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Ecological Assessment EA-2015-1611

In relation to:

Proposed Rezoning of Land

**Lot 10 DP 615775 & Lot 1 DP 1117908
19 Houston Mitchell Bonny Hills**

Prepared for Angelo Mifsud



2016

MEMBER

Report Title	Ecological Assessment
Project	Proposed rezoning of land
Property	Lot 10 DP 615775 & Lot 10 DP 1117908 19 Houston Mitchell Drive Bonny Hills
Client	Angelo Mifsud
Report No.:	EA-2015-1611
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The preparation of this report has been undertaken in accordance with the project brief provided by the client and has relied upon the information, data and results provided or collected from the sources and under the conditions outlined in the report.

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1. Executive Summary

This report describes the ecological impact of the proposed rezoning of the land within the subject site identified as Lot 10 in DP 615775 and Lot 1 in DP 1117908, Houston Mitchell Drive Bonny Hills. The site is identified for investigation for future local service industrial land within Council's Urban Growth Management Strategy. This ecological assessment therefore describes the ecological impact of the rezoning from its current Primary Production (RU1) zone to part Light Industrial (IN2) and part Environmental (E3/E2) zone. The ecological assessment will be used to assist in the preparation of a Structure Plan for a Planning Proposal (rezoning), which will identify the future development area and the areas that can be used for compensatory measures.

The northern end of the study area (adjacent to Houston Mitchell Drive) lies on a small hillslope that has a southern aspect with the slope generally ranging between 0 and 5 degrees. The land becomes flat and low-lying approximately at the midway point before gradually rising again at the southern margin. An existing dwelling and associated outbuildings as well as a large metal clad shed are located on the land in the northern part of site.

The Port Macquarie-Hastings Council (PMHC) vegetation mapping indicates that there are two (2) areas of mapped vegetation within the study area comprising a disjunct remnant patch in the northern part of the site and small area of vegetation in the southwest corner of the site that forms part of the eastern margin of a large area of vegetation within the Queens Lake State Conservation Area that extends into the Queens Lake Nature Reserve. These areas of vegetation within the study area are mapped as White Stringybark – Tallowood dry forest. The mapping also indicates that the larger proportion of the land within the study area does not contain a classified vegetation community. The floristics data and landscape position of the site suggests that the area probably contained a swamp forest community prior to land clearing. Currently, much of the land within the study area has been cleared of native vegetation and is maintained as managed grassland with retained 'paddock' trees. The retained trees within the canopy generally ranged from the mature growth stage with some trees recorded in the late-mature growth stage. This management regime appears to have been in place for a considerable number of years. The habitat within the study area contained very few terrestrial habitat features due to its cleared condition across the larger proportion of the site. The understorey was reduced to small remnants generally confined to parts of the site that are inaccessible to regular grass slashing, at the bases of trees, along fence lines and occasionally within the groundcover as resprouts and juvenile plants. Other habitat features such as fallen timber normally associated with forest communities were absent from the study area. However, there was a small number of hollow-bearing trees recorded within the study area.

In relation to Koala habitat assessment, the Atlas of NSW Wildlife database search returned 463 records of the Koala within a 0.1 degree by 0.1 degree search area around the study area. The Atlas records suggest that a local Koala population is patchily distributed across the Bonny Hills and Queens Lake area with concentrations of records in the developing areas of Lake Cathie to the north and Bonny Hills to the south as well as within the Lake Innes Nature Reserve to the north, the Queens Lake

State Conservation Area and the Queens Lake State Forest to the west and the Queens Lake Nature Reserve to the southwest. These concentrations of records are perhaps more a reflection of where ecological surveys have been undertaken previously rather than a true indication of the species distribution across the broader area. The survey work undertaken by Phillips et al (2009) in relation to the Area 14 Koala Plan of Management was wider ranging than other individual surveys and shows clusters of records immediately to the north and southwest of the site and further to the southeast around the Seafront Circuit/Beach Street area. During the field survey a search of the habitat within the study area was undertaken for actual Koala sightings as well as a search for Koala scats at the bases of trees and other indicators including scratch marks and disturbed bark on tree trunks. As all trees within the study area were surveyed for other purposes, each tree was also assessed for signs of Koala activity. No Koala scats were found; however, it was impossible to draw any conclusions from this alone given the recent heavy rain associated with the intense east coast low pressure system and extent of surface water within the site at the time of the assessment. Several trees showed signs of Koala activity, including scratches consistent with those made by Koalas on the trunk of a Forest Red Gum tree (tag no. 873) located near the eastern boundary adjacent to the larger dam within the site and disturbed bark on the trunks of four (4) Tallowood trees (tag nos. 853, 854, 857 and 858) located adjacent to the western boundary of the site. Given the evidence recorded during the Koala survey there seems little doubt that on occasion the habitat within the study area is utilised by the species. There are food resources available to the Koala within the site, which is contiguous with a large expanse of forest habitat within the Queens Lake State Conservation Area, the Queens Lake Nature Reserve and the Queens Lake State Forest. Therefore, it is likely that a population of the Koala would periodically utilise the food resources within the study area. However, the habitat is unlikely to be core Koala habitat for the purposes of SEPP 44 but is a valuable component of a larger home range of the local Koala population.

The Planning Proposal will be accompanied by a Voluntary Planning Agreement (VPA) offer to Council for the future Environmental Management Lands that will set out their establishment, maintenance and dedication requirements. The VPA will also require the preparation of a Vegetation Management Plan (VMP) to accompany the future Development Application (DA) for the industrial subdivision. The VMP will set out the detailed compensatory measures, including for example, weed control, compensatory planting numbers and locations, a hollow-bearing tree (HBT) removal strategy, a nest box strategy, a Koala fencing strategy and other measures. The VPA and VMP process will provide certainty with respect to environmental management and the compensatory measures will assist in mitigating any impacts on biodiversity.

From the habitat assessment and database/literature review, it was considered that sixteen (16) threatened species of fauna as listed under the *Threatened Species Conservation Act 1995* and *Environment Protection and Biodiversity Conservation Act 1999* could potentially utilise the habitat within the study area. The Section 5A Assessment appended to this report as Appendix F concluded that the proposal has the potential to impact on several threatened species and populations. Measures to mitigate the impact on biodiversity are outlined in Section 7 of this report.

2. Glossary of Terms and Acronyms

AABR: Australian Association of Bush Regenerators

Abundance: Means a quantification of the population of the species or community

Affected species: Means subject species likely to be affected by the proposal

AHD: Australian height datum

APZ: Asset protection zone (for bushfire protection purposes)

Assessment guidelines: Means assessment guidelines issued and in force under Section 94A of the *Threatened Species Conservation Act 1995* or, subject to Section 5C of the *Fisheries Management Act 1994*

CAVS: Census of Australian Vertebrates

Conservation status: Is regarded as the degree of representation of a species or community in formal conservation reserves

Critical habitat: The area declared to be critical habitat under Part 3 of the *Threatened Species Conservation Act 1995*

DBH: Diameter at breast height being the measurement of the tree trunk at 1.3 m above ground level

DCP: Port Macquarie-Hastings Development Control Plan 2013

DECC: Department of Environment, Conservation and Climate Change

Development: The erection of a building on that land, the carrying out of work in, on, over or under that land, the use of that land or of a building or work on that land, and the subdivision of that land

Endangered ecological community: An ecological community specified in Part 1 of Schedule 1 of the *Threatened Species Conservation Act 1995*

Endangered population: A population specified under Part 1 of Schedule 1 of the *Threatened Species Conservation Act 1995*

Endangered species: a species listed under Schedule 1 of the *Threatened Species Conservation Act 1995*

EP&A Act: *Environmental Planning and Assessment Act, 1979*

EPBC Act: *Environment Protection and Biodiversity Conservation Act 1999*

Field survey: Means on the ground flora and fauna assessment

Habitat: An area or areas occupied, or periodically or occasionally occupied by a species, population or ecological community and includes any abiotic component

Key Threatening Process: Is a threatening process listed under the *Threatened Species Conservation Act 1995*

LEP: Port Macquarie-Hastings Local Environmental Plan 2011

Locality: the area within a 5 km radius of the study area

NPW Act: *National Parks and Wildlife Act 1974*

OEH: NSW Office of Environment and Heritage

PBP: *Planning for Bushfire Protection 2006*

PCT: NSW Plant Community Type classification

PMHC: Port Macquarie-Hastings Council

PMST: Protected matters search tool

Recovery and threat abatement plan: A plan to promote the recovery of threatened species, population or an ecological community with the aim of returning the species, population, or ecological community to a position of viability in nature

ROTAP: Rare or threatened Australian plant

SEPP: State Environmental and Planning Policy

Subject Site: The identified land (Lot(s) and DP(s))

Study area: The geographic extent of the ecological assessment (may be the subject site or a portion of it)

Threatened species: A species specified in Part 1 or 4 of Schedule 1 or in Schedule 2 of the *Threatened Species Conservation Act 1995*

Threatening process: Means a threatening process that threatens, or could potentially threaten, the survival or evolutionary development of a species, population or ecological community

TSC Act: *Threatened Species Conservation Act 1995*

UIA: Urban Investigation Area

VIS: NSW Vegetation Information System (classification database)

VMP: Vegetation Management Plan

Vulnerable species: A species listed under Schedule 2 of the *Threatened Species Conservation Act 1995* or when a fish, listed under the *Fisheries Management Act 1994*.

3. Introduction

3.1 Background

FloraFauna Consulting has been engaged by Angelo Mifsud to prepare an ecological assessment report to assess the potential impacts in relation to a proposed rezoning of land situated at Houston Mitchell Drive (corner of Ocean Drive) Bonny Hills.

3.2 Locality

The locality is defined as the area within a five (5) kilometre radius around the subject site and extends from Lake Cathie and the Lake Innes Nature Reserve in the north to Limeburners Creek and the Camden Haven River in the south to the Queens Lake Nature Reserve in the west. The subject site is situated just to the north of the village of Bonny Hills within rapidly developing area.

Outside of the residential areas there are large expanses of rural zoned land in which agricultural and forestry activities are carried out. Considerable areas of land within the locality are reserved in Lake Innes Nature Reserve in the north, Dooragan National Park in the south and Queens Lake State Conservation Area, the Queens Lake Nature Reserve and the Queens Lake State Forest in the west. Significant environmental features of the locality include Lake Innes, Lake Cathie, Queens Lake, Jolly Nose Hill, the Camden River, North Brother and the Pacific Ocean.

The locality is strongly influenced by its proximity to the Pacific Ocean and associated coastal environments, which is exhibited in many of the plant communities present such as coastal swamp forest, coastal floodplain wetland forest and swamp woodland, sedgeland and seagrass meadows. In addition, significant areas of land within the locality contain dry sclerophyll forest and wet sclerophyll forest communities. The locality map indicating the relative location of the subject site is provided at Figure 3.1.



Figure 3.1: Locality map of the study area

The relative position of the subject site and its position in the landscape is shown in Figure 3.2.



Figure 3.2: Aerial view of the subject site and surrounding landscape

3.3 Study Area

The study area comprised the whole of the land within the subject site identified as Lot 10 in DP 615775 and Lot 1 in DP 1117908, 19 Houston Mitchell Drive Bonny Hills, which is approximately 9.58 hectares in size. The site is situated at the northern outskirts of Bonny Hills and the land is currently zoned RU1 – Primary Production under the *Port Macquarie-Hastings Local Environmental Plan 2011* (LEP).

The northern end of the study area (adjacent to Houston Mitchell Drive) lies on a small hillslope that has a southern aspect with the slope generally ranging between 0 and 5 degrees. The land becomes flat and low-lying approximately at the midway point before gradually rising again at the southern margin. An existing dwelling and associated outbuildings as well as a large metal clad shed are located on the land in the northern part of site. Most the land within the study area has been cleared for many years in conjunction with its rural use. Remnants of the native vegetation observed during the field survey included some retained trees and small patches of remnant understorey vegetation. Generally, the land is managed through regular slashing as derived grassland that is comprised of an assemblage of mostly exotic species with some native species persisting.

The Houston Mitchell Drive road reserve adjoins the site to the north. Beyond the road reserve further to the north the lands are zoned for residential development and a Development Application for its residential subdivision is currently with Council for consideration. These lands adjoin existing large lot residential development on their northern boundary and the Ocean Club Resort on their eastern boundary. The Ocean Drive road reserve adjoins the site to the east. The recently developed Lake Cathie Public School is located further to the east, which is surrounded by cleared residentially zoned lands. There is a Development Application for the residential subdivision of these lands currently with Council for consideration. The western boundary of the study area adjoins the Queens Lake State Conservation Area. The southern boundary of the study area adjoins a small rural holding, which is situated adjacent to a large lot residential development associated with Bonny View Drive. Further to the south there are more rural landholdings comprising areas of cleared land and areas with retained native vegetation. The northern margin of the Bonny Hills urban area is situated approximately 600 metres to the southeast of the study area. An aerial image of the study area and the adjacent land is shown in Figure 3.3.



Figure 3.2: Aerial image of the study area

3.4 Proposed Development

The site is identified for investigation for future local service industrial land within Council's Urban Growth Management Strategy. The ecological assessment therefore describes the ecological impact of the rezoning from its current Primary Production (RU1) zone to part Light Industrial (IN2) zone and part Environmental (E2/E3) zone. The proposed development area comprises:

- Land with an area of approximately 5.31 hectares in the northern half of the site forming the footprint of a future industrial subdivision that will be zoned Light Industrial (IN2);
- An allotment of land with an area of approximately 0.43 hectares in the northern part of the site that will be zoned Environmental (E2/E3); and
- A residue lot with an area of approximately 3.86 hectares occupying the southern part of the site that will be zoned Environmental (E2/E3).

The ecological assessment will be used to assist in the preparation of a Structure Plan for its rezoning, which will identify the future development area and the areas that can be used for compensatory measures. The Planning Proposal will be accompanied by a Voluntary Planning Agreement (VPA) requiring the preparation of a Vegetation Management Plan (VMP). The VPA will also set out the requirements for the establishment, maintenance and dedication of the Environmental (E2/E3) lands. The proposed Structure Plan and indicative industrial subdivision is appended to this report as Appendix A.

3.5 Legislative Context

In NSW, the *Environmental Planning and Assessment Act 1979* (EP&A Act) provides the framework for the assessment of development activities. Clause 5A of the Act requires that the significance of the impact of a proposal on threatened species, populations and endangered ecological communities is assessed by preparing a seven-part test in accordance with Clause 5A (2) of the Act.

Other State legislation relevant to the ecological assessment includes the following:

- *Threatened Species Conservation Act 1995* (TSC Act);
- *National Parks and Wildlife Act 1974* (NPW Act);
- *Noxious Weeds Act 1993* (NW Act);
- *Fisheries Management Act 1994* (FM Act);
- *State Environmental Planning Policy No. 14 – Coastal Wetlands* (SEPP 14);
- *State Environmental Planning Policy No. 26 – Littoral Rainforests* (SEPP 26);
- *State Environmental Planning Policy No.44 – Koala Habitat* (SEPP 44).

Commonwealth legislation relevant to the ecological assessment is the:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The EPBC Act protects nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the Act as matters of national environmental significance. Matters of national environmental significance relevant to biodiversity are:

- Wetlands of international importance;
- Nationally threatened species and ecological communities;
- Migratory species; and
- Commonwealth marine areas.

Significance of impacts is determined in accordance with the *Significance impact guidelines 1.1 – matters of national environmental significance* (Department of Environment, Water, Heritage and the Arts, 2006). Where a proposal is likely to have a significant impact on a matter of national environmental significance, the proposal is referred to the Federal Environment Minister. The referral process involves a decision on whether the proposal is a 'controlled action'. When a proposal is declared a controlled action, approval from the Minister is required.

3.6 Objectives of the Report

The objectives of the ecological assessment are to:

- Describe the ecological characteristics of the study area including identifying protected and threatened flora and fauna species, populations and ecological communities and their habitats;
- Identify the direct and indirect impacts of the proposed activity on flora and fauna species, populations, ecological communities and critical habitat;
- Assess the nature, extent, frequency, duration and timing of impacts;
- Assess the extent to which the proposed activity contributes to processes threatening the survival of biota on the site;
- Assess the significance of the impact of the proposed activities on species, ecological communities and populations listed under the TSC Act, FM Act and EPBC Act; and
- Propose management measures to minimise or mitigate and if necessary offset impacts.

4. Survey Methodology

4.1 Licencing

All work in relation to this ecological assessment was undertaken with appropriate licences and authorisations including:

- A Scientific Licence to conduct field surveys of flora and fauna for environmental assessment purposes issued subject to the provisions of Section 132C of the NPW Act and regulations; and
- An Animal Research Authority issued by the Department of Industries and Investment (formerly the Department of Primary Industries) Director-General's Animal Care and Ethics Committee to conduct biodiversity survey and habitat assessment at various locations throughout New South Wales.

4.2 Nomenclature

The names of plants used in this document follow the *Flora of New South Wales* (Harden, 2000) with updates from the PlantNet website (Royal Botanic Gardens Sydney, 2012).

The description of plant communities used in this document follow the Port Macquarie-Hastings Council (PMHC) vegetation community mapping. For clarity, a description based on observations recorded during the field survey has also been provided.

Tree growth stage descriptions used in this document are adapted from Jacobs, M.R. (1955) *Growth Habits of the Eucalypts*, Woodgate et al, 1994, *A Study of Old-growth Forests of East Gippsland*, and the Joint Old Growth Forest Project (JOGFP), 1996 as is currently utilised by the NSW Environmental Protection Agency (EPA) for the purposes of old growth forest field verification. Table 4.1 sets out the growth stages adopted for this document:

Table 4.1: Relationship between growth stage classifications used in this document

Jacobs (1955) Growth Stages	Woodgate et al (1994) Growth Stages	Amalgamated Major Growth Stages
Juvenile		
Sapling	Sapling	Regrowth
Pole	Pole	
Mature	Early-mature	Mature
	Mature	
	Late-mature	Senescing
Overmature	Overmature	

The names of vertebrate animals used in this document broadly follow that of Strahan (1995) and the Australian Faunal Directory (FDS) database maintained by the Australian Government, Department of the Environment.

4.3 Literature Review

The following literature was reviewed in relation to this ecological assessment:

- *Port Macquarie-Hastings Local Environmental Plan 2011* (LEP);
- *Koala Plan of Management for the Area 14 Master Planning Area*;
- Pre-lodgement meeting minutes, Port Macquarie-Hastings Council correspondence dated 12 November 2011; and
- Flood Impact Assessment Report, prepared by WorleyParsons dated 10 September 2010.

4.4 Desktop Assessment

The desktop assessment involved database searches as summarised in Table 4.2 were undertaken on 21 November 2015 and 6-20 June 2016.

Table 4.2: Database Searches

Database	Source
eSPADE – NSW Soil and Land Information	NSW Government Office of Environment and Heritage
Atlas of NSW Wildlife (0.1 degree by 0.1 degree search area)	NSW Government Office of Environment and Heritage
PlantNet: ROTAP/Threatened Species Spatial Search (10 km radius)	Sydney Royal Botanic Gardens
EPBC Act Protected Matters Search Tool (10 km buffer)	Department of Sustainability, Environment, Water, Population and Communities

4.4.1 eSPADE – NSW Soil and Land Information

The Camden Haven soil landscape mapping is unavailable. As an alternative source of information, the eSPADE database was searched to investigate any soil survey sites in proximity to the study area that could provide soil and landscape information relevant to the study area.

