, and *Lepidosperma laterale* (Variable Sword-sedge). **Condition**: Good condition, disturbances through clearing along edge of vegetation zone and low/moderate cover of exotics. **Status:** *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* (BC Act and EPBC Act).	<5cm, 5-9cm, 10-19cm, 20-29cm, 30-49cm, >50cm) All other key canopy species are spring – autumn flowering species. Low impacts from historic clearing
Vegetation Zone 2 PCT 1649 – *Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands* – Low-Moderate Condition (EEC) **Total impacted:** 0.52ha **Study Area:** 0.99 Plate 3	**Vegetation Class**: Forested Wetland (Coastal Swamp Forests) **Canopy**: *Eucalyptus robusta* (Swamp Mahogany) [Dominant], *Melaleuca quinquenervia* (Broad-leaved Paperbark), *Eucalyptus resinifera* (Red Mahogany), and *Eucalyptus capitellata* (Brown Stringybark). **Midstorey**: Sparse. *Melaleuca quinquenervia* juveniles, and *Melaleuca sieberi,* **Shrub Layer:** Cleared. Occasional *Pittosporum undulatum* (Sweet Pittosporum) and *Livistona australis* (Cabbage Tree Palm). **Groundcover**: Managed. *Andropogon virginicus* (Whisky Grass), *Themeda triandra* (Kangaroo Grass), *Sporobolus virginicus* (Sand Couch), *and Eragrostis leptostachya* (Paddock Lovegrass). Low lying areas had a greater abundance of species such as *Baumea rubiginosa, Cyperus polystachyos*, *Schoenus apogon* (Common Bog-rush), and *Juncus holoschoenus*. **Condition**: Low-Moderate condition, disturbances include a heavily reduced midstorey and shrub layer and managed groundcover. **Status:** *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* (BC Act and EPBC Act).	**High Value** Key nectar feed species (*E.robusta*). Mature trees (3 trees with dbh > 50cm per 400 m^2) Tree regeneration (all stem classes present <5cm, 5-9cm, 10-19cm, 20-29cm, 30-49cm, >50cm) All other key canopy species are spring – autumn flowering species. Impacts from clearing
Vegetation Zone 3 PCT 1649 – *Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands* – Cleared **Total impacted:** 0.25ha **Study Area:** 0.99 **Plate 4**	**Vegetation Class**: Forested Wetland (Coastal Swamp Forests) The vegetation within this Zone 3 was characterised by the absence of the canopy and midstorey detailed within Vegetation Zone 1 and 2. The groundcover is comparable to that observed within the two aforementioned vegetation zones. **Condition**: Low condition, absence of midstorey and canopy due to continual vegetation management and grazing. **Status:** *N/A*	**Low Value** No nectar or lerp feed tree species. No mature trees No tree regeneration Impacts from clearing
Vegetation Zone 4 *PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass*	**Vegetation Class**: Dry Sclerophyll Forests (Shrubby sub-formation) -Sydney Coastal Dry Sclerophyll Forests **Canopy**: *Angophora costata* (Smooth-barked Apple), *Eucalyptus haemastoma* (Broad-leaved Scribbly Gum), with *Corymbia gummifera* (Red Bloodwood) and *Eucalyptus capitellata* (Brown Stringybark).	**Moderate Value** Low-moderate cover of lerp feed tree species (*C.gummifera*).

Vegetation Zone	Vegetation Zone Description	Swift Parrot Habitat
– *shrub woodland on lowlands of the Central Coast* – Moderate Condition **Total impacted: 2.87**ha **Study Area:** 2.92 **Plate 5**	**Midstorey**: Sparse. *Allocasuarina littoralis* (She Oak), *Melaleuca* spp. and *Acacia* spp. **Groundcover**: Variable. *Themeda triandra* (Kangaroo Grass), *Aristida vagans* (Three-awn Speargrass), *Entolasia stricta* (Wiry Panic), *Microlaena stipoides* (Weeping Grass) and *Eragrostis brownii* (Brown's Lovegrass), sedges and other 'grasslike' species (*Lepidosperma laterale*, *Xanthorrhoea fulvum*, and *Cyathochaeta diandra*) and small sclerophyllous shrubs including *Acacia myrtifolia* (Myrtle Wattle), *Acacia brownii* (Prickly Moses), and *Dillwynia retorta*. **Condition**: Moderate condition, disturbances through clearing along edge of vegetation zone and low/moderate cover of exotics. **Status:** *N/A*	Mature trees (up to 3 trees with dbh > 50cm per 400 m^2) Tree regeneration (all stem classes present <5cm, 5-9cm, 10-19cm, 20-29cm, 30-49cm, >50cm) All other key canopy species are spring – autumn flowering species. Impacts from edge clearing
Vegetation Zone 5 PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast – Low-Moderate Condition **Total impacted: 6.66**ha **Study Area:** 8.59 Plate 6	**Vegetation Class**: Dry Sclerophyll Forests (Shrubby sub-formation) -Sydney Coastal Dry Sclerophyll Forests **Canopy**: *Angophora costata* (Smooth-barked Apple), *Eucalyptus haemastoma* (Broad-leaved Scribbly Gum), with *Corymbia gummifera* (Red Bloodwood) and *Eucalyptus capitellata* (Brown Stringybark). **Midstorey**: Sparse. *Allocasuarina littoralis* (She-oak). **Groundcover**: Managed. *Themeda triandra*, *Andropogon virginicus* (Whiskey Grass), *Aristida vagans*, *Entolasia stricta* (Wiry Panic), *Microlaena stipoides* (Weeping Grass) and *Eragrostis brownii* (Brown's Lovegrass) **Condition**: Low condition, disturbances include a managed groundcover and low/moderate cover of exotics. **Status:** *N/A*	**High Value** High cover of lerp feed tree species (*C.gummifera*) 5-20% cover. High number of mature trees (up to 4 trees with dbh > 50cm per 400 m^2) Tree regeneration (all stem classes present <5cm, 5-9cm, 10-19cm, 20-29cm, 30-49cm, >50cm) Mistletoe recorded All other key canopy species are spring – autumn flowering species. Impacts from edge clearing
Vegetation Zone 6 *PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast* – Low Condition **Total impacted:** 10.27ha **Study Area:** 10.36 **Plate 7**	**Vegetation Class**: Dry Sclerophyll Forests (Shrubby sub-formation) -Sydney Coastal Dry Sclerophyll Forests **Canopy**: occasional isolated tree species, such as *Angophora costata* (Smooth-barked Apple), *Eucalyptus haemastoma* (Scribbly Gum), and *Eucalyptus capitellata* (Brown Stringybark). **Midstorey**: Sparse. *Allocasuarina littoralis* (She-oak). **Groundcover**: Managed. *Themeda triandra*, *Andropogon virginicus* (Whiskey Grass), *Aristida vagans* (Three-awn Speargrass), *Entolasia stricta* (Wiry Panic), *Microlaena stipoides* (Weeping Grass) and *Eragrostis brownii* (Brown's Lovegrass). Herbs including *Hypochaeris radicata* (Cat's Ear), *Richardia humistrata* and *Gonocarpus teucrioides* (Rasp Wort) occur throughout. **Condition**: Low condition, absence of midstorey and canopy due to continual vegetation management. **Status:** *N/A*	**Low Value** No nectar or lerp feed tree species. No mature trees No tree regeneration Impacts from clearing, management of groundlayer and weeds
Vegetation Zone 7	**Vegetation Class**: Freshwater Wetlands - Coastal Freshwater Lagoons	**Moderate Value**

Vegetation Zone	Vegetation Zone Description	Swift Parrot Habitat
PCT 1737 – Typha rushland – Moderate Condition (EEC) **Total impacted:** 0.14ha **Study Area:** 0.26 **Plate 8**	*Typha orientalis* (Broad-leaved Cumbungi) with a mix *Gahnia clarkei* (Tall Saw-sedge), of herbs including *Ranunculus inundatus* (River Buttercup), *Baumea rubiginosa*, *Cyperus polystachyos*, and *Schoenus apogon* (Fluke Bog-rush). Occasional emergent of *Melaleuca quinquenervia* (Broad-leaved Paperbark) and *Eucalyptus robusta* (Swamp Mahogany). **Condition**: Low condition, low cover of exotic species, however Andropogon virginicus (Whiskey Grass) is invading the edges of the community. **Status:** *N/A*	occasional emergent or overhanging nectar or feed tree species (*E.robusta*). No mature trees No tree regeneration
Vegetation Zone 8 Exotic Vegetation **Total impacted:** 1.43ha **Study Area:** 1.43 **Plate 9**	**Vegetation Class**: Grassland. The zone is floristically largely characterised by a dominance of a canopy of *Pinus Radiata* (Radiata Pine) (a legacy of previous landuse), and an exotic dominated groundcover with a mix of *Andropogon Virginius* (Whiskey Grass), *Axonopus fissifolius* (Narrow-leafed Carpet Grass), *Sporobolus africanus* (Parramatta Grass), and *Verbena bonariensis* (Purple top). **Condition**: Low condition, low cover of exotic species, however Andropogon virginicus (Whiskey Grass) is invading the edges of the community. **Status:** *N/A*	**Low Value** No nectar or lerp feed tree species. No mature trees No tree regeneration

3.2 SWIFT PARROT FEED TREES

A total of 257 Swift Parrot Feed Trees were recorded within the Study Area. This includes 56 *Eucalyptus robusta* (Swamp Mahogany) trees (recognized nectar feed trees) and 201 *Corymbia gummifera* (Red Bloodwood) trees (recognized lerp trees). Of the 256 feed trees identified within the Study Area a total of 256 trees (60%) were recorded within the proposed Development Site, with 104 trees (40%) occurring within the proposed Conservation Areas (**Figure 2**).