4.4.2 Atlas of NSW Wildlife

The Atlas of NSW wildlife database was searched to inform of threatened species records within a 0.1 degree by 0.1 degree (approximately 10 km x 10 km) default search area around the study area. This information was used to determine:

- The threatened species recorded;
- The proximity of any threatened species records to the study area; and
- If a population of a threatened species such as the Koala is indicated.

4.4.3 EPBC Act Protected Matters Search Tool

The Protected Matters Search Tool (PMST) was utilised to generate a report that provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act around the study area employing a ten (10) kilometre buffer.

i. Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the nominated area within the ten (10) kilometre buffer.

ii. Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the EPBC Act that may relate to the nominated area within the ten (10) kilometre buffer. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth heritage values of a Commonwealth Heritage Place and the heritage values of a place on the Register of the National Estate.

4.5 Field Survey

An investigation of the study area was undertaken during 2-3 June 2016 to assess the flora, fauna and habitat as detailed below.

4.5.1 Flora Assessment

Because of the relatively small size of the study area and disturbed condition of the habitat therein, the assessment of the flora was conducted using the random meander method after Cropper (1993). The following tasks were undertaken:

- Identification of the plant communities;
- Assessment of the species assemblage within the canopy and determination of the percentage each of the recorded species constituted to assist with identification of the plant communities and the Koala assessment;
- Identification of species and populations;
- Targeted survey of threatened species identified in the database search where suitable habitat exists;
- Spatial distribution of the vegetation in the survey area;
- Assessment of the vegetation's condition; and
- Determination of the vegetation's conservation significance.

For the purposes of this ecological assessment a tree is defined as a perennial plant having a trunk diameter at breast height (DBH) of not less than 100 mm where DBH is the measurement of the trunk at 1.3 metres above ground level.

4.5.2 Habitat Assessment

The habitat assessment focused on the potential for species to occur within the survey area based on the type, suitability and condition of the habitat, and the habitat features present. Although recording threatened species during field survey can confirm their presence in an area, the lack of threatened species records does not necessarily indicate that threatened species are absent. Threatened species tend to be rare and in many cases, are cryptic by nature, consequently they are often difficult to detect. Suitable habitat is, therefore, a useful indicator and an important matter for consideration when determining the potential for the presence of threatened species. During the field survey the following information was collected:

- Habitat type;
- Habitat features including locating and mapping potentially impacted hollow-bearing trees within the study area;
- Threatened species and populations likely to be present based on the type of habitat and the habitat features present; and
- Habitat connectivity; and conservation significance (individuals, species, populations and communities).

4.5.3 Fauna Assessment

The ecological assessment incorporated a fauna survey that focussed on identifying the distribution and abundance of threatened fauna species known or likely to use the habitats in the study area. The survey effort was undertaken in accordance with the *Threatened Biodiversity Survey and Assessment Guidelines* (DEC, 2004). An assessment of the occurrence or likely occurrence of any threatened fauna species, endangered fauna populations or their habitats, in the study areas was also conducted. The fauna survey comprised the following aspects:

i. Habitat Search

The terrestrial habitat within the study area was searched for a minimum of sixty (60) minutes on two separate days.

ii. Diurnal Bird Survey

A diurnal bird survey employing the standardised search method after Watson (2007) was conducted in which a results-based stopping rule was applied with sampling continuing until two or less previously unencountered species were recorded in a forty-minute period. In addition, opportunistic species sightings were recorded continuously while undertaking other aspects of the ecological assessment.

iii. Scats and Signs

The entire site was searched for scats and signs including trees for disturbance of bark and scratch marks on the trunks.

iv. Koala Habitat Assessment and Survey

A Koala habitat assessment and survey was conducted as detailed under Section 4.6 of this report.

v. Stag Watch

Stag watch was conducted by observing potential roost hollows for 30 minutes prior to sunset and 60 minutes following sunset on two separate nights.

vi. Spotlighting

Spotlighting utilising a VariSpot variable 5~100-watt quartz halogen handheld spotlight primarily to target arboreal species including the Yellow-bellied Glider and Squirrel Glider was conducted. The survey effort was in accordance with the Guidelines i.e. 2 x 1 hour surveys across the whole of the site and immediate adjacent land on 2 separate nights.

v. Amphibian Survey

The amphibian survey comprised:

- A systematic day habitat search around each of the dams, associated overflows and ephemeral streams within the study area;
- Night search of the habitat utilising a VariSpot variable 5-100-watt quartz halogen handheld spotlight; and

Nocturnal call playback of each target species (Green and Golden Bell Frog and Green-thighed Frog) in proximity to the dams and associated streams, pools and puddles utilising an MP3 player coupled to a Toa 15-watt megaphone

vii. Bat Ultrasonic Echolocation Detection

The ultrasonic echolocation detection survey was conducted utilising one (1) Wildlife Acoustics EM3+ Echo Meter and one (1) AnaBat Express over two (2) separate nights beginning at dusk for a minimum of 4 hours per night. The most suitable time to conduct bat surveys is between October and March when bats are active. However, the relatively mild conditions experienced on site during the survey provided reasonable conditions to conduct an ultrasonic echolocation detection survey during the current study.

The region-based guide to the echolocation calls of Microchiropteran Bats; *Bat Calls of New South Wales* (Pennay et al 2001) was used for the initial analysis of call identification. Records obtained from the Atlas of NSW Wildlife (OEH, 2015) as well as distributional information provided in relevant literature including *Australian Bats* (Churchill, 2008), *A Field Guide to the Mammals of Australia* (Menkhorst and Knight, 2004) and *The Mammals of Australia* (Strahan, 1998) were used to determine the potential for the occurrence of species within the study area.

Previously obtained recording and analysis report prepared by Anna McConville of Echo Ecology, a specialist fauna call identification consultancy from a nearby site were also reviewed. The Echo Ecology analysis is provided in the results.

4.6 Koala Habitat Assessment and Survey

4.6.1 SEPP 44

State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44) “aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline.”

The ecological assessment included a SEPP 44 Koala Habitat Assessment including the following points of consideration:

- Local Government Area (LGA) listing under Schedule 1 of SEPP 44;
- Determination of ‘Potential Koala Habitat’; and
- Determination of ‘Core Koala Habitat’.

Potential Koala Habitat is defined as:

“Areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15 % of the total number of trees in the upper or lower strata of the tree component.”

For the purposes of SEPP 44 – ‘Potential Koala Habitat’, trees within the study area were surveyed as detailed in Section 4.5.1 of this report to determine the proportion of Koala feed trees as listed in Schedule 2 of SEPP 44 that were present in the upper and lower strata of the tree component. The tree species listed under Schedule 2 of SEPP 44 are provided in Table 4.2.

Table 4.2: SEPP 44 Schedule 2 Koala feed tree species

Scientific Name	Common Name
<i>Eucalyptus tereticornis</i>	Forest Red Gum
<i>Eucalyptus microcorys</i>	Tallowwood
<i>Eucalyptus punctata</i>	Grey Gum
<i>Eucalyptus viminalis</i>	Ribbon or Manna Gum
<i>Eucalyptus camaldulensis</i>	River Red Gum
<i>Eucalyptus haemastoma</i>	Broad-leaved scribbly gum
<i>Eucalyptus signata</i>	Scribbly Gum
<i>Eucalyptus albens</i>	White Box
<i>Eucalyptus populnea</i>	Bimble Box or Poplar Box
<i>Eucalyptus robusta</i>	Swamp Mahogany

Note: *Eucalyptus signata* (Scribbly Gum) is listed as a feed tree species in Schedule 2 of SEPP 44, however this is widely regarded as erroneous and Scribbly Gum is not regarded as a Koala food tree species. This view is supported by Dr Stephen Phillips of Biolink Ecological Consultants who prepared the Area 13 and Area 14 KPOM.

Core Koala Habitat is defined as:

“An area of land with a resident population of Koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population).”

For the purposes of determining the presence of Core Koala habitat, a search of the Atlas of NSW Wildlife database for Koala records was undertaken in conjunction with a search of the habitat during the site investigation for direct Koala sightings. This was supported by a search for Koala scats at the bases of trees and other indicators such as scratch marks and disturbed bark on the trunks of trees. As there was a relatively small number of trees present on the site, of which the majority were surveyed for other purposes, all surveyed trees were also assessed for Koala activity and signs.

4.6.2 EPBC Act

Koala (*Phascolarctos cinereus*) populations in Queensland (QLD), New South Wales (NSW) and the Australian Capital Territory (ACT) have been listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This listing came into legal effect on 2 May 2012. The Department of the Environment has prepared *EPBC Act referral guidelines for the vulnerable Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)* (the Guidelines), which are designed to assist proponents in deciding whether a proposed action is likely to have a significant impact on the Koala. The objectives of the Guidelines are to:

- Promote avoidance and mitigation of impacts on the Koala;
- Promote a clear, consistent and transparent approach for making decisions on whether an action is likely to result in a significant impact on the Koala;
- Promote streamlined decision-making and approval processes; and
- Promote the recovery of the Koala.

The Guidelines advise that for the most up-to-date report of whether the Koala may occur in the project area, always use the Department's Protected Matters Search Tool (PMST).

For the purposes of determining significant impacts under the EPBC Act, the distribution of the Koala has been split into two contexts (the inland and the coastal). These contexts exhibit different climatic and ecological attributes and therefore each have different considerations regarding habitat critical to the survival of the Koala and the significance of impacts on the species. To separate the coastal and inland geographic contexts the Guidelines uses the 800 mm per annum rainfall isohyet. As the study area receives more than 800 mm of rainfall per annum it falls within the coastal context. The attributes of the coastal context applicable to the study area are provided in Table 4.3 below:

Table 4.3: Koala attributes – coastal context

Attributes	Applicable to Coastal Geographic Context
Koala Habitat	• Large, connected areas of native vegetation, including in forests and woodlands where logging has altered tree species composition; • Small, isolated patches of native vegetation in rural or urban areas; • Windbreaks and narrow areas of native vegetation along riparian areas or linear infrastructure; and • Isolated food and/or shelter trees (i.e. on farm lands, in suburban streetscapes, parks and yards).
Primary threats	• Loss, fragmentation and degradation of habitat including dispersal habitats; • Mortality due to vehicle strikes, dog attacks and disease; and • High-intensity fire.
Interim recovery objective	• Protect and conserve large, connected areas of Koala habitat, particularly large, connected areas that support Koalas that are: ➤ Of sufficient size to be generally robust/operate as a viable sub-population; or ➤ Free of disease or have a very low incidence of disease; or ➤ Breeding. • Maintain corridors and connective habitat that allow movement of Koalas between large areas of habitat.

If the PMST indicates that the Koala or its habitat is known to or may occur within an area, a Koala survey and habitat assessment is necessary to establish whether habitat critical to the survival of the species occurs in the area as detailed below.

i. Koala Survey and Habitat Assessment

Appropriate surveys should be undertaken prior to assessing the proposed action or submitting a referral to the Department to gather adequate information on the following attributes:

- Koala presence (and potentially abundance or density);
- Vegetation composition;
- Habitat connectivity;
- Existing threats to Koalas; and
- Recovery value.

The Guidelines advise that the following methodology should be adopted when undertaking a Koala survey and Koala habitat assessment for the purposes of the EPBC Act:

a) Desktop Survey

A desktop survey was undertaken that included a search of Koala records in the Atlas of NSW Wildlife database and the EPBC Act Protected Matters Search Tool. To assist with the assessment of habitat quality, habitat size, habitat connectivity and Koala occurrence, aerial imagery of the study (impact) area was examined. Information regarding the intensity of existing threats to the Koala in the area was also gathered.

b) Field (On-ground) Survey

An 'on-ground' survey was undertaken. As the study area was relatively small and contained a relatively small number the entire habitat within the study area was investigated during the field survey. For the purposes of the EPBC Act, the Koala survey of the study area involved a diurnal search for direct Koala sightings. This was supported by a search for Koala scats at the bases of trees and other indicators such as scratch marks and disturbed bark on the trunks of trees. As there was a relatively small number of trees present on the site, of which the majority were surveyed for other purposes, all surveyed trees were also assessed for Koala activity and signs.

ii. Koala Habitat Assessment Tool

Habitat critical to the survival of the Koala is habitat that is important for the long-term survival and recovery of the species. The Guidelines contain a Koala habitat assessment tool to assist in determining the sensitivity, value and quality of the impact area and whether it contains habitat critical to the survival of the species. The Koala habitat assessment tool categorises five primary Koala habitat attributes, including;

- Koala occurrence;
- Vegetation composition;
- Habitat connectivity;
- Existing threats; and
- Recovery value.

Each habitat attribute is scored between zero (0) and two (2) and the scores are added together to give a total out of ten (10), providing an indication of the overall value of habitat in the impact area. An impact area that scores five (5) or more under the habitat assessment tool for the Koala is deemed to contain habitat critical to the species survival and may require referral to the Department of the Environment, subject to the assessment protocol set out in Figure 2 of the Guidelines (assessing adverse effects on habitat critical to the survival of the Koala). An extract of the Koala habitat assessment tool relevant to the study area (coastal context) is provided in Table 4.4 below:

Table 4.4: Extract of the Koala habitat assessment tool relevant to the study area

Attribute	Score	Coastal Criteria
Koala occurrence	2 (High)	Evidence of one or more Koalas within the last 2 years.
	1 (Medium)	Evidence of one or more Koalas within 2 km of the edge of the impact area within the last 5 years.
	0 (Low)	None of the above.
Vegetation composition	2 (High)	Has forest or woodland with 2 or more known Koala food tree species in the canopy; or 1 food tree species that alone accounts for >50 % of the vegetation in the relevant strata.
	1 (Medium)	Has forest or woodland with only 1 species of known Koala food tree present in the canopy.
	0 (Low)	None of the above.
Habitat connectivity	2 (High)	Area is part of a contiguous landscape $\geq$ 500 ha.
	1 (Medium)	Area is part of a contiguous landscape < 500 ha, but $\geq$ 300 ha.
	0 (Low)	None of the above.
Key existing threats	2 (High)	Little or no evidence of Koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for Koala occurrence; or Areas which score 0 for Koala occurrence and have no dog or vehicle threat present.
	1 (Medium)	Evidence of infrequent or irregular Koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for Koala occurrence; or Areas which score 0 for Koala occurrence and are likely to have some degree of dog or vehicle threat present.
	0 (Low)	Evidence of frequent or regular Koala mortality from vehicle strike or dog attack in the study area at present, or Areas which score 0 for Koala occurrence and have a significant dog or vehicle threat present.
Recovery value	2 (High)	Habitat is likely to be important for achieving the interim recovery objectives for the relevant context (see Table 4.3).
	1 (Medium)	Uncertainty exists as to whether the habitat is important for achieving the interim recovery objectives for the relevant context (see Table 4.3).
	0 (Low)	Habitat is unlikely to be important for achieving the interim recovery objectives for the relevant context (see Table 4.3).

The study (impact) area was assessed in accordance with the Koala habitat assessment tool – coastal criteria as detailed in Table 4.4.

4.7 Survey Timing and Weather Conditions

The field survey was conducted between 7 and 8 June 2016. Weather conditions during these times was mild with no rainfall recorded. The maximum and minimum temperatures at Bonny Hills during the survey period are detailed in Table 4.5.

Table 4.5: Temperature ranges during survey period

Date	Maximum Temp (C)	Minimum Temp (C)
7.06.2016	20	11
8.06.2016	21	11

The actual temperatures during the night fauna surveys ranged between 15°-11° C on 7 June and between 16°-12° C on 8 June. In the preceding days a large east coast low pressure system impacted the area bringing significant falls of rain. During the period 4-6 June Bonny Hills received nearly 121 mm of rain as detailed in Table 4.6.

Table 4.6: Rainfall recorded immediately prior to field survey

Date	Rainfall (mm)
4.06.2016	26
5.06.2016	89.4
6.06.2016	5

4.8 Survey Limitations

Ecological surveys are limited in their capacity to document all the species of flora and fauna likely to occur or are present at a given site. There are numerous factors that will influence whether a species is detected or not, including climatic and seasonal conditions, the issue of migratory species movements, availability of shelter and food resources, and how readily a species is observed or otherwise recorded given the cryptic nature of some species making them difficult to detect. The absence of a species from survey results does not necessarily indicate that the species is not present. Similarly, there are limitations applicable to the interpretation of records held in databases for the presence or absence of a species at a site. For instance, the Atlas of NSW Wildlife is a database of limited available information and it should not be assumed that the absence of records indicates that a species is not present. Therefore, to address these limitations, the habitat components of the study area have been assessed to help predict those species likely to occur within the study area based on habitat preferences.

4.9 Significance Assessments

Significance assessments were carried out for threatened species, populations and ecological communities listed under the *Threatened Species Conservation Act 1995* (TSC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In the case of the TSC Act, the significance assessments were undertaken in accordance with the *Threatened Species Assessment Guidelines – The Assessment of Significance* (Department of Environment and Climate Change, 2007). In the case of the EPBC Act, the significance assessments were undertaken in accordance with the *Significance Impact Guidelines 1.1 – Matters of National Environmental* (Department of Environment, Water, Heritage and the Arts, 2009).

The conclusions drawn in this report are based upon information obtained from the review of literature and database searches, and from the ecological assessment undertaken of the study area at the time of the field investigation. These results are not exhaustive but rather are indicative of the environmental conditions, including the presence or otherwise of threatened species, populations and ecological communities. It should also be recognised that environmental conditions are dynamic and will change over the course of time.

Habitat assessments were completed for all threatened species and populations identified in the database searches (Table 4.1) to determine whether suitable habitat exists within the subject site. This is a conservative approach that is likely to include cryptic species as well those that are otherwise difficult to detect.

4.10 Aboriginal Heritage

Aboriginal objects are physical evidence of the use of an area by Aboriginal people. These objects can also be referred to as 'Aboriginal sites', 'relics' or 'cultural material'. Aboriginal objects include:

- Physical objects, such as stone tools, Aboriginal-built fences and stockyards, scarred trees and the remains of fringe camps;
- Material deposited on the land, such as middens; and
- The ancestral remains of Aboriginal people.

Known Aboriginal objects and sites are recorded on the Aboriginal Heritage Information Management System (AHIMS) administered by the Office of Environment and Heritage (OEH). The Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW sets out the process which must be followed to satisfy due diligence requirements. The first step in this process is to check for Aboriginal sites on AHIMS by conducting an AHIMS Basic Search in proximity to your proposed activity. If the results of the initial AHIMS Basic Search indicate that AHIMS contains information about an Aboriginal site in proximity to the proposed activity an Extensive Search must be undertaken. For the purposes of due diligence, the AHIMS Basic Search results may be relied upon for twelve (12) months.

5. Results

5.1 Soil Landscape

The NSW soil and land information (eSPADE) website administered by the NSW Office of Environment and Heritage was consulted to investigate soil survey sites near the study area. The eSPADE search indicated two (2) soil survey sites with similar elevation and vegetation are located nearby. These survey sites were used to generate soil profile reports. The soil profile summary is provided below.