Table 3: Swift Parrot Feed Trees within the Study Area

Common Name	Scientific Name	Resource*	Number of trees within the Development Site Number (%)	Number of trees within the Conservation Areas Number (%)	Total Number of trees
Swamp Mahogany	*Eucalyptus robusta*	Nectar and Lerp	56 (100%)	0 (0%)	56
Red Bloodwood	*Corymbia gummifera*	Lerp	97 (48%)	104 (52%)	201
		Totals	**156 (60%)**	**104 (40%)**	**257**

*As per Saunders and Heinsohn 2008

3.2.1 Desktop Assessment

A review of available resources is summarized below:

- **Regional vegetation mapping** (DPIE 2018a) indicates that the vegetation within the Study Area is connected to larger areas of comparable vegetation communities to the north and south. This includes vegetation communities commensurate with High Value vegetation within the Study Area (i.e. PCT 1649/MU42, and PCT 1638/MU31).
- **The BAM Important Area Mapping** for the Swift Parrot indicates areas mapped as important habitat for the species occurs within the north-west corner and along the watercourse within the eastern portion of the Study Area (**Figure 2**).
- **Threatened Species Records** (within 5km of the Development Site) show a total of 76 records of Swift Parrot, including a total of 69 records associated with Swamp Mahogany Forest vegetation at Joshua Porter Reserve 1 km to the north of the Study Area.
- **Regional Biodiversity Corridor** mapping as part of the *Greater Lake Munmorah Structure Plan* (Central Coast Council 2020) and the *North Wyong Shire Structure Plan 2012* (Central Coast 2012) identifies one Regional Biodiversity Corridor (east-west direction) to the north of the Study Area. The plans also identify two Local Biodiversity Corridors, one running north-south along the western boundary of the Study Area, and in association with the mapped watercourse in the eastern portion of the Study Area (**Plate 1**).
- A first order stream within a shallow drainage channel intersects the location of the proposed road reserve adjacent to Chisholm Avenue to the west. A first order stream within a shallow drainage channel also flows in a northern direction through the eastern portion of the Study Area. Both mapped watercourses are indistinct in their southern extents, when compared to original mapping, even following high rainfall events. As such, the extent and location of each watercourse has been re-mapped through a site inspection and aerial imagery. The extent of each watercourse is illustrated in **Figure 2.**

Plate 1: Biodiversity Corridor Mapping - *Greater Lake Munmorah Structure Plan (Central Coast Council 2020). Large green arrow indicates a regional corridor, the smaller arrows are local conservation corridors*

3.2.2 Bird Surveys

A total of 47 bird species were recorded during the assessments completed within the Study Area. This included two (2) species recognized to have a negative association with Swift Parrot, Noisy Miner (*Manorina melanocephala*) and Rainbow Lorikeet (*Trichoglossus moluccanus*). There were also two (2) species known to have a positive association with the Swift Parrot, Little Lorikeet (*Glossopsitta pusilla*) [one recorded flying over the site], and Red Wattlebird (*Anthochaera carunculata*). However, Noisy Miners and Rainbow Lorikeets were likely the two most abundant bird species recorded on site.

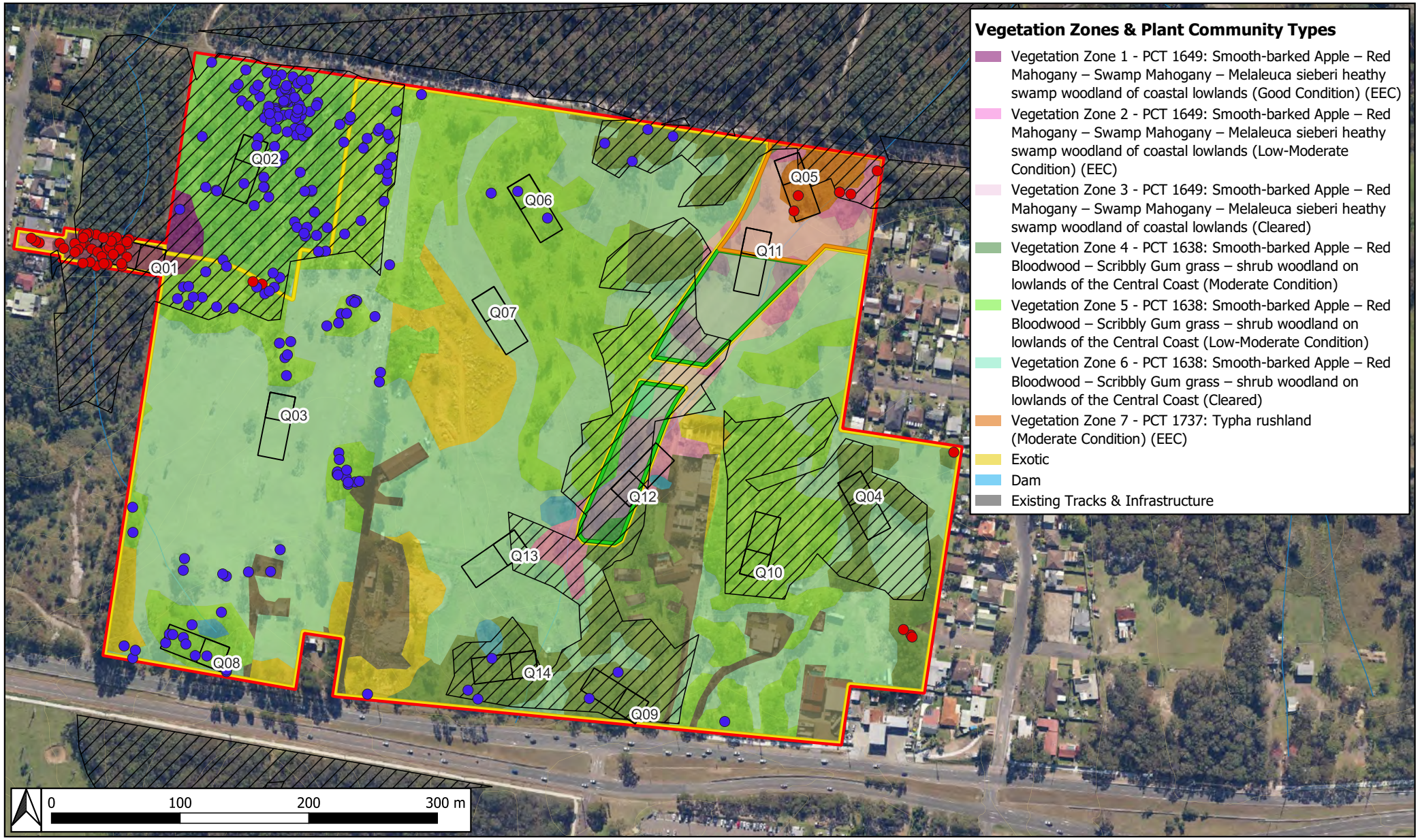
A full list of birds recorded within the Study Area is provided below in **Table 4**.

Table 4: Birds recorded within the Study Area

Common Name	Scientific Name
Australian Figbird	*Sphecotheres vieilloti*
Australian Golden Whistler	*Pachycephala pectoralis*
Australian Magpie	*Gymnorhina tibicen*
Australian Raven	*Corvus coronoides*
Australian Wood Duck	*Chenonetta jubata*
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*
Black-shouldered Kite	*Elanus axillaris*
Brown Thornbill	*Acanthiza pusilla*
Brown-headed Honeyeater	*Melithreptus brevirostris*
Channel-billed Cuckoo	*Scythrops novaehollandiae*

Common Name	Scientific Name
Common Myna	*Acridotheres tristis*
Crested Pigeon	*Ocyphaps lophotes*
Dollarbird	*Eurystomus orientalis*
Eastern Koel	*Eudynamys orientalis*
Eastern Rosella	*Platycercus eximius*
Eastern Spinebill	*Acanthorhynchus tenuirostris*
Eastern Yellow Robin	*Eopsaltria australis*
Galah	*Eolophus roseicapilla*
Grey Butcherbird	*Cracticus torquatus*
Grey Fantail	*Rhipidura albiscapa*
Laughing Kookaburra	*Dacelo novaeguineae*
Lewin's Honeyeater	*Meliphaga lewinii*
Little Corella	*Cacatua sanguinea*
Little Lorikeet**	*Glossopsitta pusilla*
Magpie Lark	*Grallina cyanoleuca*
Masked Lapwing	*Vanellus miles*
Musk Lorikeet	*Glossopsitta concinna*
Noisy Miner*	*Manorina melanocephala*
Pheasant Coucal	*Centropus phasianinus*
Pied Butcherbird	*Cracticus nigrogularis*
Pied Currawong	*Strepera graculina*
Rainbow Lorikeet*	*Trichoglossus moluccanus*
Red Wattlebird**	*Anthochaera carunculate*
Sacred Kingfisher	*Todiramphus sanctus*
Scaly-breasted Lorikeet	*Trichoglossus chlorolepidotus*
Spotted Pardalote	*Pardalotus punctatus*
Striated Thornbill	*Acanthiza lineata*
Sulphur-crested Cockatoo	*Cacatua galerita*
Superb Fairywren	*Malurus cyaneus*
Welcome Swallow	*Hirundo neoxena*
White-browed Scrubwren	*Sericornis frontalis*
White-cheeked Honeyeater	*Phylidonyris niger*
White-throated Gerygone	*Gerygone olivacea*
White-throated Needle-tail	*Hirundapus cochinensis*
Willie Wagtail	*Rhipidura leucophrys*
Yellow-faced Honeyeater	*Caligavis chrysops*

*Species known to have a **negative** association with Swift Parrot (Saunders and Heinsohn 2008)
Species known to have a **positive association with Swift Parrot (Saunders and Heinsohn 2008)



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Legend

- Study Area
- Development Site
- Conservation Area
- Conservation Area (Temporary Impacts)
- Swift Parrot Important Area Mapping