5.1.1 Soil Survey Site Details:

a. Soil Survey Site 1 (comparable to the northern part of the study area)

Site Location: Pacific (Ocean) Drive 400 metres east of Houston Mitchell Drive;

Map Reference: MGA Grid Reference: Zone 56, Easting 484044, Northing 6507529
CAMDEN HAVEN (9434) 1:100 000 sheet;

Profile Details: Soil Landscapes of the Camden Haven 1:100 000 sheet (1000351)), Profile 227, collected from a batter by Michael Eddie on 25 August 1999;

Physiography: Hillcrest under wet sclerophyll forest on dolerite lithology with nil rock outcrop; Slope 7 % (measured), elevation 20 metres, local relief very low (9-30 m), run-on is low, run-off is low;

Vegetation/Land Use: Wet sclerophyll forest, with extensive clearing at the site, used for pasture, improved pasture in the general area;

Surface Conditions: Expected to be self-mulching when dry, ground cover 99 %;

Erosion/Land Degradation: No salting evident;

Soil Hydrology: Profile is moderately permeable and well drained, no free water;

Soil Type: Melanic-Mottled Eutrophic Brown Dermosol (ASC), Prairie Soil (GSG).

Soil Description:

Layer 0: Coarse fragments are common (10-20 %), as substrate, coarse gravel (20-60 mm), cobbles (60-200 mm);

Layer 1 (A horizon): Very dark grey (brownish black) (10YR 3/1) light medium clay with strong pedality (polyhedral, 10-20 mm, rough-faced peds), abundant (>100/10x10cm) roots (<1mm), field pH is 6; Coarse fragments are common (10-20 %), as substrate, pans are not evident, segregations are not evident; gradual (50-100 mm);

Layer 2 (BC horizon): Light olive brown (yellowish brown) (2.5Y 5/4) medium silty clay with strong pedality (angular blocky, 10 - 20 mm, smooth-faced peds), common (10-

25/10x10cm) roots (<1mm), field pH is 7; Coarse fragments are abundant (50-90%), as substrate, coarse gravel (20-60 mm), cobbles (60-200 mm), stones (200-600 mm), pans are not evident, segregations are not evident; gradual (50-100 mm);

Layer 99: Strong moderately weathered rock, dolerite bedrock reached.

b. Soil Survey Site 2 (comparable to low-lying central part of the study area)

Site Location: Drain, Forest Parkway, 350 metres northeast of junction

Map Reference: MGA Grid Reference: Zone 56, Easting 483504, Northing 6508089
CAMDEN HAVEN (9434) 1:100 000 sheet;

Profile Details: Soil Landscapes of the Camden Haven 1:100 000 Sheet Survey (1000351), Profile 219, collected from a gully by Michael Eddie on December 02, 1998;

Physiography: Drainage depression under swamp complex on metamorphic lithology with nil rock outcrop; Slope 3 % (measured), elevation 5 metres, local relief extremely low (< 9m), aspect southeast, run-on is low, run-off is high;

Vegetation/Land Use: Swamp complex, with extensive clearing at the site, used for timber/scrub/unused, with urban in the general area;

Surface Conditions: Expected to be self-mulching when dry, ground cover 99 %;

Erosion/Land Degradation: No salting evident;

Soil Hydrology: Profile is moderately permeable and imperfectly drained, no free water;

Soil Type: Mottled Petroferric Brown Dermosol (ASC), Xanthozem (GSG);

Profile Field Notes: Impeded drainage due to ferruginous pan.

Soil Description:

Layer 0:

Layer 1 (A Horizon): Very dark greyish brown (brownish black) (10YR 3/2) light medium clay with strong pedality (polyhedral, 5 - 10 mm, rough-faced peds), many (25-100/10x10cm) roots (<1mm), field pH is 6; Coarse fragments are few (2-10 %), as parent material, fine gravel (2-6 mm), gravel (6-20 mm), segregations are not evident; smooth gradual (50-100 mm);

Layer 2 (B Horizon): Light olive brown (yellowish brown) (2.5Y 5/4) medium heavy silty clay with strong pedality (sub-angular blocky, 5 - 10 mm, smooth-faced peds), common (10-25/10x10cm) roots (<1mm), field pH is 7.5; Coarse fragments are common (10-20%), as parent material, fine gravel (2-6 mm), gravel (6-20 mm), segregations are not evident; wavy abrupt (5-20 mm);

Layer 3: Dark brown (7.5YR 3/3) with massive structure, none roots (<1mm). Coarse fragments are many (20-50%), as substrate, gravel (6-20 mm), coarse gravel (20-60 mm), pans are moderately cemented, continuous, concretionary, ferricrete, segregations are abundant (> 50%), ferromanganiferous; smooth gradual (50-100 mm);

Layer 99: Moderately strong ferruginised metamorphic layer continues.

5.1.2 Field Observations of Soil

During the field survey exposed areas of soil within the study area were assessed. These observations were analogous with observations recorded at the nearby soil survey sites summarised in in Section 5.1.1.

5.2 Flora

5.2.1 Port Macquarie-Hastings Council Vegetation Mapping

The Port Macquarie-Hastings Council (PMHC) vegetation mapping indicates that there are two (2) areas of mapped vegetation within the study area comprising a disjunct remnant patch in the northern part of the site and small area of vegetation in the southwest corner of the site that is the eastern margin of a large area of vegetation within the Queens Lake State Conservation Area that extends into the Queens Lake Nature Reserve. These areas of vegetation within the study area are mapped as White Stringybark – Tallowwood dry forest. The mapping also indicates that the larger proportion of the land within the study area does not contain a classified vegetation community. The PMHC vegetation community description for White Stringybark – Tallowwood dry forest is provided below:

Vegetation Formation: Dry Sclerophyll Forests

Sub-formation: Grassy

Class: Hunter-Macleay Dry Sclerophyll Forests

Floristic Type: *Eucalyptus globoidea*

Association: *Eucalyptus globoidea* – *Allocasuarina littoralis* – *Themeda australis* (*triandra*) (See Note)

Community Description:

Tallest stratum (Canopy)

A tall to very tall open forest co-dominated by *Eucalyptus globoidea* (White Stringybark) and *Eucalyptus microcorys* (Tallowwood) growing in association with *Corymbia gummifera* (Red Bloodwood) and *Syncarpia glomulifera* (Turpentine), less commonly *Eucalyptus pilularis* (Blackbutt) and *Eucalyptus carnea* (Thick-leaved Mahogany).

Mid stratum

A low to mid-high woodland dominated by *Allocasuarina littoralis* (Black She-oak) growing in association with *Ceratopetalum gummifera* (Christmas Bush), *Glochidion ferdinandi* (Cheese Tree) *Callicoma serratifolia* (Black Wattle) and other species.

Lowest stratum

A low to mid-high grassland or sedgeland co-dominated by *Imperata cylindrica* (Blady Grass), *Entolasia stricta* (Wiry Panic) and *Lomandra longifolia* (Spiny-headed Mat-rush), less commonly *Banksia spinulosa* (Hairpin Banksia) and *Breynia oblongifolia* (Coffee Bush). Other associates include *Caladenia catenata* (White Caladenia), *Calochlaena dubia* (Rainbow Fern), *Cordyline stricta* (Narrow-leaved Palm-lily), *Gymnostachys anceps* (Settlers' Twine), *Leucopogon lanceolatus*, *Lomatia silaifolia* (Crinkle Bush), *Oplismenus imbecillis* (Creeping Beard Grass), *Ottochloa gracillima* (Slender Shade Grass) and *Viola hederacea* (Ivy-leaved Violet).

Climbers include *Hardenbergia violacea* (Purple Coral Pea), *Hibbertia scandens* (Climbing Guinea Flower), *Kennedia rubicunda* (Dusky Coral Pea) and *Parsonsia straminea* (Common Silkpod).

Note: The reference to *Themeda australis* in the PMVC vegetation mapping in the association for this community is an outdated synonym. The correct species is *Themeda triandra*.

An extract of the PMHC vegetation community mapping showing the mapped White Stringybark – Tallowwood dry forest vegetation community within the study area is provided at Figure 5.1.



Figure 5.1: Mapped White Stringybark – Tallowood dry forest vegetation community

5.2.2 Field Observations

i. Structural Characteristics

Generally, the vegetation across most of the site has been significantly modified through land clearing so that the structural characteristics across the larger proportion of the site resemble a grassland community. At the northern margin of the site a

relatively small disjunct patch of remnant vegetation occurs, which retains the structural characteristics of an open forest community despite ongoing disturbance associated with the activities of a transport/trucking business at the site. Throughout the derived grassland across the wider areas of the site numerous trees were observed, which were mostly isolated individuals and occasionally within small clumps.

ii. Floristics

There was a distinct difference in the floristics recorded in the more elevated northern part of the site and the remaining lower lying areas of the site. The principal species recorded in the canopy of the remnant vegetation in the northern part of the site were *Eucalyptus microcorys* (Tallowwood) and *Eucalyptus globoidea* (White Stringybark). Associate species recorded included *Corymbia intermedia* (Pink Bloodwood), *Eucalyptus siderophloia* (Grey Ironbark) and *Eucalyptus propinqua* (Small-fruited Grey Gum). Other, less common species included *Syncarpia glomulifera* (Turpentine) and *Lophostemon confertus* (Brush Box).

The mid-stratum has largely been removed from the remnant patch in the northern part of the study area, however various species from the understorey including both native and exotic species were recorded in parts of the site inaccessible to regular grass cutting, at the bases of some trees, along fence lines and within the groundcover as resprouts and juvenile plants. The more common native species recorded in the remnant understorey during the field survey included *Acacia longifolia* subsp. *longifolia* (Sydney Golden Wattle), *Breynia oblongifolia* (Coffee Bush), *Polyscias sambucifolia* (Elderberry Panax), *Acacia implexa* (Hickory Wattle), *Allocasuarina littoralis* (Black She-oak) and *Callitris rhomboidea* (Port Jackson Pine). The more common exotic species recorded in the remnant understorey included *Lantana camara* (Lantana) and *Bidens pilosa* (Cobbler's Pegs).

Within the remnant vegetation the more common native species in the groundcover included *Imperata cylindrica* (Blady Grass), *Pteridium esculentum* (Common Bracken), *Lomandra longifolia* (Spiny-headed Mat-rush), *Entolasia marginata* (Bordered Panic), *Entolasia stricta* (Wiry Panic), *Themeda triandra* (Kangaroo Grass), *Echinopogon caespitosus* var. *caespitosus* (Tufted Hedgehog Grass), *Geitonoplesium cymosum* (Scrambling Lily), *Pratia purpurascens* (Whiteroot), *Desmodium rhytidophyllum*. Other relatively common native species in the remnant understorey included *Dianella caerulea* (Blue Flax-lily), *Eustrephus latifolius* (Wombat Berry), *Viola hederacea* (Ivy-leaved Violet), *Oplismenus aemulus* (Basket Grass), *Rubus parvifolius* (Native Raspberry), *Rubus moluccanus* var. *trilobus* (Molucca Bramble), *Hibbertia scandens* (Climbing Guinea Flower) and *Parsonsia straminea* (Common Silkpod). There were also several exotic species that were common in the groundcover of the remnant vegetation including *Andropogon virginicus* (Whisky Grass), *Paspalum mandiocanum* (Broadleaf Paspalum) and *Plantago lanceolata* (Lamb's Tongue).

Within the derived grassland across the wider low-lying areas of the site the more common species were generally exotic grasses including *Andropogon virginicus* (Whisky Grass), *Axonopus fissifolius* (Narrow-leafed Carpet Grass), *Chloris gayana* (Rhodes Grass), *Paspalum dilatatum* (Paspalum), *Paspalum urvillei* (Vasey Grass), *Paspalum mandiocanum* (Broadleaf Paspalum), *Panicum repens* (Torpedo Grass) and *Sporobolus africanus* (Parramatta grass). The more common native grasses included

Cynodon dactylon (Common Couch), *Imperata cylindrica* (Blady Grass) and *Themeda triandra* (Kangaroo Grass). There were numerous herbs that were common in the managed grassland, the majority of which were exotic species generally regarded as weeds including *Trifolium repens* (White Clover), *Hydrocotyle bonariensis*, *Hypochaeris radicata* (Catsear), *Leucanthemum vulgare* (Ox-eye daisy), *Taraxacum officinale* (Dandelion), *Plantago lanceolata* (Lamb's Tongue), *Ageratum houstonianum* (Blue Billygoat Weed), *Verbena bonariensis* (Purpletop), *Senecio madagascariensis* (Fireweed), *Sida rhombifolia* (Paddy's Lucerne), *Veronica persica* (Creeping Speedwell), *Rumex obtusifolius* (Broad-leaf Dock) and *Gladiolus* spp. The introduced sedge *Cyperus eragrostis* (Umbrella Sedge) was also widespread. Several native herb species were recorded in the derived grassland, the more common being *Viola hederacea* (Ivy-leaved Violet), *Pratia purpurascens* (Whiteroot), *Ranunculus lappaceus* (Common Buttercup), *Geranium homeanum*. In the lower lying areas, species typically associated with wetter habitats, including *Ranunculus inundatus* (River Buttercup), *Persicaria decipiens* (Slender Knotweed) and *Mitrasacme paludosa* were recorded.

The derived grassland also contained numerous trees, which were mostly isolated individuals with some occasionally occurring together in small clumps. The species recorded included *Casuarina glauca* (Swamp Oak), *Melaleuca quinquenervia* (Broad-leaved Paperbark), *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus robusta* (Swamp Mahogany), *Eucalyptus patentinervis* (*E. tereticornis* x *robusta* hybrid), *Melaleuca styphelioides* (Prickly-leaved Tea Tree) and *Melaleuca linariifolia* (Flax-leaved Paperbark). Remnants of the understorey were recorded at the bases of some trees, around the margins of several farm dams and along the fence lines at the site boundaries. Native species recorded in the remnant understorey included *Acacia implexa* (Hickory Wattle), *Callitris rhomboidea* (Port Jackson Pine), *Leptospermum polygalifolium* subsp. *cismontanum* (Tantoon), *Glochidion ferdinandi* (Cheese Tree), *Pittosporum undulatum* (Sweet Pittosporum), *Leucopogon juniperinus* (Prickly Beard-heath), *Monotoca scoparia*, *Daviesia ulicifolia* (Gorse Bitter Pea), *Breynia oblongifolia* (Coffee Bush), *Solanum densevestitum* and *Trochocarpa laurina* (Tree Heath). Two exotic species; *Lantana camara* (Lantana) and *Senna pendula* var. *glabrata* (Easter Cassia) were relatively common in the remnant understorey.

The areas of remnant understorey were also accompanied by remnants of the native groundcover. These included *Entolasia marginata* (Bordered Panic), *Oplismenus aemulus* (Basket Grass), *Pteridium esculentum* (Bracken), *Calochlaena dubia* (Rainbow Fern), *Lomandra longifolia* (Spiny-headed Mat-rush), *Blechnum cartilagineum* (Gristle Fern) and *Centella asiatica* (Indian Pennywort). Exotic species formed a relatively large proportion of the remnant understorey, which largely comprised species from the derived grassland community. Due to its tolerance of shady conditions *Paspalum mandiocanum* (Broadleaf Paspalum) was common in these remnants.

Four (4) farm dams collectively formed an aquatic habitat that has been colonised by an assemblage of aquatic plant species. There was some variation between the water bodies (dams), particularly with respect to the size of the individual water bodies, and in the species assemblage recorded, which is discussed in more detail under Section 5.3.3. The more common native aquatic plant species recorded during the flora survey

included *Eleocharis equisetina*, *Schoenoplectiella mucronata* and *Juncus continuus*. Other aquatic plant species recorded included *Typha orientalis* (Broad-leaved Cumbungi), *Philydrum lanuginosum* (Frogmouth) and introduced species; *Nymphaea capensis* (Cape Waterlily).

The floristics data supports the mapping of the remnant forest in the northern part of the site as White Stringybark – Tallowwood dry forest. Except for a small area in the southwest corner of the site that is also mapped as White Stringybark – Tallowwood dry forest, no mapped plant community is indicated across the remainder of the site. The floristics data collected during the flora survey and observations made of the vegetation on the adjacent land suggests that prior to land clearing the that was likely to have occurred in the unmapped parts of the site was a swamp forest community. The PMHC vegetation community mapping indicates several swamp forest communities in proximity to the study area including Swamp Oak – Mixed Eucalypt Coastal Floodplain Wetland Forest Complex on similar geology immediately to the east of the site, Broad-leaved Paperbark – Swamp Mahogany Swamp Forest to the south and southeast, and Broad-leaved Paperbark – Mixed Eucalypt Swamp Forest Complex to the southeast. It is noted that these plant communities are listed as an endangered ecological community (EEC). The full list of flora species recorded within the study area is appended to this report as Appendix B. The following images show the general condition of the plant community within the study area during the field survey.



Figure 5.2: Current conditions in the northern part of the study area



Figure 5.3: Remnant White Stringybark – Tallowwood dry forest



Figure 5.4: View looking south from the northern part of the study area



Figure 5.5: View of remnant vegetation in the central part of the site



Figure 5.6: View looking north from the southern part of the study area

5.2.3 Tree Survey

All trees located within the proposed development footprint that potentially will be impacted by the development of the site were surveyed. The tree survey indicated that the remnants of at least two (2) plant communities were present within the study area. In the northern part of the site the principal species recorded during the tree survey were *Eucalyptus microcorys* (Tallowwood) and *Eucalyptus globoidea* (White Stringybark). Associate species recorded included *Corymbia intermedia* (Pink Bloodwood), *Eucalyptus siderophloia* (Grey Ironbark) and *Eucalyptus propinqua* (Small-fruited Grey Gum). Other, less common species included *Syncarpia glomulifera* (Turpentine) and *Lophostemon confertus* (Brush Box). This species assemblage was indicative of a White Stringybark – Tallowwood dry forest community as described under the PMHC vegetation community mapping.

In the other areas of the site containing remnant trees the species recorded included *Casuarina glauca* (Swamp Oak), *Melaleuca quinquenervia* (Broad-leaved Paperbark), *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus robusta* (Swamp Mahogany), *Eucalyptus patentinervis* (*E. tereticornis* x *robusta* hybrid), *Melaleuca styphelioides* (Prickly-leaved Tea Tree) and *Melaleuca linariifolia* (Flax-leaved Paperbark). While no plant community is indicated in these parts of the study area, the assemblage of species was indicative of a swamp forest community. The tree survey plan and data table are appended to this report as Appendix C.

5.3 Habitat Assessment

5.3.1 Terrestrial Habitat

As previously discussed in Section 5.2, the habitat within the study area comprised the remnants of a White Stringybark – Tallowwood dry forest community, which is mapped under the PMHC vegetation community mapping. No mapped plant community is indicated under the PMHC vegetation community mapping across the remainder of the site. However, the floristics data and landscape position of the site suggests that the area probably contained a swamp forest community prior to land clearing. Currently, the majority of the land within the study area has been cleared of native vegetation and is maintained as managed grassland with retained 'paddock' trees. The retained trees within the canopy generally ranged from the mature growth stage with some trees recorded in the late-mature growth stage. This management regime appears to have been in place for a considerable number of years.

The habitat within the study area contained very few terrestrial habitat features due to its cleared condition across the larger proportion of the site. The understorey was reduced to small remnants generally confined to parts of the site that are inaccessible to regular grass slashing, at the bases of trees, along fence lines and occasionally within the groundcover as resprouts and juvenile plants. Other habitat features such as fallen timber normally associated with forest communities were absent from the study area. However, there was a small number of hollow-bearing trees recorded within the study area as detailed in Section 5.3.3.

5.3.2 Hollow-bearing Trees

Several trees containing visible hollows were recorded within the study area. Three (3) of these trees are situated within the proposed development footprint and therefore are potentially impacted by the proposed rezoning of the land to IN2 – Light Industrial. The remaining hollow-bearing trees observed within the study are situated within the proposed E3 – Environmental Management zone, and therefore will be afforded protection in line with the intent of that zoning. The details of the three (3) potentially impacted hollow-bearing trees are provided in Table 5.1.

Table 5.1: Trees containing visible hollows

Tree No.	Species	Notes
835	<i>Eucalyptus robusta</i>	3 visible hollows (2 >100 mm, 1 >50 mm)
872	<i>Eucalyptus tereticornis</i>	>5 visible hollows (2 >100 mm (+ >50 & <50
881	<i>Eucalyptus tereticornis</i>	3-4 visible hollows (1 >100 mm, 2-4 <50 mm)

The completed PMHC hollow-bearing tree assessment forms are appended to this report as Appendix D.

5.3.3 Aquatic Habitat

Four (4) farm dams collectively formed an aquatic habitat within the study area. The largest dam is situated adjacent to the eastern boundary in the southern part of the site. There is also a small dam located in the southeast corner of the site and together with the larger dam lies within the proposed E3 – Environmental Management zone. Another small dam is located within the unformed road (Lot 1) in the northern part of the site adjacent to the eastern boundary. This dam sits within the ten (10) metre vegetated buffer to Ocean Drive and therefore is outside the development footprint along with the associated regrowth vegetation surrounding it. The remaining small dam is located adjacent to the western boundary, approximately midway between the northern and southern boundaries of the site and lies within the proposed development footprint. The introduced predatory fish; *Gambusia holbrooki* (Plague Minnow) was observed in all the dams located within the study area. The relative positions of the components of the aquatic habitat within the study area are shown in Figure 5.7 below.

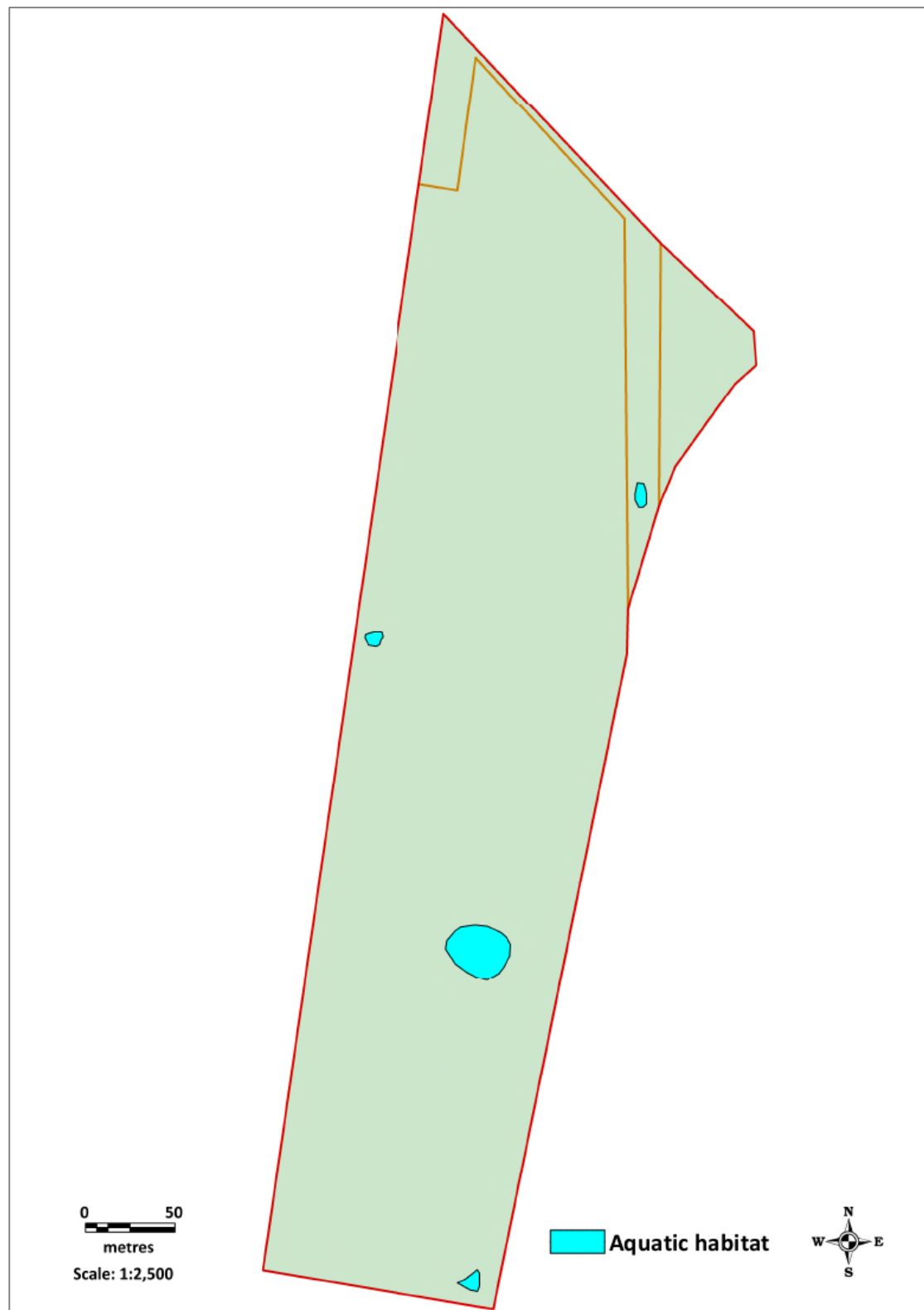


Figure 5.7: Aquatic habitat within the study area

The larger dam adjacent to the eastern boundary appeared to be in a healthy condition. Two (2) native aquatic plant species; *Eleocharis equisetina* and *Schoenoplectiella mucronata* dominated the habitat. The introduced species; *Nymphaea capensis* (Cape Waterlily) was also common and restricted to this dam only. The immediate surrounds of the dam contained vegetation that was predominantly regrowth with trees generally ranging from the early-mature to mature growth stages. The species of trees recorded

growing near the edge of the dam included *Casuarina glauca* (Swamp Oak), *Melaleuca quinquenervia* (Broad-leaved Paperbark), *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus robusta* (Swamp Mahogany) and *Eucalyptus patentinervis* (*E. tereticornis* x *robusta* hybrid). The understorey was relatively dense due to the dam surrounds generally being inaccessible to slashing equipment. The more common species recorded included *Callitris rhomboidea* (Port Jackson Pine), *Leptospermum polygalifolium* subsp. *cismontanum* (Tantoon), *Leucopogon juniperinus* (Prickly Beard-heath), *Breynia oblongifolia* (Coffee Bush) and two exotic species; *Lantana camara* (Lantana) and *Senna pendula* var. *glabrata* (Easter Cassia). Graminoids from the adjacent derived grassland were also common. The large dam and the associated vegetation occurring in its immediate surrounds is shown in Figure 5.8.



Figure 5.8: The larger dam within the study area

The small dam in the southeast corner was relatively shallow and would likely become dry after prolonged dry periods. However, at the time of the field survey it contained water after significant rainfall associated with a large east coast low pressure system was received during the previous 48 hours. There was also a small amount of regrowth vegetation associated with this water body, however the surrounding terrestrial habitat was essentially grassland that has been subjected to an ongoing slashing regime.

The dam in the northern part of the study area adjacent to the eastern boundary, although relatively small was more substantial than the dam in the southeast corner and less likely to become dry. There was a dense stand of regrowth vegetation associated with this dam in which the canopy was dominated by *Casuarina glauca* (Swamp Oak) in association with other species typically found in swamp forest communities. One individual of the invasive weed; *Cinnamomum camphora* (Camphor Laurel) was recorded in this clump of trees as well as another serious environmental weed; *Panicum repens* (Torpedo Grass), which was recorded in the adjacent grassland. The associated vegetation occurring in the immediate surrounds of this dam is shown in Figure 5.9.



Figure 5.9: Vegetation associated with the dam in the north of the site

The dam centrally located at the western boundary of the study area differed from the other dams as it contained two (2) additional aquatic plant species; *Typha orientalis* (Broad-leaved Cumbungi) and *Philydrum lanuginosum* (Frogmouth), although *Eleocharis equisetina* and *Schoenoplectiella mucronata* were the dominant species. This dam was small and shallow, however the aquatic plants recorded suggest that the water body is most likely permanent. The terrestrial habitat immediately surrounding the dam was a derived grassland with two (2) small trees and remnant understorey plants such as *Lomandra longifolia* (Spiny-headed Mat-rush) occurring near the water's edge. Swamp forest is located nearby on the adjoining land to the west within the Queens Lake State Conservation Area. The terrestrial habitat within the study area adjacent to the dam is currently subject to disturbance associated with the placement of mulch and wood chip on the land to the north of the dam. The dam lies within the proposed IN2 – Light Industrial zone and would be impacted by the proposed development of the land, while the other three dams are situated outside the proposed development footprint and are unlikely to be impacted. The dam and adjacent habitat are shown in Figure 5.10.



Figure 5.8: Small dam adjacent to the western boundary

5.4 Threatened Flora – Targeted Search

The Atlas of NSW Wildlife database search indicated six (6) records of three (3) species of threatened flora listed under the TSC Act within a 0.1 degree by 0.1 degree (default) search area. The Protected Matters Search Tool report indicated that ten (10) threatened species listed under the EPBC Act or their habitat may occur within a ten (10) kilometre radius of the study area. Details of the threatened species of flora returned in the database searches are provided in Table 5.2 below.

Table 5.2: Threatened flora returned in database searches

Species and Listing	Habitat and Distribution	Potential Occurrence
Apocynaceae		
<i>Cynanchum elegans</i> (White-flowered Wax Plant) EPBC Act & TSC Act (4 records)	Restricted to eastern NSW from Brunswick Heads to Gerroa; Usually occurs on the edge of dry rainforest; Also in littoral rainforest, Coastal Tea-tree - Coastal Banksia scrub, <i>Eucalyptus tereticornis</i> aligned open forest and woodland, <i>Corymbia maculata</i> aligned open forest and woodland, and Bracelet Honeymyrtle scrub	Unlikely
Casuarinaceae		
<i>Allocasuarina defungens</i> (Dwarf Heath Casuarina) EPBC Act	Found only in NSW in Napiac area and farther north in the North Coast region; In tall heath on sand, but can also occur on clay soils and sandstone	Unlikely
Fabaceae		
<i>Acacia courtii</i> (North Brother Wattle) EPBC Act	Usually grows on steep, dry, rocky slopes and in mixed dry forest on shallow soils, often under White Mahogany and Grey Gum	Unlikely

Myrtaceae		
<i>Callistemon pungens</i> EPBC Act	Grows in or near rocky watercourses, usually in sandy creek beds on granite or sometimes on basalt; from near Inverell to the eastern escarpment at New England N.P.	Unlikely
<i>Eucalyptus nicholii</i> (Narrow-leaved Black Peppermint) TSC Act (2 records)	Sparsely distributed on the New England Tablelands from Nundle to north of Tenterfield; rows in dry grassy woodland, on shallow soils of slopes and ridges	Unlikely
<i>Hakea archaeoides</i> (Big Nellie Hakea) EPBC Act	Restricted to the hinterland between Kempsey and Taree, around Mt Boss, Broken Bago and Lansdowne; Found on steep, rocky, sheltered slopes and in deep gullies in open eucalypt forest	Unlikely
<i>Melaleuca biconvexa</i> (Biconvex Paperbark) EPBC Act	Generally, grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects	Unlikely
Orchidaceae		
<i>Cryptostylis hunteriana</i> (Leafless Tongue-orchid) EPBC Act	Grows in swamp-heath on sandy soils, chiefly in coastal districts, south from the Gibraltar Range	Unlikely
<i>Diuris</i> sp. aff. <i>Chrysantha</i> (Byron Bay Diuris) TSC Act (1 record)	Known from a single location only, at Byron Bay in north-east NSW where only about 20 plants have been recorded; Occurs in low-growing grassy heath on clay soil	Unlikely
<i>Phaius australis</i> (Lesser Swamp-orchid) EPBC Act	Grows in <i>Melaleuca quinquenervia</i> swamps and in swampy sclerophyll forest, on the coast, at or near sea level; Reported north from Lake Cathie, but chiefly north from the Evans Head district	Possible
Orobanchaceae		
<i>Euphrasia arguta</i> EPBC Act	Recorded from Bathurst to Walcha area (possibly extinct). Historical information suggests the species could be found in open forest in subhumid places or on the grassy country near Bathurst	Unlikely
Poaceae		
<i>Arthraxon hispidus</i> (Hairy-joint Grass) EPBC Act	Occurs over a wide area in southeast Queensland and on the northern tablelands and north coast of NSW; Grows in rainforest	Unlikely
Santalaceae		
<i>Thesium australe</i> (Austral Toadflax) EPBC Act	Grows in grassland or woodland, often in damp sites; widespread but rare	Unlikely

Based on the habitat assessment and the habitat requirements of the threatened species of flora as listed in Table 5.2, potential habitat was present within the study area for *Phaius australis* (Lesser Swamp Orchid). Information obtained from the Department of Environment's species profile and threats database indicates that the

species should be surveyed during the warmer months when it is flowering. The Lesser Swamp-orchid can only be distinguished from other swamp orchids by characteristics of its flowers, which are present during spring. As the study was conducted outside the flowering season for the Lesser Swamp-orchid it was not possible to conduct a survey that directly targeted the species exclusively. However, it was possible to target Swamp-orchid species generally, which could inform as to whether further surveys targeting *Phaius australis* would be warranted. Following the targeted survey for Swamp-orchid species it was concluded that the species was unlikely to be present within the study area.

5.5 Fauna

5.5.1 Habitat Search

The entire habitat within the study area was systematically searched during the field survey. During the habitat search one (1) exotic and three (3) native species were recorded as detailed in Table 5.3.

Table 5.3: Species of (non-avian) fauna recorded during the habitat search

Family	Species	Common Name
Malacostraca		
Parastacidae	<i>Gambusia holbrooki</i> *	Plague Minnow*
Amphibia		
Myobatrachidae	<i>Crinia signifera</i>	Common Eastern Froglet
	<i>Litoria peronii</i>	Peron's Tree Frog
Mammalia		
Macropodidae	<i>Macropus giganteus</i>	Eastern Grey Kangaroo

* Indicates an introduced species

The Common Eastern Froglet was recorded across the site and as a winter breeder and following significant rain resulting in the low-lying areas of the site being inundated the species was active. Peron's tree Frog was recorded by its call only in the northern part of the site and was most likely be a brief response to the recent rainfall event. There is a small population of the Eastern Grey Kangaroo that appears to be resident at the site. These native species are both common and are not listed as threatened under the TSC Act or the EPBC Act.

5.5.2 Diurnal Bird Survey

Seven (7) avian species were recorded during the diurnal bird survey. These were all common species, none of which is listed as threatened under the TSC Act or EPBC Act. The avian species recorded within the study area during the diurnal bird survey are listed in Table 5.4.

Table 5.4: Avian species recorded during the diurnal bird survey

Family	Scientific Name	Common Name
Alcedinidae	<i>Dacelo novaeguineae</i>	Laughing Kookaburra
Anatidae	<i>Chenonetta jubata</i>	Australian Wood Duck
Artamidae	<i>Cracticus torquatus</i>	Grey Butcherbird
	<i>Cracticus tibicen</i>	Australian Magpie
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike
Charadriidae	<i>Vanellus miles</i>	Masked Lapwing
Columbidae	<i>Ocyphaps lophotes</i>	Crested Pigeon
Meliphagidae	<i>Anthochaera chrysoptera</i>	Little Wattlebird
	<i>Caligavis chrysops</i>	Yellow-faced Honeyeater
	<i>Lichmera indistincta</i>	Brown Honeyeater
	<i>Manorina melanocephala</i>	Noisy Miner
	<i>Meliphaga lewinii</i>	Lewin's Honeyeater
	<i>Philemon corniculatus</i>	Noisy Friarbird
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark
Psittacidae	<i>Platycercus eximius</i>	Eastern Rosella
	<i>Trichoglossus chlorolepidotus</i>	Scaly-breasted Lorikeet
	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet

The relatively small number of avian species recorded was attributed to the cleared condition of the habitat and associated lack of resources. The presence of a resident population of the Noisy Miner that occupied the habitat in the northern part of the study area is also likely to be excluding a significant number of smaller, less aggressive species from that part of the site. There were significant numbers of Honeyeaters recorded across the central and southern parts of the site due to several species of eucalypt situated in those parts of the site that were flowering including *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus robusta* (Swamp Mahogany) and *Eucalyptus patentinervis* (*E. tereticornis* x *robusta* hybrid). It was noted that *Eucalyptus microcorys* (Tallowwood) situated in the northern part of the study area was also flowering, however it is likely that the presence of the Noisy Miners is likely rendering these resources unavailable to several of the smaller species of Honeyeater.

5.5.3 Scats and Signs Survey

Several scats were recorded within the study area during the survey. These scats were identified as those of the Eastern Grey Kangaroo. Scratch marks were also recorded on two (2) Forest Red Gum trees situated adjacent to the eastern boundary near the large dam. Disturbed bark was observed on the trunks of several Tallowwood trees situated adjacent to the western boundary in the northern part of the study area. Details of these trees are provided in the tree survey table and plan appended to this report as Appendix C.

5.5.4 Stag Watch

Stag watching was conducted at the hollow-bearing tree with tag number 872. As this tree is proposed to be removed to facilitate the development of the site, stag watching formed part of a suit of survey methods aimed at determining what species may be

utilising the hollows within the tree. No species were observed directly utilising the hollows, however at least one (1) Microchiropteran Bat was observed flying in the immediate surrounds of the tree. Given that the tree is essentially an isolated 'paddock' tree it is likely that the utilisation of the hollows would be restricted to some avian and Microchiropteran Bat species. Most avian species were not breeding at the time of the survey and therefore no avian species were observed entering the hollows despite large numbers of Lorikeets being observed feeding in the canopy of flowering trees within the site.

5.5.5 Spotlight Survey

During the spotlight survey numerous individuals of the Grey-headed Flying-fox were recorded flying above the canopy and observed feeding in the canopy of the trees within the site that are currently flowering. The Grey-headed Flying-fox is listed as vulnerable under Schedule 2 of the TSC Act.