Swift Parrot Habitat Trees

- Corymbia gummifera
- Eucalyptus robusta
- BAM Plots
- Minor creek
- Contours

Swift Parrot Habitat

Figure: **2**

Rose Living Pty Ltd, C-/ Barker Ryan Stewart
Swift Parrot Habitat Assessment
Lakes Ridge, 285 - 335 Pacific Highway, Lake Munmorah NSW 2259

4. DISCUSSION

A total of 7ha of mapped Swift Parrot Important Habitat (with canopy trees) occur within the Study Area, of that, a total of 4.65 ha (65%) occurs within the disturbance footprint, while a total of 2.35 ha (35%) occurs within the proposed Conservation Areas. The results of the Swift Parrot Habitat Assessment indicate that the highest value Swift Parrot habitat occurs within Vegetation Zones 1, 2, and 5 owing to their good condition, and canopy species mix, including the occurrence of two (2) preferred Swift Parrot feed tree species (*Eucalyptus robusta* and *Corymbia gummifera*). These vegetation zones also contained the majority of the preferred feed trees occurring within the Study Area (243 trees of 256), the remaining 13 trees occur as scattered paddock trees within Vegetation Zone 6 and the exotic vegetation zone. The highest concentration of preferred Swift Parrot feed trees occur within the north western corner of the Study Area, with known nectar feed trees (*Eucalyptus robusta*) occurring in a high density within the creek corridor and known lerp feed trees (*Corymbia gummifera*) occurring in the open woodland area. These areas largely follow existing Important Area Mapping for the Swift Parrot (DPIE 2022). Large areas of mapped Important Habitat within the eastern half of the Study Area (within the Development Site and Conservation Areas) (**Figure 2**) have a low occurrence of feed trees in comparison. Swift Parrot foraging resources within the rest of the Study Area is comparatively sparse.

A summary of Swift Parrot habitat values occurring within the proposed conservation areas in comparison to the development site is provided below:

Conservation Areas

- The conservation areas contain all three (3) High Habitat Value vegetation zones, which are characterised by high condition vegetation, a diverse native canopy, mature trees, and a mix of tree ages (including signs of regeneration).
- The conservation areas contain a high proportion and density of preferred Swift Parrot feed trees (104 [40%]).
- The North-west Conservation Area is located in close proximity to a first order watercourse and mapped coastal wetland. This area is therefore likely to represent a highly productive landscape (high soil water content). The vegetation within this area is also in close proximity to wetlands to the immediate west that are commensurate with PCT 1649, a forested wetland community dominated by a *Eucalyptus robusta* (Swamp Mahogany) canopy. As this is a preferred nectar feed tree it represents a complimentary food resource with the *Corymbia gummifera* (Red Bloodwood) trees within the conservation area known for their lerp food resource.

- The conservation areas are highly connected to large areas of remnant vegetation to the north of the Study Area where Swift Parrot records occur (Joshua Porter Reserve). This area of vegetation is also associated with a regional corridor for the species. The vegetation within the Study Area is also largely cleared, providing little connectivity.
- Whilst the conservation areas are occupied by a high number of birds recognized to have a negative association with Swift Parrot, Noisy Miner (*Manorina melanocephala*) and Rainbow Lorikeet (*Trichoglossus moluccanus*), they also contain records of more positively associated species such as the Little Lorikeet and Red Wattlebird.

Development Site

- The Development Site is characterised by a mix of vegetation zones. The most significant areas of suitable habitat for the Swift Parrot occur within the proposed road corridor connecting the Study Area with Chisholm Avenue to the west (**Figure 2**).
- The Development Site contains the majority of Swift Parrot Habitat trees within the Study Area (156 [60%]). A large number of these trees (49 of 156) occur entirely within the proposed road corridor. Preferred feed trees are comparatively sparse throughout the rest of the Study Area.
- The Development Site is occupied by a high number of birds recognized to have a negative association with Swift Parrot, Noisy Miner (*Manorina melanocephala*) and Rainbow Lorikeet (*Trichoglossus moluccanus*).

5. REFERENCES

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APPENDIX 1. PHOTOS

Plate 2: Vegetation Zone 1 - PCT 1649 – *Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands* (Good) EEC – Inside the Swift Parrot Important Area Mapping

Plate 3: Vegetation Zone 2 PCT 1649 – *Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands* (Low-Mod) EEC – Inside the Swift Parrot Important Area Mapping

Plate 4: Vegetation Zone 3 PCT 1649 – *Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands* (Cleared)– Inside the Swift Parrot Important Area Mapping (No canopy)

Plate 5: Vegetation Zone 4 - *PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast* (Moderate) – Inside the Swift Parrot Important Area Mapping

Plate 6: Vegetation Zone 5 - *PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast* (Low-Mod) – Inside the Swift Parrot Important Area Mapping

Plate 7: Vegetation Zone 6 - *PCT 1638 – Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast* (Cleared) – Inside the Swift Parrot Important Area Mapping – No Canopy

Plate 8: Vegetation Zone 7 - *PCT 1737 – Typha rushland* – Within the Swift Parrot Important Area Mapping - No Canopy

Plate 9: Vegetation Zone 8 – Exotic Grassland – Within the Swift Parrot Important Area Mapping -No Canopy

APPENDIX 1. STAFF CONTRIBUTIONS

The following staff were involved in the project:

Name	Qualifications	Title	Contribution
David Martin	Master of Science BEnvSc & Mgt Accredited BAM Assessor	Senior Ecologist	Report Author, flora and fauna assessments, Swift Parrot habitat assessment fieldwork.
Mark Dean	BEnvSc & Mgt	Ecologist	Flora and fauna assessments, Swift Parrot habitat assessment fieldwork
Samara Schulz	BEnvSc & Mgt (Hons)	Principal Botanist	Report Review, GIS and figure preparation

APPENDIX 2. SCIENTIFIC LICENCING AND PERMITS

Wedgetail employees involved in the current study are licensed or approved under the *Biodiversity Conservation Act 2016* (License Number: SL102506, Expiry: 28 February 2023) and the *Animal Research Act 1985* to harm/trap/release protected native fauna and to pick for identification purposes native flora and to undertake fauna surveys.

APPENDIX J – STORMWATER MANAGEMENT PLAN (BARKER RYAN STEWART 2022)

APPENDIX K – BAM PLOT DATASHEETS

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of 6	**Date**	30/7/21	**Survey name**	BRS – LAKE MUNMORAH	**Plot identifier**	Q01		
Recorders	GILBERT WHITE			**IBRA region**	SYDNEY BASIN	**Veg zone ID**	F01		
[1]Datum	WGS84	**Coordinate system**	□ Projected □ Geographic	**MGA zone**	56	**[1]X coordinate**	33°11'13"	**[1]Y coordinate**	151°33'42
Location description	ROAD RESERVE WEST OF SITE								
[1] Plot dimensions	For composition & structure (400m²): 20 m x 20 m For fauna (1000m²): 20 m x 50 m					**[1] Orientation of midline from 0 m point**	90 Magnetic °	**Photo #**	✓

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate**: Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	**Structure** (400 m² plot)		Sum values (%) (may sum to >100%)	**Function** (1000 m² plot) [3] Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count 1
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	Count (best practice)/tick. If large tree benchmark size ≥50 cm, count 0
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥ 30 cm, count ✓
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥ 20 cm, count ✓
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick ✓
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick
						[4]Tree regeneration <5 cm	Tick ✓
			Total high threat weed cover		%	[5] Length of fallen logs	Tally space: 𝍸 𝍸 𝍸 IIII Total 14 m
						[6] Hollow bearing trees	Tick

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7] Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	10 10 10 10 10	a b c d e	a b c d e	a b c d e
Average of the 5 subplots	10			

These attributes require consideration of site observations and may be completed after field work:

Vegetation class	COASTAL SWAMP	[8] **Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)	1649	**EEC**	Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		*Landform element*		*Landform pattern*		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)	—	
Cultivation (inc. pasture)	—	
Soil erosion	—	
Firewood / CWD removal	—	
Grazing (id. native/stock)	—	
Fire damage	—	
Storm damage	—	
Weediness	—	
Other	—	

Brief site description or other notes

GOOD CONDITION DIVERSE.

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 30 7 2021	BRS - LAKE M	Q01	GILBERT WHYTE

	GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
1		EUCALYPTUS RACEMOSA		20	2	
2		ANGOPHORA FLORIBUNDA		15	5	
3		EUCALYPTUS ROBUSTA		5	1	
4		MELALEUCA SIEBERI		20	30	
5		XANTHORRHOEA MEDIA		10	20	
6		DILLWYNIA RETORTA		5	20	
7		LEPTOSPERMUM TRINERVIUM		2	10	
8		GOMPHOLOBIUM LATIFOLIUM		1	50	
9		PIMELEA LINIFOLIA		1	50	
10		MELALEUCA THYMIFOLIA		2	20	
11		LEPIDOSPERMA LATERALE		5	20	
12		MIRBELIA RUBIFOLIA		1	10	
13		LEPYRODIA SCARIOSA		20	1000	
14		ENTOLASIA STRICTA		20	1000	
15		ACACIA ~~STRIC~~ SUAVEOLENS		2	20	
16		ALLOCASUARINA LITTORALIS		5	10	
17		LEPIDOSPERMA CONCAVUM		2	20	
18		ACACIA LONGIFOLIA		2	10	
19		GONOCARPUS TEUCRIOIDES		0.5	20	
20		ARISTIDA VAGANS		1	10	
21		DIANELLA CAERULEA		1	20	
22		DAVESIA ULICIFOLIA		1	20	
23		CRYPTOSTYLIS SUBULATA		0.5	10	
24		XANTHORRHOEA LATIFOLIA		2	20	
25		THEMEDA AUSTRALIS.		10	1000	
26		IMPERATA CYLINDRICA		5	1000	
27		ERAGROSTIS LEPTOSTACHYA		0.5	100	
28		SCHOENUS BREVIFOLIUS		2	500	
29		PROTEA PURPURASCENS		0.5	50	
30		LINDSAEA LINEARIS		0.5	20	
31		TRACHYMENE INCISA		0.5	50	
32		POTTSIA SERICEA		0.5	20	
33		BANKSIA OBLONGIFOLIA		1	5	
34		ANDROPOGON VIRGINICUS		5	1000	
35		PINUS RADIATA		10	5	