5.5.6 Amphibian Survey

Two (2) amphibian species; *Crinia signifera* (Common Eastern Froglet) and *Litoria peronii* (Peron's Tree Frog) were recorded during the amphibian survey. The Common Eastern Froglet was recorded across the site and as a winter breeder and following significant rain resulting in the low lying areas of the site being inundated the species was active. Peron's tree Frog was recorded by its call only in the northern part of the site and was most likely a brief response to the recent rainfall event.

5.5.6 Microchiropteran Bat Ultrasonic Echolocation Detection

At least one (1) Microchiropteran Bat was active during the current study, which was recorded by ultrasonic echolocation detection and analysed using the Wildlife Acoustics Kaleidoscope software. One species; *Vespadelus pumilus* (Eastern Forest Bat) was identified with a reasonable degree of confidence based on the region-based guide to the echolocation calls of Microchiropteran Bats; *Bat Calls of New South Wales* (Pennay et al 2001).

However, as the current study was conducted in early June, which is outside the survey period recommended by the Guidelines (October – March) and evening temperatures were relatively cool (minimum overnight temperature was 10° Celsius) it is likely that at least some Microchiropteran Bat species were inactive and may have been present within the study but not recorded. To address this deficiency in the current survey, the findings of a study conducted during last September at a nearby site at Bundarra Way Bonny Hills have been included to assist in predicting the Microchiropteran Bat species likely to utilise the habitat within the study area. The ultrasonic echolocation detection recordings collected at the Bundarra Way site were forwarded to Echo Ecology; a specialist fauna call identification consultancy for identification. Four (4) species were identified with confidence, as detailed in Table 5.5.

Table 5.5: Microchiropteran Bats recorded with confidence within the study area

Family	Species	Common Name
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat
	<i>Chalinolobus morio</i>	Chocolate Wattled Bat
	<i>Miniopterus australis</i>	Little Bentwing Bat
	<i>Vespadelus pumilus</i>	Eastern Forest Bat

One of these species; *Miniopterus australis* (Little bentwing Bat) is listed as vulnerable in NSW under Schedule 2 of the TSC Act.

There was a further ten (10) species of Microchiropteran Bats that potentially occurred at the Bundarra Way site that could not be confidently identified. The species of Microchiropteran Bat that could not be identified with confidence but could potentially occur within the study area based on the Echo Ecology analysis are shown below in Table 5.6.

Table 5.6: Microchiropteran Bats recorded without confidence within the study area

Family	Species	Common Name
Molossidae	<i>Mormopterus (Ozimops) ridei</i>	Eastern Free-tailed Bat
Vespertilionidae	<i>Chalinolobus nigrogriseus</i>	Hoary Wattled bat
	<i>Falsistrellus tasmaniensis</i>	Eastern Falsistrelle
	<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat
	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat
	<i>Scotorepens orion</i>	Eastern Broad-nosed Bat
	<i>Vespadelus darlingtoni</i>	Large Forest Bat
	<i>Vespadelus regulus</i>	Southern forest bat
	<i>Vespadelus troughtoni</i>	Eastern Cave Bat
	<i>Vespadelus vulturnus</i>	Little Forest Bat

Three of the Microchiropteran Bats species recorded without confidence are listed as vulnerable in NSW under Schedule 2 of the TSC Act including:

- *Falsistrellus tasmaniensis* (Eastern Falsistrelle);
- *Scoteanax rueppellii* (Greater Broad-nosed Bat); and
- *Vespadelus troughtoni* (Eastern Cave Bat).

It should be noted that the Bundarra Way survey was undertaken in early September, which is outside the survey period recommended by the Guidelines (October – March). However, weather conditions up to and including the time of the survey had been warm and mild, therefore it could be reasonably assumed that most species of Microchiropteran Bats were active. The detailed Bat call identification report prepared by Echo Ecology is appended to this report as Appendix E.

To further ensure that the threatened species of Microchiropteran Bats that could potentially occur within the study area were adequately considered a search of the Atlas of NSW Wildlife database was conducted to determine what additional threatened Microchiropteran Bat species have been recorded in proximity to the study

area. Based on the Atlas of NSW Wildlife records, no additional threatened species of Microchiropteran Bats were recorded within two (2) kilometres of the study area. Therefore, the threatened species of Microchiropteran Bats, which are known or are considered to have potential to utilise the habitat within the study area include:

- *Miniopterus australis* (Little bentwing Bat);
- *Falsistrellus tasmaniensis* (Eastern Falsistrelle);
- *Scoteanax rueppellii* (Greater Broad-nosed Bat); and
- *Vespadelus troughtoni* (Eastern Cave Bat)

5.5.7 Threatened Species

Five (5) threatened mammalian species including *Pteropus poliocephalus* (Grey-headed Flying-fox) and four (4) Microchiropteran bats as detailed in Section 5.5.6 were recorded within the study area or at the nearby Bundarra Way site. These and other species which could potentially utilise the habitat within the study area have been included for consideration under the Assessment of Significance (Seven Part Test) appended to this report as Appendix F.

5.6 Protected Matters

Under the provisions of the EPBC Act approval is required for any action that may have a significant impact on matters of National Environmental Significance (NES) or on Commonwealth land. A search of the Department of Environment web site employing the Protected Matters Search Tool with a ten (10) kilometre buffer was undertaken to identify the matters of NES that may occur in, or may relate to the site.

5.6.1 Matters of National Environmental Significance

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Significance:	None
Great Barrier Marine Parks	None
Commonwealth Marine Areas:	1
Threatened Ecological Communities:	3
Threatened Species:	60
Migratory Species:	56

The threatened species returned in the Protected Matters Search Tool have been considered under the Assessment of Significance in Appendix F of this report.

The three (3) threatened ecological communities listed in the Protected Matters Search Tool report are detailed below:

- Littoral Rainforest and Coastal Vine Thickets of Eastern Australia
- Lowland Rainforest of Subtropical Australia; and
- Subtropical and Temperate Coastal Saltmarsh.

None of these plant communities were recorded within the site during the field survey.

5.6.2 Other Matters Protected by the EPBC Act

Commonwealth Land :	2
Commonwealth Heritage Places:	None
Listed Marine Species:	73
Whales and other Cetaceans:	14
Critical Habitats:	None
Commonwealth Reserves (Terrestrial):	None
Commonwealth Reserves (Marine):	None
State and Territory Reserves:	7
Regional Forest Agreements:	1
Invasive Species:	37
Nationally Important Wetlands:	1
Key Ecological Features (Marine):	None

With respect to the thirty-seven (37) invasive species returned in the Protected Matters Search, three avian and five mammalian species are considered to have potential to occur within or utilise the habitat within the study area. The Protected Matters report also lists sixteen (16) weed species under Invasive Species, which includes some of the weeds of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. Three (3) WoNS were recorded within the study area during the field survey, including *Asparagus aethiopicus* (Asparagus Fern), *Senecio madagascariensis* (Fireweed) and *Lantana camara* (Lantana). The invasive species that are known or are considered to have potential to occur within the study area are listed in Table 5.7 below.

Table 5.7: Invasive species known or likely to occur within the study area

Scientific Name	Common Name
Plantae (Weeds)	
<i>Asparagus aethiopicus</i>	Asparagus Fern*
<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i>	Bitou Bush
<i>Senecio madagascariensis</i> *	Fireweed*
<i>Lantana camara</i> *	Lantana*
Aves	
<i>Acridotheres tristis</i>	Indian Myna
<i>Passer domesticus</i>	House Sparrow
<i>Streptopelia chinensis</i>	Spotted Turtle-dove
Mammalia	
<i>Canis lupus familiaris</i>	Domestic Dog
<i>Felis catus</i>	Domestic Cat
<i>Cervus spp.</i>	Feral Deer
<i>Mus musculus</i>	House Mouse
<i>Rattus rattus</i>	Black Rat
<i>Vulpes vulpes</i>	Red Fox

* Indicates species recorded within the study area during the field survey

5.7 Koala Habitat Assessment and Koala Survey

5.7.1 SEPP 44

The study area is situated in the Port Macquarie-Hastings Council LGA, which is listed on Schedule 1 – Local Government Areas of SEPP 44.

As per SEPP 44, *Potential Koala Habitat* is defined as:

“Areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15 % of the total number of trees in the upper or lower strata of the tree component.”

Three (3) species listed in Schedule 2 of SEPP 44 were recorded within the study area. These included *Eucalyptus microcorys* (Tallowwood), *Eucalyptus robusta* (Swamp Mahogany) and *Eucalyptus tereticornis* (Forest Red Gum) and collectively constituted more than 15 % of the ‘remnant’ tree component. Therefore, the habitat within the site satisfies the criteria for Potential Koala Habitat under SEPP 44.

As per SEPP 44, *Core Koala Habitat* is defined as:

“An area of land with a resident population of Koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.”

The Atlas of NSW Wildlife database search returned 463 records of the Koala within a 0.1 degree by 0.1 degree search area around the study area. The Atlas records suggest that a local Koala population is patchily distributed across the Bonny Hills and Queens Lake area with concentrations of records in the developing areas of Lake Cathie to the north and Bonny Hills to the south as well as within the Lake Innes Nature Reserve to the north, the Queens Lake State Conservation Area and the Queens Lake Stater Forest to the west and the Queens Lake Nature Reserve to the southwest. These concentrations of records are perhaps more a reflection of where ecological surveys have been undertaken previously rather than a true indication of the species distribution across the broader area. The survey work undertaken by Phillips et al (2009) in relation to the Area 14 Koala Plan of Management was wider ranging than other individual surveys and shows clusters of records immediately to the north and southwest of the site and further to the southeast around the Seafront Circuit/Beach Street area. The locations of the Koala records within the search area from the Atlas of NSW Wildlife (OEH, 2016) are shown in Figure 5.9.

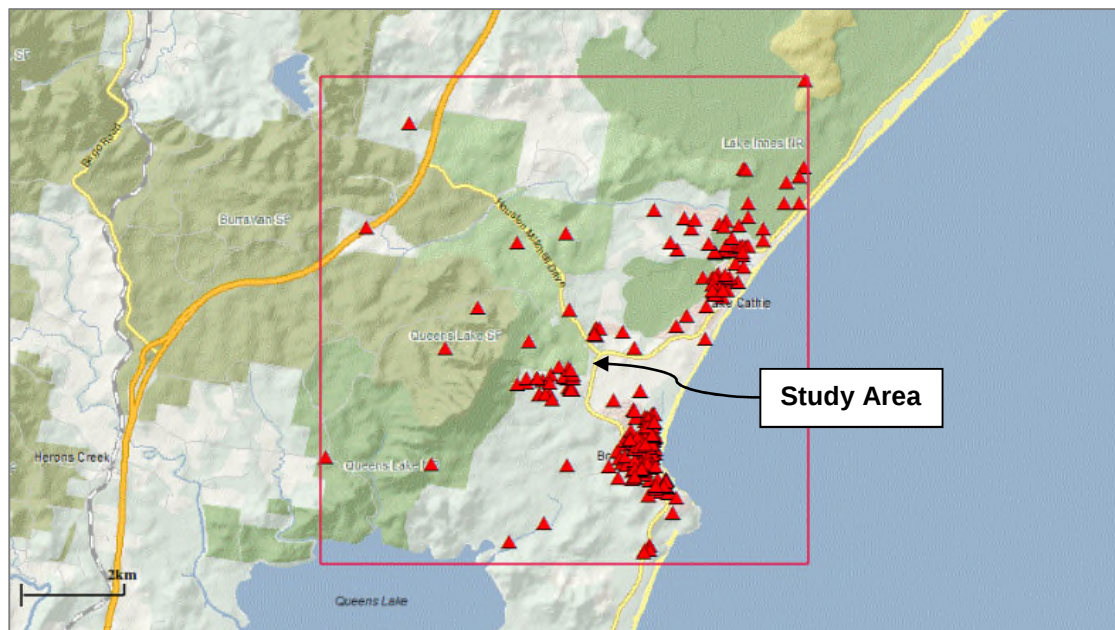


Figure 5.9: Koala records within the default search area. (Atlas of NSW Wildlife – OEH)

During the field survey a search of the habitat within the study area was undertaken for actual Koala sightings as well as a search for Koala scats at the bases of trees and other indicators including scratch marks and disturbed bark on tree trunks. As all trees within the study area were surveyed for other purposes, each tree was also assessed for signs of Koala activity. No Koala scats were found; however, it was impossible to draw any conclusions from this alone given the recent heavy rain associated with the intense east coast low pressure system and extent of surface water within the site. Several trees showed signs of Koala activity, including scratches consistent with those made by Koalas on the trunk of a Forest Red Gum tree (tag no. 873) located near the eastern boundary adjacent to the larger dam within the site and disturbed bark on the trunks of four (4) Tallowwood trees (tag nos. 853, 854, 857 and 858) located adjacent to the western boundary of the site. The following images show some of the signs of Koala activity recorded within the study area.



Figure 5.10: Scratch marks on the trunk of a Forest Red Gum tree



Figure 5.11: Disturbed bark on the trunk of a Tallowwood tree

Given the evidence recorded during the Koala survey there seems little doubt that on occasion the habitat within the study area is utilised by the species. There are food resources available to the Koala within the site, which is contiguous with a large expanse of forest habitat within the Queens Lake State Conservation Area, the Queens Lake Nature Reserve and the Queens Lake State Forest. Therefore, it is likely that a population of the Koala would utilise the food resources within the study area. However, the habitat is unlikely to be core Koala habitat for the purposes of SEPP 44 but is a valuable component of a larger home range of the local Koala population.

5.7.2 EPBC Act

For the purposes of the EPBC Act a desktop survey, 'on-ground' (field) survey and habitat assessment (utilising the habitat assessment tool) were undertaken as per the EPBC Act Referral Guidelines.

i. Desktop Survey

The Atlas of NSW Wildlife database search returned 463 records of the Koala within a 0.1 degree by 0.1 degree search area around the study area. This indicates that there is a local Koala population in the search area. The locations of the Koala records within the search area from the Atlas of NSW Wildlife (OEH, 2016) are shown previously in Figure 5.9. The search results of the Atlas of NSW Wildlife database show a cluster of records near within the Queens Lake State Conservation Area to the west of the site as well as a few records on the land to the north of Houston Mitchell Drive. The survey work undertaken by Phillips et al (2009) in relation to the Area 14 Koala Plan of Management, which was wider ranging than other individual surveys shows clusters of records immediately to the north and southwest of the site and further to the southeast around the Seafront Circuit/Beach Street area. Aerial imagery indicates that the study area is contiguous with forest habitat within the Queens Lake State Conservation Area, the Queens Lake Nature Reserve and the Queens Lake State Forest. The EPBC Act Protected Matters Search Tool advises that the Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) or the species habitat is known to occur in the area.

Advice received from the Koala Hospital at Port Macquarie indicates that there have been several Koala rescues undertaken in the Bonny Hills area. Most these rescues were associated with vehicle strikes on Ocean Drive near the headland near the local fuel station/general store within the village to the south of the study area. There have also been a small number of rescues of sick Koalas from the Panorama Drive area as well.

ii. On-ground (Field) Survey

The entire habitat within the study area was investigated. This included searching the site for actual Koala sightings as well as searching for Koala scats at the base of all trees within the study area and looking for other indicators such as scratch marks on tree trunks. No Koala scats were found; however, it was impossible to draw any conclusions from this alone given the recent heavy rain associated with the intense east coast low pressure system and extent of subsequent surface water within the site. Several trees showed signs of Koala activity, including scratches consistent with those made by Koalas on the trunk of a Forest Red Gum tree (tag no. 873) located near the eastern boundary adjacent to the larger dam within the site and disturbed bark on the trunks of four (4) Tallowwood trees (tag nos. 853, 854, 857 and 858) located adjacent to the western boundary of the site. Five (5) species of Koala food tree as listed under the Recovery Plan for the Koala (DECC, 2008) were recorded within the study area. These included three (3) primary Koala food tree species; *Eucalyptus microcorys* (Tallowwood), *Eucalyptus robusta* (Swamp Mahogany) and *Eucalyptus tereticornis* (Forest red Gum), and two (2) secondary/supplementary Koala food tree species; *Eucalyptus propinqua* (Small-fruited Grey Gum) and *Eucalyptus globoidea* (White

Stringybark)). An additional species; *Melaleuca quinquenervia* (Broad-leaved Paperbark) is listed as an 'other' browse species under the DCP.

iii. Koala Habitat Assessment

The Koala habitat assessment tool score is detailed in Table 5.9.

Table 5.9: Koala habitat assessment (coastal criteria)

Attribute	Coastal Criteria	Score
Koala occurrence	Evidence of 1 or more Koalas within the last 2 years (current study)	2
Vegetation composition	Has 2 or more known Koala food tree species in the canopy (of the remnant vegetation)	2
Habitat connectivity	Study is part of a contiguous landscape ≥ 500 hectares	2
Key existing threats	Evidence of infrequent or irregular Koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for Koala occurrence	1
Recovery value	Uncertainty exists as to whether the habitat is important for achieving the interim recovery objectives	1
Total		8

The Koala habitat assessment tool score of 8 indicates that the habitat within the study area may contain habitat critical to the species survival for the purposes of the EPBC Act.

Note: The mitigation of impacts which may interfere with the recovery of the Koala only applies to impact areas which score ≥ 5 using the habitat assessment tool, as these areas are considered likely to be important for the long-term survival of the species.

iv. Assessing adverse effects on habitat critical to the survival of the Koala (Figure 2 of the Guidelines)

Applying Figure 2 of the Guidelines:

- Koala habitat assessment tool (habitat) score of 8 – the habitat within the study area may contain habitat critical to the survival of the Koala;
- The land to be cleared within the study area contains known Koala food trees;
- The amount of land to be cleared under the current proposal is less than two (2) hectares (given the extent of site that is currently cleared).

Based on the assessment under Figure 2 of the Guidelines, as the amount of proposed clearing is less than two (2) hectares, referral to the Department of the Environment for adversely affecting habitat critical to the survival of the Koala is not recommended.

5.8 Significance Assessments

From the habitat assessment and database/literature review, it was considered that sixteen (16) threatened species as listed under the *Threatened Species Conservation Act 1995* and *Environment Protection and Biodiversity Conservation Act 1999* could potentially utilise the habitat within the study area. The Section 5A Assessment is appended to this report as Appendix F.

5.9 Aboriginal Heritage

For the purposes of determining the details and location of any Aboriginal object or Aboriginal place that may be situated on the subject site a search of the Aboriginal Heritage Information Management System (AHIMS) on the NSW Office of Environment and Heritage (OEH) website was undertaken on 8 September. The basic search indicated that no Aboriginal sites are recorded in or near the subject site and that no Aboriginal places have been declared in or near the subject site. The AHIMS Web Services search result form is appended to this report as Appendix G.

6. Potential Impacts on Biodiversity

It is proposed to rezone the land from RU1 – Primary Production zoned to part IN2 – Light Industrial and part E3 – Environmental Management, consistent with Council's Urban Growth Management Strategy. Much of the land within the study area has been cleared of native vegetation for many years and is maintained as managed grassland with retained 'paddock' trees as well as small patches of regrowth vegetation. In the longer term, there would be a continuation of a human presence on the site. The potential impacts on biodiversity associated with the proposed development are detailed below.