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of 2	**Date**	30/7/21	**Survey name**	BRS - Lake Munmorah	**Plot identifier**	Q02		
Recorders	David Martin & Gilbert Whyte			**IBRA region**	Sydney	**Veg zone ID**	VegZone2		
[1]Datum	WGS84	**Coordinate system**	□ Projected □ Geographic	**MGA zone**	56	**[1]X coordinate**	366009	**[1]Y coordinate**	6327173

Location description GENTLE SLOPE (descriptive notes to locate site without grid reference)

[1] Plot dimensions For composition & structure (400m²): 20 m x 20 m; For function (1000m²): 20 m x 50 m — 400m²

[1] Orientation of midline from 0 m point Magnetic ° — **Photo #** ✓

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate**: Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	**Structure** (400 m² plot)		Sum values (%) (may sum to >100%)	**Function** (1000 m² plot) [3] Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count. 11
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	Count (best practice)/tick. If [3]large tree benchmark size ≥50 cm, count 11
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick. If [3]large tree benchmark size ≥ 30 cm, count ✓
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. If [3]large tree benchmark size ≥ 20 cm, count ✓
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick ✓
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick ✓
						[4]Tree regeneration <5 cm	Tick ✓
			Total high threat weed cover		%	[5]Length of fallen logs	Tally space — Total m
						[6]Hollow bearing trees	Tick

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7]Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	60	40	70	40	30	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots									✓					✓					✓	

These attributes require consideration of site observations and may be completed after field work:

Vegetation class	SYDNEY COASTAL.	[8]**Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)	PCT 1638.	**EEC**	Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		*Landform element*		*Landform pattern*		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Brief site description or other notes

SANDY SOIL - DRY SCLEROPHYLL SHRUB LAYER ABSENT.

MANAGED.

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 30 07 2021	BRS - LAKE MUNMORD	QOZ	GILBERT WHYTE

	GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
1		EUCALYPTUS ~~RACEMOSA~~ HAEMASTOMA		40	5	
2		CORYMBIA GUMMIFERA		5	2	
3		EUCALYPTUS CAPITELLATA		5	2	
4		ANGOPHORA COSTATA		2	1	
5		IMPERATA CYLINDRICA		2	500	
6		LEPTOSPERMUM TRINERVIUM		1	50	
7		PULTENAEA ROSMARINIFOLIA		1	50	
8		GONOCARPOS TEUCRIOIDES		2	500	
9		ENTOLASIA STRICTA		2	500	
10		HYPOCHAERIS RADICATA		5	1000	
11		RICHARDIA HUMISTRATA		2	1000	
12		EPACRIS PULCHELLA		1	200	
13		HARDENBERGIA VIOLACEA		1	200	
14		ERAGROSTIS LEPTOSTACHYA		2	1000	
15		MICROLAENA STIPOIDES		2	1000	
16		CALADENIA CATENATA		0.1	2.	
17						
18						
19						
20						
21						
22						
23						
24						
25						
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Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1/2	**Date**	30/7/21	**Survey name**	BRS-Lake Munmorah		**Plot identifier**	Q03	
Recorders	David Martin & Gilbert Whyte			**IBRA region**	Sydney		**Veg zone ID**	3	
[1]Datum	GDA 2020	**Coordinate system**	□ Projected □ Geographic	**MGA zone**	56	**[1]X coordinate**	366047	**[1]Y coordinate**	6326964
Location description	descriptive notes to locate site without grid reference – CLEARED AREA								
[1] Plot dimensions	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 m x 50 m (400 m²)					**[1] Orientation of midline from 0 m point**	Magnetic °	**Photo #**	

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate**: Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	**Structure** (400 m² plot)		Sum values (%) (may sum to >100%)	**Function** (1000 m² plot) [3]Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥50 cm, count
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥ 30 cm, count
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥ 20 cm, count
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick
						[4]Tree regeneration <5 cm	Tick
			Total high threat weed cover		%	[5]Length of fallen logs	Tally space / Total m
						[6]Hollow bearing trees	Tick

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7]Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	1	2	1	1	2	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots																				

These attributes require consideration of site observations and may be completed after field work:

Vegetation class	Syd Coastal Dry Scl	**[8]Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)	1638		**EEC** Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		*Landform* element		*Landform* pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Brief site description or other notes

ISOLATED TREES - CLOSER THAN 50m. CANT USE PADDOCK TREE MODULE.

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 30 07 2021	BRS - LAKE MUN	Q03	GILBERT WHYTE

	GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
1		ANGOPHORA COSTATA		5	1	
2		GAMOCHAETA AMERICANA		50	10000	
3		CYNODON INCOMPLETUS		40	10000	
4		EUPHORBIA DRUMMONDII		1	20	
5		PLANTAGO LANCEOLATA		1	20	
6		MOXONIUM FISSIFOLIUS		1	20	
7						
8						
9						
10						
11						
12						
13						
14						
15						
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Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, …, 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 …, when ≤10, estimate when >10, 20, 30 … 100, 200, 300 …, 1000, 2000, 3000 … (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of 2	**Date**	018/21	**Survey name**	Lake Munmorah BDAR		**Plot identifier**	Q04	
Recorders	DAVID MARTIN			**IBRA region**	Sydney/Wyong		**Veg zone ID**		
[1]Datum	GDA2020	**Coordinate system**	□ Projected □ Geographic	**MGA zone**	56	**[1]X coordinate**	366475	**[1]Y coordinate**	6326898
Location description	descriptive notes to locate site without grid reference								
[1] Plot dimensions	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20m x 50 m 20x20m + 20x50m					**[1] Orientation of midline from 0 m point**	M/Magnetic 168°	**Photo #**	

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate**: Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation Integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	**Structure** (400 m² plot)		Sum values (%) (may sum to >100%)	**Function** (1000 m² plot) **[3]Tree stem size class (DBH)**	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of **[2] foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count 1
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	Count (best practice)/tick. If [8]large tree benchmark size ≥50 cm, count 3
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick. If [8]large tree benchmark size ≥ 30 cm, count 6
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. If [8]large tree benchmark size ≥ 20 cm, count 6
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick 1
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick 1
						[4]Tree regeneration <5 cm	Tick 1
			Total high threat weed cover		%	**[5]Length of fallen logs**	Tally/space 8 Total m
						[6]Hollow bearing trees	Tick 1

Vegetation integrity - function cont. (five 1 m²) **plots)**	**[7]Litter cover (%)**	Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	80 90 15 20 20	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	45%															

These attributes require consideration of site observations and may be completed after field work:

Vegetation class		**[8]Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)		**EEC**	**Tick**	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness	1	
Other		

Brief site description or other notes

Remnant native vegetation characterised by a small number of mature (hollow-bearing) trees + dense Allocasuarina regrowth in areas. Native groundcover, some weeds.

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 10/08/21	Lake Munmorah BDAR	Q04	DAVID MARTIN

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
	1 Eucalyptus haemastoma		15	3	
	2 Melaleuca quinquenervia		2	4	
	3 Allocasuarina littoralis		45	40	
	4 Leptospermum trinervium		0.5	4	
	5 Acacia longifolia		0.2	2	
	6 Xanthorrhoea fulva		3	7	
	7 Andropogon virginicus		0.1	20	
	8 Lomandra obliqua		0.1	30	
	9 Themeda australis		5	100	
	10 Entolasia stricta		1	50	
	11 Carex inversa		0.1	30	
	12 Dianella caerulea		0.3	30	
	13 Taraxacum officinale		0.1	40	
	14 Setaria pumila		0.2	20	
	15 Ehrharta erecta		10	200	
	16 Opercularia varia		0.1	5	
	17 Hydrocotyle bonariensis		0.1	10	
	18 Lepidosperma neesii		1	30	
	19 Dillwynia retorta		0.1	5	
	20 Ptilothrix deusta		0.5	30	
	21 Dichondra repens		0.1	50	
	22 Pratia purpurascens		0.1	50	
	23 Sporobolus virginicus		15	300	
	24 Cyathochaeta diandra		40	1000	
	25 Cyperus polystachyos		0.1	20	
	26 Lindsaea linearis		0.1	20	
	27 Oxalis perennans		0.1	10	
	28 Agapanthus praecox		0.1	10	
	29 Archontophoenix cunninghamiana		0.1	1	
	30 Angophora costata		0.1	10	
	31 Fimbristylis dichotoma		0.1	30	
	32 Lepidosperma laterale		2	20	
	33 Epacris pulchella		0.1	10	
	34				
	35				

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1/2	**Date**	10/8/21	**Survey name**	Lake Munmorah BDAR	**Plot identifier**	Q05
Recorders	David Martin			**IBRA region**	Sydney / Wyong	**Veg zone ID**	
[1]Datum	GDA2020	**Coordinate system**	☐ Projected ☐ Geographic	**MGA zone**	56	**[1]X coordinate**	366429
[1]Y coordinate	6327183						
Location description	description notes to locate site without grid reference	PCT 1649 – Low – mod					
[1] Plot dimensions	For condition assessment (400m²): 20 m x 20 m For function (1000m²): 20m x 50 m	20x20m 20x50m	**[1] Orientation of midline from 0 m point**	Magnetic °	176	**Photo #**	

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate**: Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	**Structure** (400 m² plot)		Sum values (%) (may sum to >100%)	**Function** (1000 m² plot) **[3]Tree stem size class (DBH)**	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of **[2] foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	Count (best practice)/tick. If large tree benchmark size ≥50 cm, count: 1
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick. If large tree benchmark size ≥ 30 cm, count: 1
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. If large tree benchmark size ≥ 20 cm, count: 1
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick: 1
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick: 1
						[4]Tree regeneration <5 cm	Tick: 1
			Total high threat weed cover		%	**[5]Length of fallen logs**	Tally space: 0 — Total: m
						[6]Hollow bearing trees	Tick: 3

Vegetation integrity - function cont. (five 1 m²) **plots)**	**[7]Litter cover (%)**					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	10	5	15	10	10	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	10%																			

These attributes require consideration of site observations and may be completed after field work:

Vegetation class		**[8]Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)			**EEC** Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Brief site description or other notes

Lower condition PCT1649 cleared, on edge of wetland at northern boundary of subject site.