6.1 Vegetation and Habitat Removal

6.1.1 Terrestrial Habitat

Vegetation removal to facilitate the proposed rezoning and development of the land for light industrial purposes will essentially be confined to tree removal as the habitat within the study largely comprises a derived grassland containing remnant trees. It will be necessary to remove a total of fifty-three (53) trees (including a small stand of juvenile Swamp Oak saplings with tag number 833, which have been counted as a single tree) located within the proposed development footprint as detailed in the tree survey plan and data table are appended to this report as Appendix C. There are two main issues associated with the removal of the trees from within the study area. The first is the loss of habitat features including the small number of tree hollows that were recorded within one (1) hollow-bearing tree (tag no. 881) during the habitat assessment, which is proposed to be removed. The second is the removal of food resources, particularly with respect to the removal of preferred Koala food trees.

In relation to the removal of tree hollows, the results of the fauna survey suggest that the small number of hollows observed in the hollow-bearing tree proposed to be removed are likely to retain limited ecological value due to the tree being an isolated 'paddock' tree and the extent of human impact (artificial lighting and disturbance within the site) that currently exists. The fauna survey did not detect any species of fauna utilising the tree hollows directly, however a single individual of *Vespadelus pumilus* (Eastern Forest Bat) was observed in the immediate vicinity of the tree in question during the stag watching survey and concurrently recorded by ultrasonic echolocation detection. As the eastern Forest Bat roosts, primarily in tree hollows it would be a reasonable assumption that the observed Bat may roost in the hollow-bearing tree. The other likely candidates for utilising the tree hollows are other undetected species of Microchiropteran Bat and several avian species. Based on the tree's position in the landscape, present conditions of the habitat, the size of the observed tree hollows and previous observations of similar hollow-bearing trees in the general area, the species considered most likely to utilise the tree hollows are *Trichoglossus haematodus* (Rainbow Lorikeet) and *Eolophus roseicapillus* (Galah).

In relation to the removal of preferred Koala food trees, it will be necessary to remove twenty-two (22) Koala browse trees (as detailed in Table 2.6.1 of the DCP) that are situated within the proposed development footprint as detailed in Section 6.5. It is noted that the larger proportion of the trees located in the northern patch of remnant

vegetation will be retained within a proposed parcel of public land. Most trees proposed to be removed are in the central part of the site. All trees located within the proposed Environmental (E2/E3) zone will be retained. This part of the site will form the revegetation area containing compensatory plantings as detailed in Section 7.1.

6.1.2 Aquatic Habitat

One component of the aquatic habitat, comprising the small dam located within the proposed IN2 – Light Industrial zone and would be impacted by the proposed development of the land. It is noted that the terrestrial habitat within the study area adjacent to the dam is currently subject to disturbance associated with the placement of mulch and wood chip on the land to the north of the dam. However, the dam could provide potential habitat for several amphibian species including the green and Golden Bell Frog.

6.2 Interruption to Ecosystem Processes

Ecosystems require a suite of processes to function properly. These processes include climatic processes, primary processes (production of biomass), hydrological processes, nutrient cycling, interspecific and intraspecific interactions, movement of organisms and natural disturbance regimes such as fire and flooding (Gleeson et al, 2012). Ecosystem processes are complex and therefore difficult to quantify. Most development in natural environments has the potential to interrupt ecosystem processes.

6.3 Weed Invasion

Weed invasion could potentially have a negative impact on biodiversity in the future. It is generally accepted that weeds are a significant threat to biodiversity as well as being an economic problem. Depending on the species, weeds can increase shading, compete with native plants for nutrients, smother native plants or chemically suppress their germination or growth through allelopathy. Much of the land within the study area has been cleared to form a derived grassland largely dominated by graminoids. Because of the modified condition of the habitat an assemblage of introduced species including several species regarded as weeds are already established within the study area. It is noted that three (3) established weeds within the study area; *Asparagus aethiopicus* (Asparagus Fern), *Senecio madagascariensis* (Fireweed) and *Lantana camara* (Lantana) are listed as weeds of national significance and that further disturbance of the habitat within the site and lack of weed management has the potential to further escalate their progression. It is also noted that invasion, establishment and spread of *Lantana camara* (Lantana) is listed in NSW as Key Threatening Processes.

6.4 EPBC Act Koala Guideline Referral Considerations

The following impacts as detailed in Section 8 of the EPBC Act referral guidelines are considered likely to substantially interfere with the recovery of the Koala:

- Increasing Koala fatalities in habitat critical to the survival of the Koala due to dog attacks to a level that is likely to result in multiple, ongoing mortalities;
- Increasing Koala fatalities in habitat critical to the survival of the Koala due to vehicle-strikes to a level that is likely to result in multiple, ongoing mortalities;
- Facilitating the introduction or spread of disease or pathogens to an area, for example *Chlamydia* or *Phytophthora cinnamomi*, to habitat critical to the survival of the Koala that are likely to significantly reduce the reproductive output of female Koalas or reduce the carrying capacity of the habitat;
- Creating a barrier to movement to, between or within habitat critical to the survival of the Koala that is likely to result in a long-term reduction in genetic fitness or access to habitat critical to the survival of the Koala;
- Changing hydrology which degrades habitat critical to the survival of the Koala to the extent that the carrying capacity of the habitat is reduced in the long-term.

Several isolated 'paddock' trees are proposed to be removed from within the study area, however much of the land has been previously cleared of native vegetation and no further significant clearing in terms of area is necessary. As the amount of clearing proposed is less than two (2) hectares, referral under the EPBC Act Koala referral guidelines for adversely affecting habitat critical to the survival of the Koala is not recommended by the Department of the Environment.

6.5 Koala DCP Legislative Requirements

Six (6) species of trees recorded within the study area are listed as Koala browse trees in Table 2.6.1 of the DCP. These included *Eucalyptus microcorys* (Tallowwood), *Eucalyptus robusta* (Swamp Mahogany) and *Eucalyptus tereticornis* (Forest Red Gum), which are listed as primary browse species, *Eucalyptus propinqua* (Small-fruited Grey Gum) and *Eucalyptus globoidea* (White Stringybark), which are listed as secondary/supplementary browse species and *Melaleuca quinquenervia* (Broad-leaved Paperbark), which is listed as 'other' browse species. The details of the twenty-two (22) Koala food trees that are proposed to be removed from the site are provided in Table 6.1.

Table 6.1: Koala Food Trees

Tree Tag	Species	Common Name	Category
803	<i>Eucalyptus globoidea</i>	White Stringybark	Secondary
807	<i>Eucalyptus microcorys</i>	Tallowwood	Primary
829	<i>Eucalyptus tereticornis</i>	Forest Red Gum	Primary
830	<i>Eucalyptus tereticornis</i>	Forest Red Gum	Primary
832	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	Other
836	<i>Eucalyptus robusta</i>	Swamp Mahogany	Primary
838	<i>Eucalyptus robusta</i>	Swamp Mahogany	Primary
839	<i>Eucalyptus robusta</i>	Swamp Mahogany	Primary
840	<i>Eucalyptus robusta</i>	Swamp Mahogany	Primary
841	<i>Eucalyptus tereticornis</i>	Forest Red Gum	Primary
843	<i>Eucalyptus globoidea</i>	White Stringybark	Secondary
853	<i>Eucalyptus microcorys</i>	Tallowwood	Primary
866	<i>Eucalyptus tereticornis</i>	Forest Red Gum	Primary
867	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	Other
869	<i>Eucalyptus tereticornis</i>	Forest Red Gum	Primary
878	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	Other
879	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	Other
881	<i>Eucalyptus tereticornis</i>	Forest Red Gum	Primary
882	<i>Eucalyptus tereticornis</i>	Forest Red Gum	Primary
887	<i>Eucalyptus robusta</i>	Swamp Mahogany	Primary
892	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	Other
894	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	Other

The DCP indicates that the removal of Koala browse tree species is to be offset by compensatory planting at a ratio of two (2) replacement trees for each Koala browse tree that is removed.

6.6 Other Impacts Associated with Human Activities

6.6.1 Changes in Animal Behaviour

Behavioural changes in species of native fauna can occur because of the physical presence of a development or due to interaction with humans at the site of a development. There are various types of behavioural changes possible such as changes in the choice of foraging and reproductive behaviour. In some cases, animals may be drawn to a development by an improved food supply associated with the presence of humans. For example, species like the Eastern Grey Kangaroo, Brushtail Possum, Magpie, Pied Butcherbird, Kookaburra and Noisy Miner often live near humans because of the improved foraging opportunities. Other more secretive or cryptic species such as the large forest Owls and the Bush Rat are more likely to avoid areas near a development. In other cases, modification of the habitat in proximity to a development such as removal of the understory to create a parkland-like setting favours particular species that can result in the absence of other species. For example, a parkland cleared site is favoured habitat of the Noisy Miner, an aggressive, cooperative breeder that will exclude many other avian species from an area. Such

conditions already exist within the study area and the Noisy Miner was recorded during the diurnal bird survey. It is noted that aggressive exclusion of birds by the Noisy miner (*Manorina melanocephala*) is listed in NSW as a Key Threatening Process.

In addition, there is an existing trucking business and associated workshop located in the northern part of the study area that is undoubtedly influencing animal behaviour. The use of machinery, significant human presence and associated modification of the habitat has contributed to the exclusion of numerous species from the site. Similarly, the adjacent public road system, including the recent upgrading of the intersection of Houston Mitchell Drive and Ocean Drive as well as the recently developed school on the adjacent land to the east would have contributed to changes in animal behaviour.

6.6.2 Artificial Lighting

Artificial lighting can cause disruption of foraging behaviour, increased potential for collision with structures, and disruption of reproduction and movement. The effects of artificial lighting on most Australian fauna are not fully understood, nor has it been sufficiently studied. The site is currently impacted significantly by artificial light, particularly from the recently upgraded intersection of Houston Mitchell Drive and Ocean Drive as well as the recently developed school on the adjacent land to the east, as indicated in the image of artificial street lighting at Figure 6.1 taken from within the study area during the field survey.



Figure 6.1: Image of artificial lighting impacting the study area

7. Managing Potential Impacts

7.1 Vegetation

As previously detailed in the habitat assessment the land within the study area is maintained as managed grassland and it is likely that this management regime would continue. To facilitate the development of the land within the study area it will be necessary to remove a total of fifty-three (53) trees (including a small stand of juvenile Swamp Oak saplings with tag number 833, which have been counted as a single tree) that are located within the proposed development footprint as detailed in the tree survey plan and data table are appended to this report as Appendix C. The trees to be removed include one (1) hollow-bearing tree and twenty-two (22) preferred Koala food trees as previously detailed in Section 6 of this report. Mitigation measures to offset the removal of these trees, including hollow-bearing trees and preferred Koala food trees from within the study area are detailed below.

7.1.1 Tree Removal (General)

Prior to the commencement of any land clearing operations the ecologist shall undertake the following tasks:

- Survey the area to determine if species of fauna are present; and
- If any species of fauna is found, then clearing operations must not occur within 25 metres of the fauna until it moves away of its own volition.

7.1.2 Hollow-bearing Tree Removal

Hollow-bearing trees are those trees that contain hollows or other features that potentially provide nesting or refuge sites for fauna species. It is proposed to remove one (1) hollow-bearing tree. Any hollow-bearing trees approved for removal shall be removed as follows:

- A qualified ecologist shall be present on site during removal of all hollow-bearing trees;
- All hollow-bearing trees are to be left in place until at least 48 hours after all other trees and vegetation located within 25 metres of the hollow-bearing tree has been removed;
- Once the other trees and vegetation have been removed from around a hollow-bearing tree, the hollow-bearing tree is to be bumped on the side at least twice per day, using the on-site clearing equipment or other appropriate means, to encourage any resident fauna to depart the tree;
- The bumping is to be repeated at one minute intervals over a period of at least 5 minutes immediately prior to the felling of the tree;
- During the bumping the contractor is to take precautions to ensure that there is no risk of personal injury or equipment damage from falling limbs.
- Hollow-bearing trees are to be either cut (from the top down) in sections following examination of all hollows or carefully felled on to stockpiles of previously felled timber or other material to adequately soften the impact of felling;

- Immediately following the felling of a hollow-bearing tree the Ecologist is to properly inspect the tree for signs of fauna occupation. If hollows cannot be viewed over their full length, then they are to be sectioned carefully to enable a full inspection of the hollow. When the ecologist is satisfied, the tree is free of fauna, the tree can be removed;
- An inventory of the number and size of all tree hollows shall be maintained to determine the number and type of nest boxes to be provided in the nest box strategy;
- Where fauna is found within a hollow of the felled hollow-bearing tree all work within 25 metres of the fauna shall cease until it has moved away of its own volition or is captured for later release; and
- The ecologist will need to make a judgement call in some instances as to whether fauna found within a hollow of a felled hollow-bearing tree should be left to move away of its own volition or should be captured for later release or placed into care with a member of FAWNA NSW Inc.

7.1.3 Captured Fauna

Where tree hollows or other habitat features are found to contain species of fauna that did not leave the area prior to removal of the vegetation and are subsequently captured for their welfare and protection, the following specifications shall apply:

- Fauna captured shall be kept in a dark environment prior to release in retained vegetation at dusk on the day of capture;
- If fauna is injured during the process, the animals are to be taken to the nearest veterinarian for treatment prior to release; and
- Any injured fauna should be immediately taken to veterinarian for treatment.

7.1.4 Nest Box Strategy

Due to the modified condition of the habitat within the study area the threatened species most likely to be impacted include a small number of hollow-dependant Microchiropteran Bats as detailed in Table 7.1.

Table 7.1: Target hollow-bearing dependent threatened species

Species	Common Name	Nest Box Type
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	Micro Bat
<i>Kerivoula papuensis</i>	Golden-tipped Bat	Micro Bat
<i>Myotis macropus</i>	Southern Myotis	Micro Bat
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	Micro Bat

The nest box strategy shall incorporate the following measures:

- Nest boxes shall be provided at a ratio of two (2) nest boxes for each tree hollow to be removed as determined by the tree hollow inventory (approximately six (6) nest boxes);
- Nestboxes shall be installed in trees that do not contain existing hollows located within the proposed Environmental (E2/E3) zone;

- Nest boxes shall be suitable for Microchiropteran Bats with (typical) dimensions of 500 mm high x 360 mm wide x 150 mm deep, with 20 hole/15 slit and fixed to a tree at a height of 2-5 metres;
- Nest boxes will be manufactured to reduce the likelihood of occupation by feral animals such as the Common Myna and Honey Bee per industry standards;
- Nest boxes are to be installed in trees (both rough-barked and smooth-barked eucalypts) that do not already have hollows;
- A 40 mm to 50 mm thick layer of wood shavings is to be placed in the base of nest boxes to simulate decaying hollows and provide extra insulation;
- All nest boxes will be attached to the tree using the *Habisure* system, which involves:
 - A length of 3.15 mm plastic-coated soft fencing wire passed through the nest box and around the tree trunk;
 - The wire must be folded into at least four folds about 60 mm tall and 15 mm apart at the sides of the box to allow for tree growth;
 - Where the wire is in contact with the tree trunk or branch, it must be threaded through a length of garden hose to protect the tree;
 - Where possible the wire around the tree should pass over a branch behind the trunk, although nest boxes can be installed directly on a straight-stemmed tree; and
 - Nest boxes will be positioned on the north-west to east sector of tree trunks to avoid hot afternoon sun and the predominant aspect of severe storms

7.1.5 Tree Replacement

All trees to be removed should be offset by compensatory planting of replacement trees within the proposed Environmental (E2/E3) zone. Each tree shall be of the same species as detailed below.

i. Preferred Koala Food Trees

The twenty-two (22) preferred Koala food trees that are proposed to be removed from the site are detailed in Section 6.5. The DCP indicates that the removal of Koala browse tree species is to be offset by compensatory planting at a ratio of two (2) replacement trees for each Koala browse tree that is removed. Therefore, forty-four (44) replacement Koala browse trees are required as detailed below in Table 7.2.

Table 7.2: Replacement Koala food trees

Species	Common Name	Replacement Trees Required
<i>Eucalyptus microcorys</i>	Tallowwood	4
<i>Eucalyptus robusta</i>	Swamp Mahogany	10
<i>Eucalyptus tereticornis</i>	Forest Red Gum	14
<i>Eucalyptus globoides</i>	White Stringybark	4
<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	12

ii. Non-Koala Food Trees

In addition to the preferred Koala food trees to be removed as detailed above, thirty-one (31) non-Koala food trees are proposed to be removed. Removal of non-Koala browse tree species is to be offset by compensatory planting at a ratio of one (1) replacement trees for each tree that is removed as detailed below in Table 7.3.

Table 7.2: Replacement non-Koala food trees

Species	Common Name	Replacement Trees Required
<i>Casuarina glauca</i>	Swamp Oak	16
<i>Corymbia intermedia</i>	Pink Bloodwood	6
<i>Eucalyptus patentinervis</i>	<i>E. tereticornis</i> x <i>E. robusta</i>	5
<i>Eucalyptus siderophloia</i>	Grey Ironbark	2
<i>Melaleuca linariifolia</i>	Flax-leaved Paperbark	1
<i>Melaleuca styphelioides</i>	Prickly-leaved Teatree	1

7.1.6 Regeneration Within Retained Vegetation

It is proposed to retain a significant number of trees located in the northern part of the site within an allotment that will be zoned E2/E3 environmental management. Currently, this area is parkland cleared and consequently has become preferred habitat for a population of *Manorina melanocephala* (Noisy Miner). The Noisy Miner is an undesirable communal species that excludes numerous avian species from an occupied area due to its aggressive behaviour. The species is also known to attack reptiles and some small mammals. To help minimise the opportunities available to the Noisy Miner within the site it is recommended that the understorey and native groundcover within the proposed E2/E3 environmental management land in the northern part of the site be restored. Similarly, the revegetation of the E2/E3 environmental management zoned land in the southern part of the site should also incorporate restoration of the understorey and native groundcover. The specific management actions in relation to these measures shall be provided under a Vegetation Management Plan.

7.1.7 Aquatic Habitat

The aquatic habitat comprised four (4) dams of which three (3) including the large dam located in the southern part of the site will be retained within either the proposed E3 – Environmental Management zone or the vegetated buffer adjacent to the eastern boundary. An on-balance approach has been taken and although the small dam within the development footprint (where frogs were not recorded) is to be removed, the remaining three dams will be retained within the future environmental (E2/E3) zone, which comprises an area of approximately 3.86 hectares. The dam that is situated within the development footprint is small and could be readily investigated prior to its removal during appropriate weather/climatic conditions to confirm the presence or absence of the Green and Golden Bell Frog as well as any other amphibian species.

7.2 Interruption to Ecosystem Processes

There is considerable complexity associated with the functioning of an ecosystem that are largely outside the parameters of this report. Clearly there is significant disturbance of the habitat within the study area as well as on the adjacent land to the north, east and south, which is likely to have impacted ecosystem processes generally. The proposed revegetation and associated restoration of the habitat within the Environmental (E2/E3) zone will mitigate these impacts to some extent.