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 16 08 21	Lake Munmorah BDAR	Q05	DAVID MARTIN

	GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
1		Angophora costata		5	2	
2		Melaleuca quinquenervia		5	10	
3		Eucalyptus haemastoma		0.1	0	
4		Pinus radiata		~~0.5~~ 0.1	0	
5		Gahnia clarkei		15 ~~35~~	20	
6		Andropogon virginicus		~~350+~~	1000	
7		Dampieronium minus		0.1	10	
8		Goodenia bellidifolia		0.1 ~~0.5~~	20	
9		Fimbristylis dichotoma		0.5	50	
10		Selaginella uliginosa		0.5	50	
11		Schoenus apogon		4	200	
12		Gleichenia dicarpa		1	300	
13		Juncus holoschoenus		3	50	
14		Allocasuarina littoralis		0.1	1	
15		Leptospermum polygalifolium		0.1	1	
16		Conocarpus micranthus		0.1	20	
17		Dichondra repens		0.1	20	
18		Baumea rubiginosa		30	1000	
19		Juncus cognatus		2	60	
20		Cyperus polystachyos		5	60	
21		Hydrocotyle bonariensis		0.1	80	
22		Ranunculus inundatus		0.1	5	
23		Megathyrsus maximus		1	5	
24		Cyperus sanguinolentus.		2	50	
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	Date	30/8/21	Survey name	Lake Munmorah	Plot identifier	Q06
Recorders	DAVID MARTIN			IBRA region	Sydney Basin	Veg zone ID	
[1]Datum	GDA2020	Coordinate system	☐ Projected ☑ Geographic	MGA zone	56	[1]X coordinate	366206	[1]Y coordinate	6327138
Location description	288 - 316 Pacific Highway, Lake Munmorah.						
[1]Plot dimensions	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 x 50m 20x50m				[1]Orientation of midline from 0 m point	Magnetic °	Photo #	

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). MGA Zone (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). X/Y coordinate: Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	**Structure** (400 m² plot)		Sum values (%) (may sum to >100%)	**Function** (1000 m² plot) [3]Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count 111
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	Count (best practice)/tick. If large tree benchmark size ≥50 cm, count 1
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick. If large tree benchmark size ≥ 30 cm, count 1
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. If large tree benchmark size ≥ 20 cm, count
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick 1
						[4]Tree regeneration <5 cm	Tick 1
			Total high threat weed cover		%	[5]Length of fallen logs	Tally space 2m Total m
						[6]Hollow bearing trees	Tick

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7]Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	10	10	5	5	5	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	7%																			

These attributes require consideration of site observations and may be completed after field work:

Vegetation class		[8]Large tree benchmark size	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)		EEC	Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Brief site description or other notes

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 30 08 21	Lake Munmorah BDAR.	Q06	DAVID MARTIN

	GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
1		Eucalyptus haemastoma		25	3	
2		Pinus radiata		2	15	
3		Acacia longifolia		6	10	
4		Dillwynia retorta		1	10	
5		Mirbellea rubiifolia		0.5	20	
6		Lomandra obliqua		0.1	10	
7		Epacris pulchella		0.3	20	
8		Senecio madagascariensis		0.1	10	
9		Andropogon virginicus		30	1000	
10		Oxalis perennans		0.1	20	
11		Pratia purpurescens		0.1	20	
12		Cyperus polysachus		1	50	
13		Eragrostis leptostachya		5	500	
14		Taraxacum officinale		0.2	100	
15		Dianella caerulea		0.2	20	
16		Richardia humistrata		0.1	20	
17		Caginifera stipitata		0.1	60	
18		Setaria pumila		10	50	
19		Entolasia stricta		5	100	
20		Themeda australis		2	40	
21		Conocarpus leucrioides		0.1	40	
22		Sporobolus virginicus		0.5	50	
23		Allocasuarina littoralis		0.1	1	
24		Imperata cylindrica		15	1000	
25		Hydrocotyle bonariensis		0.1	20	
26		Hardenbergia violacea		0.1	2	
27		Verbena bonariensis		0.1	1	
28		Angophora costata		0.1	5	
29		Plantago lanceolata		0.2	50	
30		Lepidosperma laterale		0.1	5	
31		Corymbia gummifera		5	1	
32		Acacia ulicifolia		0.2	3	
33		Cenchrus clandestinus		10	1000	
34		Dichondra repens		0.1	40	
35						

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, …, 1, 2, 3, 4, 5, 10, 15, 20, 25, …100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 …, when ≤10, estimate when >10, 20, 30 … 100, 200, 300 …, 1000, 2000, 3000 … (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	**Date**	30/08/21	**Survey name**	Lake Munmorah BOAR		**Plot identifier**	Q07	
Recorders	DAVID MARTIN			**IBRA region**	Sydney Basin		**Veg zone ID**		
[1]Datum		**Coordinate system**	□ Projected □ Geographic	**MGA zone**	56	**[1]X coordinate**	366184	**[1]Y coordinate**	6327059
Location description	Central part of LOT 438 DP 755266								
[1] Plot dimensions	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20m x 50m					**[1] Orientation of midline from 0 m point**	161° Magnetic	**Photo #**	

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate**: Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)			**Structure (400 m² plot)**			**Function (1000 m² plot)**	
		Sum values			Sum values (%) (may sum to >100%)	[3] Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count ✓
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥50 cm, count ✓
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥ 30 cm, count ✓
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥ 20 cm, count ✓
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick 1
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick ✓
						[4]Tree regeneration <5 cm	Tick ✓
			Total high threat weed cover		%	[5] Length of fallen logs	Tally ounce 0 Total 0m m
						[6] Hollow bearing trees	Tick 0

Vegetation integrity - function cont. (five 1 m²) plots)	[7] Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	2	5	2	2	2	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots																				

These attributes require consideration of site observations and may be completed after field work:

Vegetation class	Syd Coastal Dry Sclero	[8] **Large tree benchmark size**	20/ 30/ 50/ 80 DBH		Confidence	H/ M/ L
Plant community type (PCT)	PCT 1638 - Smooth-barked Apple - BW - SG		**EEC**	Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Brief site description or other notes

Cleared form of PCT 1638 (vegetation zone 6).
- Disturbance from earthworks and land mgmt.
- Weeds
WH

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot: | Survey name | Plot identifier | Recorders

Date 30/08/2021 | LAKE MUNMORAH BOAR | Q07 | DAVID MARTIN

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abundance	Voucher
	Andropogon virginicus		30	1000	
	Plantago lanceolata		1	1000	
	Senecio madagascariensis		1	50	
	Oxalis perennans		0.5	100	
	Eragrostis leptostachya		10	1000	
	Richardia humistriata		0.5	300	
	Axonopus fissifolius		45	1000	
	Tagetes minuta		0.1	10	
	Taraxacum officinale		0.5	100	
	Angophora costata		1	2	
	Securigera varia		0.3	100	
	Cyperus polystachyos		1	50	
	Verbena bonariensis		0.2	5	
	Juncus cognatus		0.1	40	
	Lepidosperma neesii		0.1	4	
	Melaleuca quinquenervia		0.1	1	
	Juncus subsecundus		0.2	50	
	Schoenus apogon		0.1	100	
	Sporobolus africanus		5	500	
	Sida rhombifolia		0.1	5	
	Lysimachia arvensis		0.1	10	
	Medicago spp.		0.1	10	

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, …, 1, 2, 3, 4, 5, 10, 15, 20, 25, …100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 …, when ≤10, estimate when >10, 20, 30 … 100, 200, 300 …, 1000, 2000, 3000 … (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	**Date**	30/8/21	**Survey name**	LAKE MUNMORAH			**Plot identifier**	QC6
Recorders	DAVID MARTIN			**IBRA region**	Sydney basin			**Veg zone ID**	
[1]Datum		**Coordinate system**	☐ Projected ☐ Geographic	**MGA zone**	56	**[1]X coordinate**	365980	**[1]Y coordinate**	6326777
Location description	descriptive notes to locate site without grid reference								
[1] Plot dimensions	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 m x 50 m			**[1] Orientation of midline from 0 m point**		Magnetic 293°		**Photo #**	

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate**: Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)			**Structure** (400 m² plot)			**Function** (1000 m² plot)	
		Sum values			Sum values (%) (may sum to >100%)	[3] Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count 0
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	Count (best practice)/tick. If [8]large tree benchmark size ≥50 cm, count 1
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick If [8]large tree benchmark size ≥ 30 cm, count 8
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. If [8]large tree benchmark size ≥ 20 cm, count 2
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick 4
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick 0
						[4]Tree regeneration <5 cm	Tick 0
			Total high threat weed cover		%	[5] Length of fallen logs	Tally space 0 Total m
						[6] Hollow bearing trees	Tick 0

Vegetation integrity - function cont. (five 1 m²) plots)	[7] Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	20	20	0	10	60	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots																				

These attributes require consideration of site observations and may be completed after field work:

Vegetation class		**[8] Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)			**EEC** Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Brief site description or other notes

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot: | Survey name | Plot identifier | Recorders

Date 30/08/2021 | LAKE MUNMORAH BOAR | Q08 | DAVID MARTIN

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
	Angophora costata		15	4	
	Corymbia gummifera		20	4	
	Pinus radiata		20	8	
	Entolasia stricta		2	50	
	Dodonaea triquetra		0.1	1	
	Taraxacum officinale		0.1	20	
	Lepidosperma concavum		0.1	1	
	Axonopus fissifolius		1	40	
	Senecio madagascariensis		0.1	10	
	Eucalyptus armenoides		2	6	
	Lagenifera stipitata		0.1	20	
	Microlaena stipoides		0.5	50	
	Richardia humistrata		0.1	20	
	Lobelia purpurascens		0.1	10	
	Banksia oblongifolia		0.1	1	
	Sida rhombifolia		0.1	1	
	Plantago lanceolata		0.1	10	
	Schoenus apogon		0.1	2	
	Poa annua		1	40	

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

[1] **GF Code:** see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1/3	**Date**	30/8/21	**Survey name**	LAKE MUNMORAH		**Plot identifier**	Q09	
Recorders	DAVID MARTIN			**IBRA region**	Sydney basin.		**Veg zone ID**		
[1]Datum	GDA 2020	**Coordinate system**	☐ Projected ☑ Geographic	**MGA zone**	56	**[1]X coordinate**	366312	**[1]Y coordinate**	6326732
Location description	descriptive notes to locate site without grid reference								
[1] Plot dimensions	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 m x 50 m			**[1] Orientation of midline from 0 m point**	Magnetic 298°		**Photo #**		

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate:** Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)			**Structure** (400 m² plot)			**Function** (1000 m² plot)	
		Sum values			Sum values (%) (may sum to >100%)	[3] Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	Count (best practice)/tick. If [3] large tree benchmark size ≥50 cm, count 11
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick. If [3] large tree benchmark size ≥ 30 cm, count 111 111
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. If [3] large tree benchmark size ≥ 20 cm, count 1111
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick 1
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick C
						[4]Tree regeneration <5 cm	Tick 0
			Total high threat weed cover		%	[6] Length of fallen logs	Tally space 0 Total m
						[8] Hollow bearing trees	Tick 3

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7] Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	50	60	80	30	20	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	56%																			

These attributes require consideration of site observations and may be completed after field work:

Vegetation class		[8] **Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)			**EEC** Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Brief site description or other notes

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 30/08/21	Lake Munmorah BDAR	Q09	DAVID MARTIN

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
	1 Eucalyptus haemastoma		35	6		
	2 Angophora costata		10	3		
	3 Monotoca elliptica		2	10		
	4 Dillwynia retorta		5	20		
	5 Hardenbergia violacea		0.1	30		
	6 Lagenifera stipitata		0.1	50		
	7 Echtolasia stricta		10	1000		
	8 Mirbelia rubiifolia		1	30		
	9 Themeda australis		~~20~~30	1000		
	10 Eragrostis leptostachya		2	500		
	11 Lomandra obliqua		0.5	20		
	12 Lepidosperma neesii		0.1	10		
	13 Lomandra ~~obliqua~~ multiflora		0.1	20		
	14 Andropogon virginicas		2	100		
	15 Pratia purpurescens		0.1	20		
	16 Epacris pulchella		1	50		
	17 Ptilotrix deuster		10	1000		
	18 Stylidium graminifolium		0.1	20		
	19 Cassytha glabella		0.1	20		
	20 Glycine tabacina		0.1	30		
	21 Patersonia sericea		0.1	5		
	22 Pultenaea tuberculata		0.1	3		
	23 Lepidosperma laterale		1	20		
	24 Viola hederacea		0.1	40		
	25 Plantago lanceolata		0.1	40		
	26 Taraxacum officinale		0.1	30		
	27 Fimbristylis dichotoma		0.1	5		
	28 Bulbine bulbosa		0.1	30		
	29 Senecio madagascariensis		0.1	5		
	30 ~~Lepidosperma~~					
	31 Pultenaea spp.		0.1	10		
	32 Briza maxima		0.2	10		
	33 Acacia fimbristylis		0.5	5		
	34 Caladenia catenata		0.1	5		
	35 Juncus cognatus		0.1	50		
	36 Pimelea latifolia		0.1	2		
	37 Allocasuarina littoralis		0.1	1		
	38 Cryptostylis subulata		0.1	30		
	39 Cyclospermum leptophyllum		0.1	15		
	40 Xanthorrhoea fulva		0.5	5		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

400 m² plot: Sheet 3 of 3	Survey Name	Plot Identifier	Recorders
Date 30/08/21	Lake Munmorah SOAK	Q09	DAVID MARTIN

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
	1 Juncus subsecundus		0.1	10		
	2 Microlis sp.		0.1	5		
	3 Pittosporum undulatum		0.1	2		
	4 Billaderia scandens		0.1	50		
	5 Microlaena stipoides		5	500		
	6 Conyza bonariensis		0.1	2		
	7 Hydrocotyle bonariensis		0.1	20		
	8 Thelymitra paucitlora		0.1	5		
	9 Thelymitra branwhitei		0.1	10		
	10 Lomandra cylindrica		0.1	10		
	11 Parsonsia straminea		0.1	3		
	12 Rhytidosperma pallidum		1	30		
	13 Agnocarpus teucrioides		0.1	5		
	14 Haemodorum planifolium		0.1	4		
	15 Hovea linearis		0.1	5		
	16 Schoenus apogon		0.1	30		
	17 Dampiera stricta		0.1	10		
	18 Dianella caerulea		0.1	3		
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	Date	30/08/21	Survey name	LAKE MUNMORAH	Plot identifier	Q10
Recorders	DAVID MARTIN			IBRA region	Sydney Basin	Veg zone ID	
[1]Datum		Coordinate system	□ Projected □ Geographic	MGA zone		[1]X coordinate		[1]Y coordinate	
Location description	descriptive notes to locate site without grid reference						
[1] Plot dimensions	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 m x 50 m			[1] Orientation of midline from 0 m point	Magnetic °	Photo #	

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate**: Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)			**Structure** (400 m² plot)			**Function** (1000 m² plot)	
		Sum values			Sum values (%) (may sum to >100%)	[3]Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count: 1
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥50 cm, count: 0
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥ 30 cm, count: 1
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥ 20 cm, count: 1 1 1
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick: IHT ... ✓
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick: 0
						[4]Tree regeneration <5 cm	Tick: 0
			Total high threat weed cover		%	[5]Length of fallen logs	Tally space: 0 ✓ Total: m
						[6]Hollow bearing trees	Tick: ✓ 1

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7]Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	20 10 10 60 10	a b c d e	a b c d e	a b c d e
Average of the 5 subplots	22			

These attributes require consideration of site observations and may be completed after field work:

Vegetation class		[8] **Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)		EEC	Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Brief site description or other notes

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² plot: Sheet _ of _

Date	Survey Name	Plot Identifier	Recorders
30/08/21	Lake Munmorah BOAR	Q10	DAVID MARTIN

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
	1 Eucalyptus haemastoma		5	1		
	2 Angophora costata		30	4		
	3 Melaleuca quinquenervia		5	1		
	4 Allocasuarina littoralis		10	13		
	5 Fimbristylis dichotoma		0.1	10		
	6 Richardia humistrata		0.1	20		
	7 Cenchrus clandestinus		5	500		
	8 Poa annua		10	500		
	9 Stachys arvensis		0.1	10		
	10 Opercularia diphylla		0.1	20		
	11 Eragrostis brownii		5	500		
	12 Eragrostis leptostachys		10	1000		
	13 Oxalis perennans		0.1	50		
	14 Dichondra repens		0.1	40		
	15 Plantago lanceolata		0.5	50		
	16 Lepidosperma neesii		0.1	5		
	17 Lindsaea linearis		0.1	10		
	18 Mirbelia rubiifolia		0.1	5		
	19 Microlaena stipoides		20	1000		
	20 Hypericum perforatum		0.1	10		
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	Date	31/8/21	Survey name	LAKE MUNMORAH ROAR	Plot identifier	Q11
Recorders	DAVID MARTIN			IBRA region	Sydney basin	Veg zone ID	
[1]Datum	GDA2020	Coordinate system	□ Projected □ Geographic	MGA zone	56	[1]X coordinate	366508
[1]Y coordinate	6327053						
Location description	descriptive notes to locate site without grid reference						
[1] Plot dimensions	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 m x 50 m			[1] Orientation of midline from 0 m point	M 194°	Photo #	

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate:** Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	**Structure** (400 m² plot)		Sum values (%) (may sum to >100%)	**Function** (1000 m² plot)	
						[3]Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species (richness) in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] foliage cover of native plant species by growth form group	Trees (TG)		80 + cm	Count
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	Count (best practice)/tick. If [3]large tree benchmark size ≥50 cm, count
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick. If [3]large tree benchmark size ≥ 30 cm, count
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. If [3]large tree benchmark size ≥ 20 cm, count
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick
						[4]Tree regeneration <5 cm	Tick ✓ M.Qvin
			Total high threat weed cover		%	[5]Length of fallen logs	Tally space 0 Total 0 m
						[6]Hollow bearing trees	Tick 0

Vegetation integrity - function cont. (five 1 m²) plots)	[7]Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	1 1 5 0 1	a b c d e	a b c d e	a b c d e
Average of the 5 subplots	1.6%			

These attributes require consideration of site observations and may be completed after field work:

Vegetation class		[8] Large tree benchmark size	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)		EEC	Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Brief site description or other notes

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date: 31/08/21	Lake Munmorah BOAR	Q11	DAVID MARTIN