7.3 Weed Management

As discussed previously in Section 5 most the land within the study is cleared and contains some remnant native in association with a significant assemblage of exotic/weed species. The major areas where weeds are most likely to be of ecological concern are at the interface between areas of the native vegetation and the development footprint, particularly along the western boundary adjoining the Queens Lake State Conservation Area. In the long term an integrated weed management program could be implemented. This would involve a long-term approach that incorporates several weed management techniques including:

- Physical control such as hand removal, mulching, tilling and mowing;
- Chemical control using appropriate herbicides;
- Biological control where available; and
- Cultural control by encouraging the competitiveness of desired species that helps to suppress weed growth by reducing access to available sunlight, nutrients and moisture.

In the longer term, the potential for garden escapes and inappropriate disposal of green waste will remain as a potential impact on biodiversity. The measures to mitigate these potential impacts will be provided separately under a Vegetation Management Plan.

7.4 Koala (DPC) Considerations

As per the DCP, removal of Koala food trees from the site should be offset by a compensatory replanting strategy within the proposed E3 zoned residue lot at a ratio of two (2) replacement trees for each primary Koala food tree that is removed as previously detailed previously in Section 7.1.5. It is proposed to install Koala proof fencing along the western boundary of the site as part of the overall strategy to encourage Koala movements through the Environmental (E2/E3) zone land in the south of the site where habitat linkage has been identified under the Area 14 Master Plan. It is envisaged that a solid fence will be constructed along the western boundary to prevent Koala movement onto the site and to create a visual barrier to reduce edge effects and discourage undesirable actions such as littering and dumping of waste material. It is also envisaged that the proponent will work cooperatively with Council through the Vegetation Management Plan (VMP) process to ensure that future on-site fencing can work in association with the recently upgraded culvert in Ocean Drive, located adjacent to the site.

7.5 Changes in Animal and Artificial Lighting

Due to the extent of existing development in proximity to the study area there is currently a significant human presence in the general area that is potentially impacting on some more sensitive species. It is also noted that artificial lighting is already in play due to the existing street lighting and other infrastructure in proximity to the study area. Therefore, it is considered unlikely that the proposed development will contribute significantly to changes in animal behaviour or to impacts associated with artificial lighting. No specific recommendations are made in relation to these impacts given the relatively small scale of the proposed development and the extent of the human presence that currently exists in the surrounding area.

8. Conclusion

This report has been prepared to assess the ecological impact of a proposed rezoning of the land within the subject site identified as Lot 10 in DP 615775 and Lot 1 in DP 1117908, Houston Mitchell Drive Bonny Hills. The site is identified for investigation for future local service industrial land within Council's Urban Growth Management Strategy. This ecological assessment therefore describes the ecological impact of the rezoning from its current Primary Production (RU1) zone to part Light Industrial (IN2) and part Environmental (E3/E2) zone. The ecological assessment will be used to assist in the preparation of a Structure Plan for a Planning Proposal (rezoning), which will identify the future development area and the areas that can be used for compensatory measures.

The northern end of the study area (adjacent to Houston Mitchell Drive) lies on a small hillslope that has a southern aspect with the slope generally ranging between 0 and 5 degrees. The land becomes flat and low-lying approximately at the midway point before gradually rising again at the southern margin. An existing dwelling and associated outbuildings as well as a large metal clad shed are located on the land in the northern part of site.

The Port Macquarie-Hastings Council (PMHC) vegetation mapping indicates that there are two (2) areas of mapped vegetation within the study area comprising a disjunct remnant patch in the northern part of the site and small area of vegetation in the southwest corner of the site that forms part of the eastern margin of a large area of vegetation within the Queens Lake State Conservation Area that extends into the Queens Lake Nature Reserve. These areas of vegetation within the study area are mapped as White Stringybark – Tallowood dry forest. The mapping also indicates that the larger proportion of the land within the study area does not contain a classified vegetation community. The floristics data and landscape position of the site suggests that the area probably contained a swamp forest community prior to land clearing. Currently, most the land within the study area has been cleared of native vegetation and is maintained as managed grassland with retained 'paddock' trees. The retained trees within the canopy generally ranged from the mature growth stage with some trees recorded in the late-mature growth stage. This management regime appears to have been in place for a considerable number of years. The habitat within the study area contained very few terrestrial habitat features due to its cleared condition across the larger proportion of the site. The understorey was reduced to small remnants generally confined to parts of the site that are inaccessible to regular grass slashing, at the bases of trees, along fence lines and occasionally within the groundcover as resprouts and juvenile plants. Other habitat features such as fallen timber normally associated with forest communities were absent from the study area. However, there was a small number of hollow-bearing trees recorded within the study area.

In relation to Koala habitat assessment, the Atlas of NSW Wildlife database search returned 463 records of the Koala within a 0.1 degree by 0.1 degree search area around the study area. The Atlas records suggest that a local Koala population is patchily distributed across the Bonny Hills and Queens Lake area with concentrations of records in the developing areas of Lake Cathie to the north and Bonny Hills to the south as well as within the Lake Innes Nature Reserve to the north, the Queens Lake

State Conservation Area and the Queens Lake Stater Forest to the west and the Queens Lake Nature Reserve to the southwest. These concentrations of records are perhaps more a reflection of where ecological surveys have been undertaken previously rather than a true indication of the species distribution across the broader area. The survey work undertaken by Phillips et al (2009) in relation to the Area 14 Koala Plan of Management was wider ranging than other individual surveys and shows clusters of records immediately to the north and southwest of the site and further to the southeast around the Seafront Circuit/Beach Street area. During the field survey a search of the habitat within the study area was undertaken for actual Koala sightings as well as a search for Koala scats at the bases of trees and other indicators including scratch marks and disturbed bark on tree trunks. As all trees within the study area were surveyed for other purposes, each tree was also assessed for signs of Koala activity. No Koala scats were found; however, it was impossible to draw any conclusions from this alone given the recent heavy rain associated with the intense east coast low pressure system and extent of surface water within the site at the time of the assessment. Several trees showed signs of Koala activity, including scratches consistent with those made by Koalas on the trunk of a Forest Red Gum tree (tag no. 873) located near the eastern boundary adjacent to the larger dam within the site and disturbed bark on the trunks of four (4) Tallowood trees (tag nos. 853, 854, 857 and 858) located adjacent to the western boundary of the site. Given the evidence recorded during the Koala survey there seems little doubt that on occasion the habitat within the study area is utilised by the species. There are food resources available to the Koala within the site, which is contiguous with a large expanse of forest habitat within the Queens Lake State Conservation Area, the Queens Lake Nature Reserve and the Queens Lake State Forest. Therefore, it is likely that a population of the Koala would periodically utilise the food resources within the study area. However, the habitat is unlikely to be core Koala habitat for the purposes of SEPP 44 but is a valuable component of a larger home range of the local Koala population.

The Planning Proposal will be accompanied by a Voluntary Planning Agreement (VPA) offer to Council for the future Environmental Management Lands that will set out their establishment, maintenance and dedication requirements. The VPA will also require the preparation of a Vegetation Management Plan (VMP) to accompany the future Development Application (DA) for the industrial subdivision. The VMP will set out the detailed compensatory measures, including for example, weed control, compensatory planting numbers and locations, a hollow-bearing tree (HBT) removal strategy, a nest box strategy, a Koala fencing strategy etc. The VPA and VMP process will provide certainty with respect to environmental management and the compensatory measures will assist in mitigating any impacts on biodiversity.

From the habitat assessment and database/literature review, it was considered that sixteen (16) threatened species of fauna as listed under the *Threatened Species Conservation Act 1995* and *Environment Protection and Biodiversity Conservation Act 1999* could potentially utilise the habitat within the study area. The Section 5A Assessment appended to this report as Appendix F concluded that the proposal has the potential to impact on several threatened species and populations. Measures to mitigate the impact on biodiversity are outlined in Section 7 of this report.

9. References

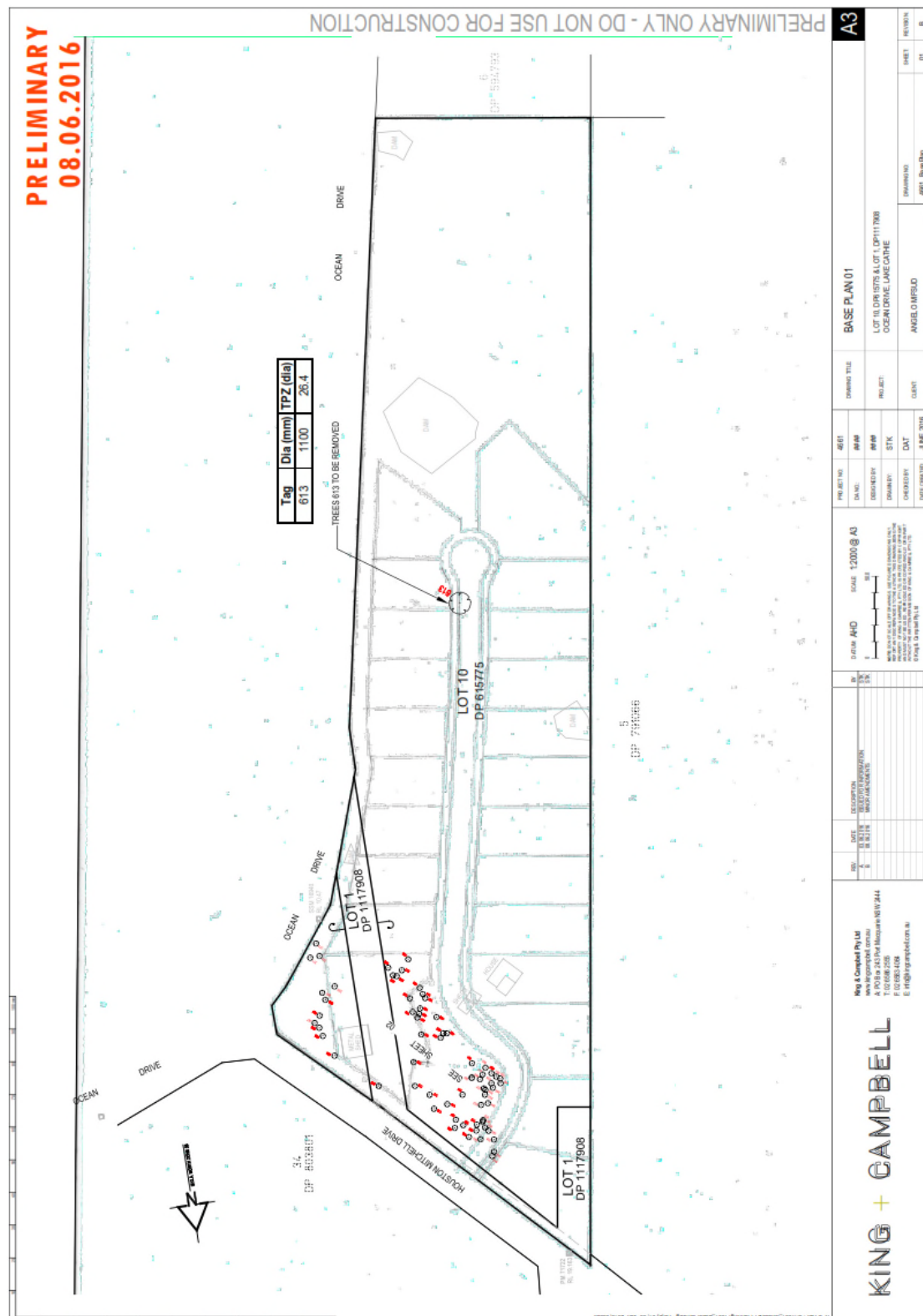
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11. Appendix B: Flora Species List

The species of flora recorded within the study area during the field survey are detailed in Table B.1 below.

Table B.1: Flora species recorded within the study area

Family	Species	Common Name
Adiantaceae	<i>Adiantum aethiopicum</i>	Common Maidenhair
Apiaceae	<i>Centella asiatica</i>	Indian Pennywort
	<i>Hydrocotyle bonariensis</i> *	
	<i>Hydrocotyle tripartita</i>	Pennywort
	<i>Parsonsia straminea</i>	Common Silkpod
Araliaceae	<i>Polyscias sambucifolia</i>	Elderberry Panax
Asparagaceae	<i>Asparagus aethiopicus</i> *	Asparagus Fern*
Asteraceae	<i>Ageratum houstonianum</i> *	Blue Billygoat Weed*
	<i>Bidens pilosa</i> *	Cobbler's Pegs*
	<i>Cirsium vulgare</i> *	Spear Thistle*
	<i>Conyza bonariensis</i> *	Flax-leaf Fleabane*
	<i>Hypochaeris radicata</i> *	Catsear*
	<i>Senecio madagascariensis</i> *	Fireweed*
	<i>Taraxacum officinale</i> *	Dandelion*
	<i>Tripleurospermum maritimum</i> subsp. <i>inodorum</i> *	Scentless Mayweed*
Blechnaceae	<i>Blechnum cartilagineum</i>	Gristle Fern
Casuarinaceae	<i>Allocasuarina littoralis</i>	Black She-oak
	<i>Casuarina glauca</i>	Swamp Oak
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed
Cupressaceae	<i>Callitris rhomboidea</i>	Port Jackson Pine
Cyperaceae	<i>Carex appressa</i>	
	<i>Cyperus breviculmis</i> *	Umbrella Sedge*
	<i>Eleocharis equisetina</i>	
	<i>Fimbristylis dichotoma</i>	Common Fringe-sedge
	<i>Lepidosperma laterale</i>	Variable Sword-sedge
	<i>Schoenoplectiella mucronata</i>	
Dennstaedtiaceae	<i>Pteridium esculentum</i>	Common Bracken
Dicksoniaceae	<i>Calochlaena dubia</i>	Rainbow Fern
Dilleniaceae	<i>Hibbertia scandens</i>	Climbing Guinea Flower
Ericaceae	<i>Leucopogon juniperinus</i>	Prickly Beard-heath
	<i>Monotoca scoparia</i>	
	<i>Trochocarpa laurina</i>	Tree Heath
Fabaceae (Caesalpinioideae)	<i>Senna pendula</i> var. <i>glabrata</i> *	Easter Cassia*
Fabaceae (Faboideae)	<i>Daviesia ulicifolia</i>	Gorse Bitter Pea
	<i>Desmodium rhytidophyllum</i>	
	<i>Glycine clandestina</i>	Twining Glycine
	<i>Glycine microphylla</i>	Small-leaf Glycine
	<i>Trifolium repens</i> *	White Clover*
Fabaceae (Mimosoideae)	<i>Acacia implexa</i>	Hickory Wattle
	<i>Acacia longifolia</i> subsp. <i>longifolia</i>	Sydney Golden Wattle

Iridaceae	<i>Gladiolus sp.*</i>	Gladiola*
Juncaceae	<i>Juncus continuus</i>	
Lauraceae	<i>Cinnamomum camphora*</i>	Camphora Laurel*
Lobeliaceae	<i>Pratia purpurascens</i>	Whiteroot
Loganiaceae	<i>Mitrasacme alsinoides</i>	
Lomandraceae	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush
Loranthaceae	<i>Amyema congener</i> subsp. <i>congener</i>	
Luzuriagaceae	<i>Eustrephus latifolius</i>	Wombat Berry
	<i>Geitonoplesium cymosum</i>	Scrambling Lily
Malvaceae	<i>Sida rhombifolia*</i>	Paddy's Lucerne*
Myrtaceae	<i>Corymbia intermedia</i>	Pink Bloodwood
	<i>Eucalyptus globoidea</i>	White Stringybark
	<i>Eucalyptus microcorys</i>	Tallowwood
	<i>Eucalyptus patentinervis</i>	<i>E. tereticornis</i> x <i>E. robusta</i>
	<i>Eucalyptus propinqua</i>	Small-fruited Grey Gum
	<i>Eucalyptus robusta</i>	Swamp Mahogany
	<i>Eucalyptus siderophloia</i>	Grey Ironbark
	<i>Eucalyptus tereticornis</i>	Forest Red Gum
	<i>Leptospermum laevigatum</i>	Coast Teatree
	<i>Leptospermum polygalifolium</i> subsp. <i>cismontanum</i>	Tantoon
	<i>Lophostemon confertus</i>	Brush Box
	<i>Melaleuca linariifolia</i>	Flax-leaved Paperbark
	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark
	<i>Melaleuca styphelioides</i>	Prickly-leaved Tea Tree
	<i>Syncarpia glomulifera</i>	Turpentine
Nymphaeaceae	<i>Nymphaea caerulea</i> subsp. <i>zanzibarensis*</i>	Cape Waterlily
Ochnaceae	<i>Ochna serrulata*</i>	Micky Mouse Plant*
Oxalidaceae	<i>Oxalis exilis</i>	
Phormiaceae	<i>Dianella caerulea</i>	Blue Flax Lily
Philydraceae	<i>Philydrum lanuginosum</i>	Frogsmouth
Phyllanthaceae	<i>Breynia oblongifolia</i>	Coffee Bush
	<i>Glochidion ferdinandi</i>	Cheese Tree
Pittosporaceae	<i>Pittosporum undulatum</i>	Sweet Pittosporum
Plantaginaceae	<i>Plantago lanceolata*</i>	Lamb's Tongues*
	<i>Veronica persica*</i>	Creeping Speedwell*
Poaceae	<i>Andropogon virginicus*</i>	Whisky Grass*
	<i>Aristida vagans</i>	Threeawn Speargrass
	<i>Axonopus fissifolius*</i>	Narrow-leafed Carpet Grass*
	<i>Chloris gayana*</i>	Rhodes Grass*
	<i>Cynodon dactylon</i>	Common Couch
	<i>Digitaria parviflora</i>	Small-flowered Finger Grass
	<i>Echinopogon caespitosus</i> var. <i>caespitosus</i>	Tufted Hedgehog Grass
	<i>Entolasia marginata</i>	Bordered Panic
	<i>Entolasia stricta</i>	Wiry Panic
	<i>Eragrostis brownii</i>	Brown's Lovegrass
	<i>Imperata cylindrica</i>	Blady Grass
	<i>Oplismenus aemulus</i>	Basket Grass
	<i>Panicum repens*</i>	Torpedo Grass*

	<i>Paspalum dilatatum</i> *	Paspalum*
	<i>Paspalum mandiocanum</i> *	Broadleaf Paspalum*
	<i>Paspalum urvillei</i> *	Vasey Grass*
	<i>Sporobolus africanus</i> *	Parramatta Grass*
	<i>Themeda triandra</i>	Kangaroo Grass
Polygonaceae	<i>Persicaria decipiens</i>	Slender Knotweed
	<i>Rumex obtusifolia</i> *	Broad-leaf Dock*
Proteaceae	<i>Banksia spinulosa</i>	Hairpin Banksia
	<i>Persoonia levis</i>	Broad-leaved Geebung
Ranunculaceae	<i>Ranunculus lappaceus</i>	Common Buttercup
Rosaceae	<i>Rubus moluccanus</i> var. <i>trilobus</i>	Molucca Bramble
	<i>Rubus parvifolius</i>	Native Raspberry
Solanaceae	<i>Solanum hapalum</i>	
Thymelaeaceae	<i>Pimelea linifolia</i> subsp. <i>linifolia</i>	Slender Rice Flower
Typhaceae	<i>Typha orientalis</i>	Broad-leaved Cumbungi
Verbenaceae	<i>Lantana camara</i> *	Lantana*
	<i>Verbena bonariensis</i> *	Purpletop*
Violaceae	<i>Viola hederaceae</i>	Ivy-leaved Violet