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
	1 Melaleuca quinquenervia		0.1	5		
	2 Andropodon virginicus		2	500		
	3 Lepyrodia muelleri		5	500		
	4 Schoenus apogon		30	1000		
	5 Selaginella uliginosa		0.2	100		
	6 Xyris graeilis		1	50		
	7 Juncus cognatus		1	50		
	8 Cynodon dactylon		30	1000		
	9 Crassula multicava		2	100		
	10 Gonocarpus micranthus		0.1	100		
	11 Hydrocotyle bonariensis		0.2	100		
	12 Cyperus polystaches		20	1000		
	13 Trifolium repens		0.1	50		
	14 Pertulacea oleracea		1	50		
	15 Juncus subsecundus		0.5	100		
	16 Sporobolus virginicus		5	500		
	17 Philydrum lanuginosum		0.1	50		
	18 Paspalum dilatatum		10	500		
	19 Melaleuca sieberi		0.1	1		
	20 Fimbristylis dichotoma		0.3	50		
	21 Ranunculus inundatus		0.1	20		
	22 Axonopus fissifolius		1	100		
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of 2	Date	31/8/21	Survey name	LAKE MUNMORAH BDAR	Plot identifier	Q12
Recorders	DAVID MARTIN			IBRA region	Sydney Basin	Veg zone ID	
[1]Datum	GDA2020	Coordinate system	☐ Projected ☑ Geographic	MGA zone	56	[1]X coordinate	366280
[1]Y coordinate	6326798						
Location description	descriptive notes to locate site without grid reference						
[1] Plot dimensions	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 m x 50 m			[1] Orientation of midline from 0 m point	Magnetic 43°	Photo #	

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate**: Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation Integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)			**Structure** (400 m² plot)			**Function** (1000 m² plot)	
		Sum values			Sum values (%) (may sum to >100%)	[3]Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species (**richness**) in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	Count (best practice)/tick. If [5]large tree benchmark size ≥50 cm, count
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick. If [5]large tree benchmark size ≥ 30 cm, count
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. If [5]large tree benchmark size ≥ 20 cm, count
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick
						[4]Tree regeneration <5 cm	Tick
			Total high threat weed cover		%	[6]Length of fallen logs	Tape/space 5m Total m
						[6]Hollow bearing trees	Tick

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7]Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	10	5	20	5	5	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	23%																			

These attributes require consideration of site observations and may be completed after field work:

Vegetation class		[8]**Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)		EEC	Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Brief site description or other notes

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot: Survey name: Lake Munmorah BOAR | Plot identifier: Q12 | Recorders: DAVID MARTIN

Date: 31/08/21

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abundance	Voucher
	Eucalyptus resinifera		15	2	
	Melaleuca quinquenervia		30	6	
	Cinnamomum camphora		5	1	
	Livistona australis		3	1	
	Pratia purpurescens		0.5	500	
	Rubus anglocandicans		5	20	
	Cenchrus clandestinus		65	1000	
	Sporobolus virginicus		5	300	
	Plantago lanceolata		0.5	100	
	Melaleuca sieberi		3	1	
	Glochidion ferdinandi		2	3	
	Taraxacum officinale		0.2	30	
	Setaria pumila		5	100	
	Cyperus leptostachya		5	100	
	Paspalum dilatatum		5	100	
	Geranium solanderi		0.5	100	
	Commelina cyanea		0.1	20	
	Schoenus apogon		5	1000	
	Asparagus aethiopicus		0.1	4	
	Oxalis perennans		0.1	40	
	Juncus subsecundus		0.1	50	
	Echinopogon caespitosus		5	1000	
	Dichondra repens		0.1	100	

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	**Date**	31/8/21	**Survey name**	LAKE MUNMORAH BDAE.		**Plot identifier**	Q13.	
Recorders	DAVID MARTIN			**IBRA region**	Sydney Basin.		**Veg zone ID**		
[1]Datum	GDA2020	**Coordinate system**	☐ Projected ☐ Geographic	**MGA zone**	56.	**[1]X coordinate**	366278	**[1]Y coordinate**	6326756
Location description	descriptive notes to locate site without grid reference								
[1] Plot dimensions	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 m x 50 m			**[1] Orientation of midline from 0 m point**	Magnetic° 258		**Photo #**		

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate:** Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)			**Structure** (400 m² plot)			**Function** (1000 m² plot)	
		Sum values			Sum values (%) (may sum to >100%)	[3]Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count 1
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	Count (best practice)/tick. If [8]large tree benchmark size ≥50 cm, count 1
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick. If [8]large tree benchmark size ≥ 30 cm, count ~~1~~
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. If [8]large tree benchmark size ≥ 20 cm, count ~~1~~
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick 1
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick ~~1~~
						[4]Tree regeneration <5 cm	Tick ~~1~~
			Total high threat weed cover		%	[6]Length of fallen logs	Tally since 0 Total m
						[6]Hollow bearing trees	Tick 1

Vegetation integrity - function cont. (five 1 m² plots)	[7]Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	5	1	10	5	1	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots																				

These attributes require consideration of site observations and may be completed after field work:

Vegetation class		**[8]Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L	
Plant community type (PCT)		**EEC**	Tick	Confidence	H/ M/ L	

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Brief site description or other notes

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot: | Survey name | Plot identifier | Recorders

Date 31/08/21 | Lake Munmorah BDAR | Q13 | DAVID MARTIN

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abundance	Voucher
	Eucalyptus haemastoma		10	2	
	Glochidian ferdinandi		2	1	
	Axonopus fissifolius		30	1000	
	Andropogon virginicus		5	500	
	Hydrocotyle bonariensis		5	~~500~~1000	
	Hyparrhenia hirta		35	1000	
	Verbena bonariensis		0.2	5	
	Gomphocarpus fruticosus		0.1	5	
	Senecio madagascariensis		1	50	
	Echinopogon caespitosus		20	1000	
	Sida rhombifolia		0.2	10	
	Plantago lanceolata		0.1	50	
	Iris spp.		1	20	
	Medicago lupulina		0.1	40	
	Angophora costata		0.5	1	
	Sporobolus africanus		5	500	

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	Date	31/8/21	Survey name	LAKE MUNMORAH BOAK	Plot identifier	Q14
Recorders	DAVID MARTIN			IBRA region	Sydney Basin	Veg zone ID	
[1]Datum GDA2020	Coordinate system	☐ Projected ☑ Geographic	MGA zone 56	[1]X coordinate	366214	[1]Y coordinate	6326742
Location description	descriptive notes to locate site without grid reference						
[1] Plot dimensions	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 m x 50 m			[1] Orientation of midline from 0 m point	Magnetic ° 255	Photo #	

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate:** Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)			**Structure** (400 m² plot)			**Function** (1000 m² plot)	
		Sum values			Sum values (%) (may sum to >100%)	[3] Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species (**richness**) in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)		80 + cm	Count 111
	Shrubs (SG)			Shrubs (SG)		50 – 79 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥50 cm, count
	Grasses etc. (GG)			Grasses etc. (GG)		30 – 49 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥ 30 cm, count
	Forbs (FG)			Forbs (FG)		20 – 29 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥ 20 cm, count
	Ferns (EG)			Ferns (EG)		10 – 19 cm	Count (best practice)/tick ✓
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice)/tick ✓
						[4] Tree regeneration <5 cm	Tick ✓
			Total high threat weed cover		%	[5] Length of fallen logs	Tally space 6 Total m
						[6] Hollow bearing trees	Tick 11

Vegetation integrity - function cont. (five 1 m²) plots)	[7] Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots																				

These attributes require consideration of site observations and may be completed after field work:

Vegetation class		[8] **Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)			EEC / Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Brief site description or other notes

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 31/08/21	Lake Munmorah BDAR	Q14	DAVID MARTIN

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
	1 Angophora costata		40	2	
	2 Pinus radiata		2	5	
	3 Rubus anglocandicans		5	50	
	4 Lantana camara		1	5	
	5 Melaleuca sieberi		0.2	2	
	6 Imperata cylindrica		50	1000	
	7 Sporobolus africanus		5	500	
	8 Setaria pulima		1	80	
	9 Hyparrhenia hirta		15	500	
	10 Dichondra repens		0.1	200	
	11 Pratia purpurescens		0.1	50	
	12 Juncus subsecundus		0.5	20	
	13 Entolasia stricta		0.5	100	
	14 Cyperus leptostachya		0.5	20	
	15 Schoenus apogon		0.1	20	
	16 Allocasuarina littoralis		0.2	10	
	17 Eragrostis leptostachya		0.5	100	
	18 Briza maxima		0.5	100	
	19 Echinopogon caespitosus		2	50	
	20 Lemeda australis		1	100	
	21 Pimelea latifolia		0.1	2	
	22 Paspalum dilatatum		10	100	
	23 Gonocarpus tetragynus		0.1	10	
	24 Axonopus fissifolius		5	100	
D	25 Juncus spp.		0.1	10	
	26 Eucalyptus capitellata		5	0	
	27				
	28				
	29				
	30				
	31				
	32				
	33				
	34				
	35				

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	**Date**	16/09/22	**Survey name**	Lake Munmorah			**Plot identifier**	Q15
Recorders	David Martin and Jake Mauge			**IBRA region**	Sydney Basin			**Veg zone ID**	
[1]Datum		**Coordinate system**	☒ Projected ☐ Geographic	**MGA zone**		**[1]X coordinate**	366138	**[1]Y coordinate**	6322029
Location description	descriptive notes to locate site without grid reference								
[1] Plot dimensions	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 m x 50 m				**[1] Orientation of midline from 0 m point**	Magnetic °		**Photo #**	

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate**: Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)			**Structure** (400 m² plot)			**Function** (1000 m² plot)	
		Sum values			Sum values (%) (may sum to >100%)	[3] Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)	0	Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)	0	80 + cm	Count 0
	Shrubs (SG)	1		Shrubs (SG)	0.2	50 – 79 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥50 cm, count 0
	Grasses etc. (GG)	1		Grasses etc. (GG)	1	30 – 49 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥ 30 cm, count 0
	Forbs (FG)	0		Forbs (FG)	0	20 – 29 cm	Count (best practice)/tick. If [8] large tree benchmark size ≥ 20 cm, count 0
	Ferns (EG)	0		Ferns (EG)	0	10 – 19 cm	Count (best practice)/tick 0
	Other (OG)	0		Other (OG)	0	5 – 9 cm	Count (best practice)/tick 0
						[4]Tree regeneration <5 cm	Tick ✓
			Total high threat weed cover		100.1 %	[5] Length of fallen logs	Tally space — Total 106 m
						[6] Hollow bearing trees	Tick 0

Vegetation integrity - function cont. (five 1 m²) **plots)**	[7] Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	1%																			

These attributes require consideration of site observations and may be completed after field work:

Vegetation class		**[8] Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)		**EEC**	Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Brief site description or other notes

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 16/09/22	Lake Munmoral	Q15	David Martin & Jake Mauge

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
	1 Pinus radiata		1	3	
	2 Acacia falcata		0.2	1	
	3 Andropogon virginicus		5	100	
	4 Axonopus fissifolius		80	1000	
	5 Paspalum dilatatum		10	1000	
	6 Sporobolus africanus		10	1000	
	7 Imperata cylindrica		1	100	
	8 Juncus cognatus		0.2	100	
	9 Bougainvillea glabra		1	1	
	10 Vicia spp.		2	5	
	11 Tagetes minuta		0.5	10	
	12 Senecio madagascarensis		0.5	20	
	13 Hydrocotyle bonariensis		3	1000	
	14 Trifolium repens		2	1000	
	15 Medicago spp.		0.1	20	
	16 Bidens pilosa		0.1	30	
	17 Hypochaeris radicata		0.1	20	
	18 Plantago lanceolata		0.1	20	
	19 Tradescantia fluminensis		0.1	10	
	20 Senna pendula		0.5	1	
	21 Briza subaristata		5	100	
	22 Medicago lupulina		0.2	100	
	23 Modiola caroliniana		0.1	20	
	24				
	25				
	26				
	27				
	28				
	29				
	30				
	31				
	32				
	33				
	34				
	35				

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, …, 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 …, when ≤10, estimate when >10, 20, 30 … 100, 200, 300 …, 1000, 2000, 3000 … (as integer values).

Numbers 1-8 on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	**Date**	16/09/22	**Survey name**	Lake Munmorah BCAR		**Plot identifier**	Q16	
Recorders	David Martin & Jake Mayer			**IBRA region**	Sydney Basin		**Veg zone ID**		
[1]**Datum**		**Coordinate system**	▫ Projected ▫ Geographic	**MGA zone**		[1]**X coordinate**	366071	[1]**Y coordinate**	6327034
Location description	describe Pine Plantation adjacent to telco tower								
[1] **Plot dimensions**	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 m x 50 m			[1] **Orientation of midline from 0 m point**	Magnetic ° 358		**Photo #**		

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). **MGA Zone** (for Projected coordinate. system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). **X/Y coordinate:** Long/Lat (for Projected coordinate. system), Easting/Northing (for geographic coordinate. system)

Vegetation Integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	**Structure** (400 m² plot)		Sum values (%) (may sum to >100%)	**Function** (1000 m² plot) [3]Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species **(richness)** in each growth form group (not individual plants within each growth form)	Trees (TG)	1	Sum of [2] **foliage cover** of native plant species by growth form group	Trees (TG)	0.5	80 + cm	Count 0
	Shrubs (SG)	0		Shrubs (SG)	0	50 – 79 cm	Count (best practice)/tick. If large tree benchmark size ≥50 cm, count 0
	Grasses etc. (GG)	1		Grasses etc. (GG)	1	30 – 49 cm	Count (best practice)/tick. If large tree benchmark size ≥ 30 cm, count 0
	Forbs (FG)	0		Forbs (FG)	0	20 – 29 cm	Count (best practice)/tick. If large tree benchmark size ≥ 20 cm, count 0
	Ferns (EG)	0		Ferns (EG)	0	10 – 19 cm	Count (best practice)/tick 0
	Other (OG)	0		Other (OG)	0	5 – 9 cm	Count (best practice)/tick 0 ✓
						[4]Tree regeneration <5 cm	Tick ✓
			Total high threat weed cover		21.1%	[5]Length of fallen logs	Tally space / Total 3m m
						[6]Hollow bearing trees	Tick 0

Vegetation integrity - function cont. (five 1 m²) plots)	[7]Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	90	10	50	5	90	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	49																			

These attributes require consideration of site observations and may be completed after field work:

Vegetation class		[8]**Large tree benchmark size**	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)		**EEC**	Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (id. native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Brief site description or other notes

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe   Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 16/09/22	Lake Munmorah BCHR	Q16	David Martin & Jake Mauger

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
	1 Angophora costata		0.5	1	
	2 Pinus radiata		65	14	
	3 Cynodon dactylon		1	50	
	4 Asparagus aethiopicus		0.1	3	
	5 Senecio madagascariensis		0.1	4	
	6 Axonopus fissifolius		20	1000	
	7 Hypochaeris radicata		0.1	10	
	8 Briza subaristata		1	30	
	9 Trifolium repens		0.1	20	
	10 Bidens pilosa		0.1	1	
	11 Plantago lanceolata		0.1	10	
	12 Cenchrus clandestinus		45	1000	
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	15				
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Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, …, 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 …, when ≤10, estimate when >10, 20, 30 … 100, 200, 300 …, 1000, 2000, 3000 … (as integer values).

APPENDIX L – OPEN SPACE PLAN

DRAFT

Connection to:
- Lake Munmorah Local Centre (retail + community services)
- Gumbuyah Oval and open space areas and location of proposed regional park
- Lake Munmorah Foreshore
- Public transport
- Munmorah Sportsground

Connection to:
- Lake Munmorah Foreshore
- Lake Macquarie Foreshore
- Public transport
- Public + Private Primary and High Schools

Recreation / Open Space Principles + Opportunities:

- Conservation areas provide a natural bushland setting with treed vistas for the residents.
- Landscape with native species to contribute to ecological connectivity at local scale.
- The combination of the street trees, the landscaped buffer and conservation areas will assist in reducing the urban heat.
- Provide recreation opportunities for diverse age groups accessible for all people.
- Regenerative play linking back to nature.
- Ease of access to recreational areas through shared walking and cycle paths building a healthier and active community.
- Walking and cycling networks designed to ensure safe, amenable and convenient pedestrian and cycle connections.
- Accessible play areas and well connected.
- Feature elements including the water basins and conservation areas providing amenity for walkers/cyclists and the surrounding dwellings.
- Orientate houses to overlook open space and pathways to provide informal surveillance.

LEGEND

A Lakes Ridge Local Park - area 3,200m^2

B Eastern activity connector

C Western activity connector

Refer concept plans for further information

1 Conservation areas providing habitat for fauna and visual amenity for the residents.

2 Main connector road through the residential estate.

3 The main walking and cycling network. The network takes advantage of the natural areas and the water basins to provide amenity for its users. More direct routes are also included providing practical access to uses such as the Lake Munmorah Local Centre.

4 Pedestrian crossings provided at relevant intersections and along key desire lines.

5 Water basins providing visual amenity to the surrounding areas.

6 Landscaped buffer retaining native trees adjoining the Pacific Highway.

Concepts are indicative only and subject to detailed design at DA stage

ALDA PROPERTIES PTY LTD | ROSE | URBAN VILLAGER CREATING THRIVING COMMUNITIES

Lakes Ridge

Recreation / Open Space

Job No.: 22_002 Dwg No.: SK201
Date: 05/08/2022 Revision: A

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APPENDIX M – STAFF CONTRIBUTIONS

The following staff were involved in the compilation of this report.

Table M1 Kleinfelder Staff Contributions

Name	Qualification	Title/Experience	Contribution
David Martin	MSc Accredited BAM Assessor	Ecologist (Botanist)	BAM Accredited Ecologist, Report Author, Flora and Fauna surveys, Vegetation Mapping and PCT Allocation, BAM plot data, Koala Habitat Assessment
Dr. Gilbert Whyte	BSc (Hons), PhD Accredited BAM Assessor	Senior Ecologist	BAM Accredited Ecologist, reporting
Mark Dean	BEnvSc & Mgt	Ecologist (Zoologist)	Fauna surveys
Gayle Joyce	BSc (Forestry) (Hons)	GIS Specialist	GIS and figure preparation
Alan McDonaugh			
Dr. Daniel O'Brien	BEnvSc & Mgt (Hons), PhD Accredited BAM Assessor	Senior Ecologist	Report Review, Fauna Surveys

Table M2 Sub-Contractor Contributions

Name	Qualification	Title/Experience	Contribution
David Martin **Wedgetail project Consulting**	MSc BEnvSc & Mgt Accredited BAM Assessor	Senior Ecologist (Botanist)	Report Author, Swift Parrot Habitat Assessment
Mark Dean **Wedgetail project Consulting**	BEnvSc & Mgt	Ecologist (Zoologist)	Swift Parrot Habitat Assessment

Table M3 Suitably Qualified Persons – Koala SEPP 2021

Name	Qualification	Title/Experience
David Martin Ecologist (Botanist)	Bachelor of Environmental Science and Management. Master of Science (First Class Honours) – Management of the overabundant koala population on French Island, Victoria.	▪ Has lead research on the overabundant Koala population on French Island, undertaking hundreds of Koala population surveys, Spot Assessment Technique surveys, and assessments on Koala feed tree condition. ▪ Has completed Koala surveys locally in the Port Stephens LGA and the Central Coast of NSW with familiarity of suitable Koala habitat and the identification of Koala scats. ▪ Has a botany background and completed vegetation mapping and assessments throughout NSW and Victoria, including the identification of Koala feed trees.

APPENDIX N – LICENSING

Kleinfelder employees involved in the current study are licensed or approved under the *Biodiversity Conservation Act 2016* (License Number: SL100730, Expiry: 31 March 2023) and the *Animal Research Act 1985* to harm/trap/release protected native fauna and to pick for identification purposes native flora and to undertake fauna surveys.