* Indicates an introduced species

12. Appendix C: Tree Survey

Tag No.	Species	DBH (cm)	Height (m)	Notes
801	<i>Eucalyptus siderophloia</i>	43	15	
802	<i>Corymbia intermedia</i>	97	20	
803	<i>Eucalyptus globoidea</i>	58	15	
804	<i>Corymbia intermedia</i>	34	15	
805	<i>Corymbia intermedia</i>	14	12	
806	<i>Eucalyptus siderophloia</i>	33	15	
807	<i>Eucalyptus microcorys</i>	17	8	
808	<i>Eucalyptus microcorys</i>	52	20	
809	<i>Eucalyptus microcorys</i>	42	20	
810	<i>Eucalyptus microcorys</i>	34	15	
811	<i>Eucalyptus microcorys</i>	49	20	
812	<i>Corymbia intermedia</i>	23	15	
813	<i>Eucalyptus globoidea</i>	50	15	2 trunks
814	<i>Eucalyptus microcorys</i>	58	20	
815	<i>Eucalyptus microcorys</i>	32	20	
816	<i>Eucalyptus microcorys</i>	44	20	
817	<i>Eucalyptus microcorys</i>	82	25	
818	<i>Eucalyptus siderophloia</i>	20	10	
819	<i>Eucalyptus microcorys</i>	48	20	
820	<i>Eucalyptus microcorys</i>	72	20	2 trunks
821	<i>Eucalyptus microcorys</i>	72	20	
822	<i>Eucalyptus globoidea</i>	48	20	
823	<i>Eucalyptus globoidea</i>	41	20	
824	<i>Eucalyptus siderophloia</i>	41	20	
825	<i>Eucalyptus globoidea</i>	87	25	
826	<i>Eucalyptus siderophloia</i>	43	12	
827	<i>Casuarina glauca</i>	51	10	
828	<i>Melaleuca styphelioides</i>	35	8	3 trunks
829	<i>Eucalyptus tereticornis</i>	65	12	
830	<i>Eucalyptus tereticornis</i>	44	12	
831	<i>Eucalyptus patentinervis</i>	82	15	Hybrid
832	<i>Melaleuca quinquenervia</i>	65	10	
833	<i>Casuarina glauca</i>		8	Stand of small trees
834	<i>Casuarina glauca</i>	54	12	
835	<i>Eucalyptus robusta</i>	81	12	
836	<i>Eucalyptus robusta</i>	15	8	
837	<i>Eucalyptus robusta</i>	45	15	
838	<i>Eucalyptus robusta</i>	15	8	
839	<i>Eucalyptus robusta</i>	39	15	
840	<i>Eucalyptus robusta</i>	35	12	

841	<i>Eucalyptus tereticornis</i>	44	10	
842	<i>Eucalyptus patentinervis</i>	32	12	Hybrid
843	<i>Eucalyptus globoidea</i>	19	10	
844	<i>Corymbia intermedia</i>	33	12	2 trunks
845	<i>Melaleuca quinquenervia</i>	40	12	
846	<i>Eucalyptus globoidea</i>	51	15	
847	<i>Corymbia intermedia</i>	23	10	
848	<i>Corymbia intermedia</i>	25	12	
849	<i>Casuarina glauca</i>	48	12	
850	<i>Eucalyptus robusta</i>	15	8	
851	<i>Eucalyptus globoidea</i>	40	15	
852	<i>Eucalyptus microcorys</i>	21	12	
853	<i>Eucalyptus microcorys</i>	47	15	Disturbed bark (Koala)
854	<i>Eucalyptus microcorys</i>	34	15	Disturbed bark (Koala)
855	<i>Melaleuca quinquenervia</i>	57	15	
856	<i>Eucalyptus globoidea</i>	34	15	
857	<i>Eucalyptus microcorys</i>	45	20	Disturbed bark (Koala)
858	<i>Eucalyptus microcorys</i>	64	20	Disturbed bark (Koala)
859	<i>Casuarina glauca</i>	32	12	
860	<i>Casuarina glauca</i>	34	12	
861	<i>Casuarina glauca</i>	22	12	
862	<i>Casuarina glauca</i>	20	12	
863	<i>Casuarina glauca</i>	27	15	
864	<i>Eucalyptus tereticornis</i>	66	12	2 trunks
865	<i>Eucalyptus tereticornis</i>	42	12	
866	<i>Eucalyptus tereticornis</i>	57	15	
867	<i>Melaleuca quinquenervia</i>	49	12	5 trunks
868	<i>Corymbia intermedia</i>	16	8	
869	<i>Eucalyptus tereticornis</i>	16	8	
870	<i>Melaleuca linariifolia</i>	24	8	
871	<i>Melaleuca quinquenervia</i>	28	8	3 trunks
872	<i>Eucalyptus tereticornis</i>	104	25	HBT
873	<i>Eucalyptus tereticornis</i>	74	25	Scratch marks (Koala)
874	<i>Casuarina glauca</i>	48	15	2 trunks
875	<i>Casuarina glauca</i>	21	10	
876	<i>Casuarina glauca</i>	26	12	
877	<i>Casuarina glauca</i>	17	8	
878	<i>Melaleuca quinquenervia</i>	22	8	2 trunks
879	<i>Melaleuca quinquenervia</i>	49	10	5 trunks
880	<i>Melaleuca linariifolia</i>		8	Multiple trunks
881	<i>Eucalyptus tereticornis</i>	107	20	HBT (Tree 613)
882	<i>Eucalyptus tereticornis</i>	21	10	
883	<i>Eucalyptus patentinervis</i>	21	10	Hybrid
884	<i>Eucalyptus patentinervis</i>	103	20	Hybrid

885	<i>Eucalyptus patentinervis</i>	39	15	Hybrid
886	<i>Eucalyptus patentinervis</i>	73	20	Hybrid
887	<i>Eucalyptus robusta</i>	26	15	
888	<i>Casuarina glauca</i>	46	15	
889	<i>Casuarina glauca</i>	47	15	
890	<i>Casuarina glauca</i>	30	12	
891	<i>Casuarina glauca</i>	23	12	
892	<i>Melaleuca quinquenervia</i>	42	12	2 trunks
893	<i>Casuarina glauca</i>	36	12	
894	<i>Melaleuca quinquenervia</i>		10	Multiple trunks

Note: Trees shown red sit within the proposed development footprint in such a position that their retention is considered unviable.

TABLE 1 - continued					TABLE 1 - continued					TABLE 1 - continued				
Tag No.	Species	DBH (cm)	Height (m)	Notes	Tag No.	Species	DBH (cm)	Height (m)	Notes	Tag No.	Species	DBH (cm)	Height (m)	Notes
805	Escalypsis sphaeroloba	43	12	16.2 Tag 458	801	Escalypsis globulata	43	15		876	Casuarina glauca	26	12	
807	Corymbia alternata	51	10		802	Escalypsis microcarpa	21	12		877	Casuarina glauca	17		
808	Melaleuca quinquenervia	35	8	3 turks	803	Escalypsis microcarpa	47	15		878	Melaleuca quinquenervia	22	10	2 turks
809	Escalypsis leucocarpa	65	12		804	Escalypsis microcarpa	34	15	Disturbed tank (Koa)	879	Melaleuca quinquenervia	49	10	5 turks
810	Escalypsis leucocarpa	44	12		805	Melaleuca quinquenervia	57	15		880	Melaleuca leucocarpa	8		
811	Escalypsis leucocarpa	62	15	Hybrid	806	Escalypsis globulata	34	15		881	Escalypsis leucocarpa	107	20	16.2 Tag 613, HIT
812	Melaleuca quinquenervia	65	10		807	Escalypsis microcarpa	45	20	Disturbed tank (Koa)	882	Escalypsis leucocarpa	21	10	
813	Casuarina glauca	54	12	Stand of small trees	808	Escalypsis microcarpa	64	20	Disturbed tank (Koa)	883	Escalypsis leucocarpa	21	10	Hybrid
814	Casuarina glauca	81	12	HIT	809	Casuarina glauca	32	12		884	Escalypsis leucocarpa	103	20	Hybrid
815	Escalypsis robusta	15	8		810	Casuarina glauca	34	12		885	Escalypsis leucocarpa	39	15	Hybrid
816	Escalypsis robusta	45	15		811	Casuarina glauca	22	12		886	Escalypsis leucocarpa	73	20	Hybrid
817	Escalypsis robusta	15	8		812	Casuarina glauca	20	12		887	Escalypsis robusta	26	15	
818	Escalypsis robusta	35	15		813	Casuarina glauca	37	15		888	Casuarina glauca	46	15	
819	Escalypsis robusta	35	12		814	Escalypsis leucocarpa	68	12	2 turks	889	Casuarina glauca	47	15	
820	Escalypsis robusta	44	10		815	Escalypsis leucocarpa	42	12		890	Casuarina glauca	30	12	
821	Escalypsis robusta	19	10	Hybrid	816	Escalypsis leucocarpa	57	15		891	Casuarina glauca	23	12	
822	Escalypsis robusta	33	12	2 turks	817	Melaleuca quinquenervia	49	12	5 turks	892	Melaleuca quinquenervia	42	12	2 turks
823	Escalypsis robusta	40	12		818	Corymbia alternata	15	8		893	Casuarina glauca	36	12	
824	Escalypsis robusta	51	15		819	Escalypsis leucocarpa	15	8		894	Melaleuca quinquenervia	26	10	16.2 Tag 613, HIT
825	Escalypsis robusta	72	20	16.2 Tag 161, 2 turks	820	Melaleuca quinquenervia	28	8		895	Melaleuca quinquenervia	26	10	16.2 Tag 613, HIT
826	Escalypsis robusta	72	20	16.2 Tag 161, 2 turks	821	Escalypsis globulata	51	15		896	Casuarina glauca	47	15	
827	Escalypsis robusta	48	20	16.2 Tag 459	822	Escalypsis globulata	23	10		897	Casuarina glauca	30	12	
828	Escalypsis robusta	41	20	16.2 Tag 500	823	Corymbia alternata	25	12		898	Melaleuca quinquenervia	42	12	2 turks
829	Escalypsis robusta	41	20	16.2 Tag 500	824	Casuarina glauca	48	12		899	Melaleuca quinquenervia	26	10	16.2 Tag 613, HIT
830	Escalypsis robusta	87	25	16.2 Tag 158	825	Escalypsis robusta	15	8		900	Melaleuca quinquenervia	26	10	16.2 Tag 613, HIT

13. Appendix D: HBT Assessment Forms

Port Macquarie – Hastings Council

Hollow-bearing tree assessment

LGA/Project: Houston Mitchell Drive

Date: 7/6/16 Easting: 152.82552 Northing: -31.56684 Datum: GDA

Tree species (if known): E. tereticornis

Tag no. 881

Alive	Dead	Score
✓		3

Height (m): 20 DBH (cm): 107

DBH Score
3

Number of visible hollows:

> 5	2 - 4	0 - 1	Score
	✓		1.5

Hollow Size (variable: 1 or more):

>100mm	>50mm	<50mm	Score
1		2	3

Habitat Proximity:

In situ	< 30m	> 30m	Score
		✓	0

Longevity:

High	Medium	Low	Score
✓			3

TOTAL SCORE: 13.5

Evidence of existing use Possibly Vespertilio pumilus
(Eastern Forest Bat)

Recommendation(s):

.....

.....

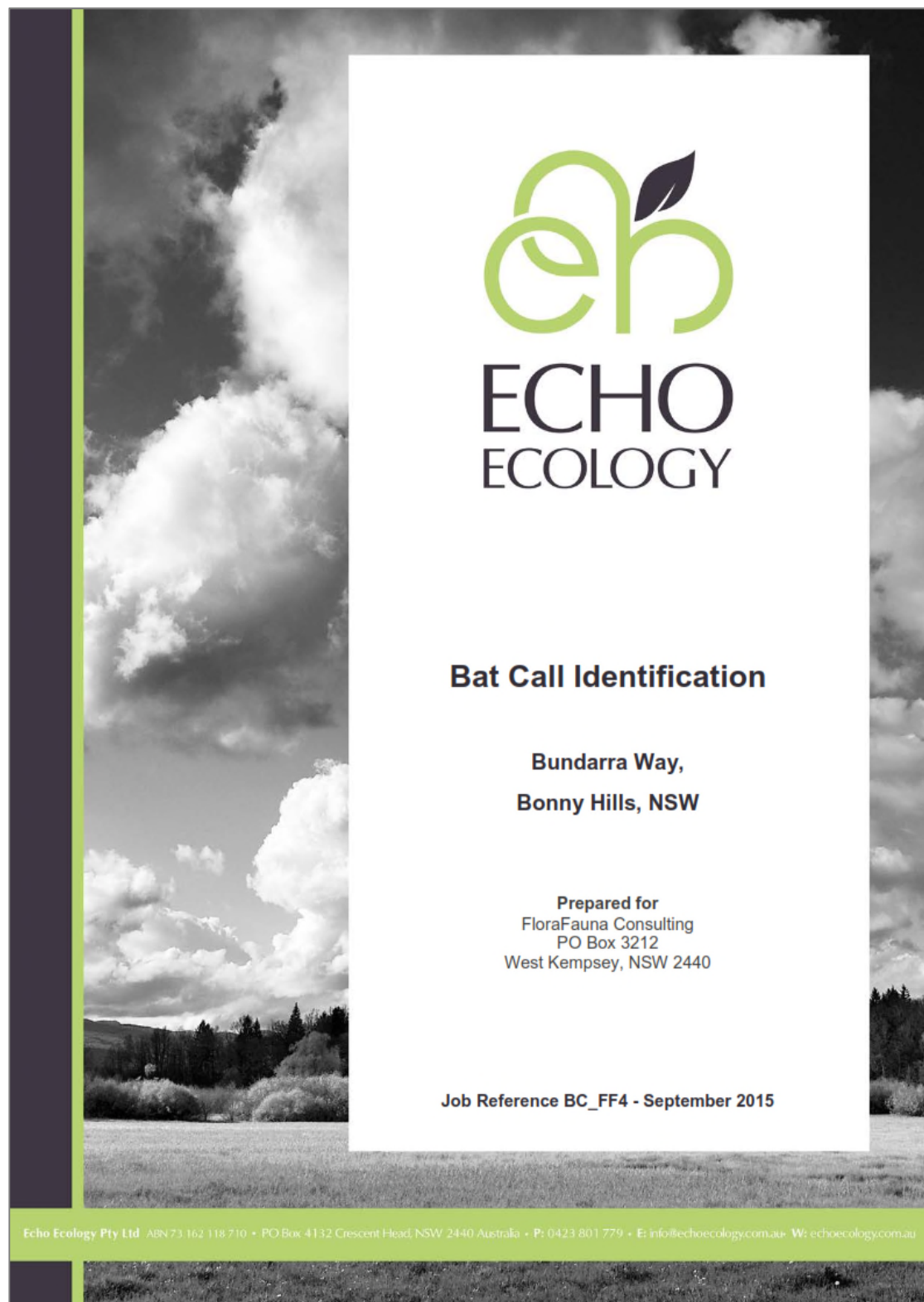
.....

Explanatory Notes:
Hollow-bearing trees (HBTs) are an important element in the Australian landscape and a significant factor affecting biodiversity values. This assessment sheet is intended to provide a more quantitative and ecologically meaningful approach to the ranking of HBTs than is otherwise currently applied. As advocated by Gibbons & Lindenmayer (2002), the emphasis



**PORT MACQUARIE
HASTINGS**

14. Appendix E: Bat Analysis Report





Bat Call Analysis
Bonny Hills, NSW

This report has been prepared to document the analysis of digital ultrasonic bat echolocation calls received from a third party. The data was not collected by the author and as such no responsibility is taken for the quality of data collection or for the suitability of its subsequent use.

This report was authored by

A handwritten signature in black ink, appearing to read 'Anna McConville'.

Dr Anna McConville
PhD, B.Env.Sc.

Job Reference: BC_FF4
15 September 2015



Bat Call Analysis
Bonny Hills, NSW

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Bat Call Analysis
Bonny Hills, NSW

1.0 INTRODUCTION

This report has been commissioned by FloraFauna Consulting to analyse bat echolocation call data (EM3, Wildlife Acoustics) collected from Bundarra Way, Bonny Hills, NSW. Data was provided electronically to the author. This report documents the methods involved in analysing bat call data and the results obtained only.

2.0 METHODS

The identification of bat echolocation calls recorded during surveys was undertaken using AnalookW (Version 4.1t) software. The identification of calls was undertaken with reference to Pennay *et al.* (2004) and through the comparison of recorded reference calls from north-eastern NSW. Reference calls were obtained from the NSW database and from the authors personal collection.

Each call sequence ('pass') was assigned to one of five categories, according to the confidence with which an identification could be made, being:

- Definite - Pass identified to species level and could not be confused with another species
- Probable - Pass identified to species level and there is a low chance of confusion with another species
- Possible - Pass identified to species level but short duration or poor quality of the pass increases the chance of confusion with another species
- Species group - Pass could not be identified to species level and could belong to one of two or more species. Occurs more frequently when passes are short or of poor quality
- Unknown - Either background 'noise' files or passes by bats which are too short and/or of poor quality to confidently identify.

Call sequences that were less than three pulses in length were not analysed and were assigned to 'Unknown' and only search phase calls were analysed. Furthermore, some species are difficult to differentiate using bat call analysis due to overlapping call frequencies and similar shape of plotted calls and in these cases calls were assigned to species groups.

The total number of passes (call sequences) per unit per night was tallied to give an index of activity.

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Bat Call Analysis
Bonny Hills, NSW

It should be noted that the activity levels recorded at different sites may not be readily able to be compared. Such comparisons are dependent on many variables which need to be carefully controlled during data collection and statistically analysed. Influential variables include wind, rain, temperature, duration of recording, season, detector and microphone sensitivity, detector placement, weather protection devices etc.

2.1 Characteristics Used to Differentiate Species

Miniopterus australis was differentiated from *Vespadelus pumilus*, by characteristic frequency or the presence of a down-sweeping tail on pulses. Call sequences which had a majority of pulses containing an up-sweeping tail were assigned to *Vespadelus pumilus*.

Chalinolobus gouldii was differentiated from other species by the presence of curved, alternating call pulses.

Scotorepens orion, *Scoteanax rueppellii*, *Chalinolobus nigrogriseus* and *Falsistrellus tasmaniensis* were unable to be differentiated from one another.

Chalinolobus morio calls were differentiated from those of *Vespadelus* sp. by the presence of a down-sweeping tail on the majority of pulses.

3.0 RESULTS

A total of 243 call sequences were recorded, of which 102 call sequences were able to be analysed (ie were not 'noise' files or bat calls of short length). Of the bat calls, 29 call sequences (28 %) were able to be confidently identified (those classified as either definite or probable identifications) to species level (Table 3-1). Species recorded confidently within the site include:

- *Chalinolobus gouldii* (Gould's wattled bat)
- *Chalinolobus morio* (Chocolate wattled bat)
- *Miniopterus australis* (Little bentwing bat)
- *Vespadelus pumilus* (Eastern forest bat)

Additionally, the following bat species potentially occurred within the site, but could not be confidently identified (those calls classified as possible or as a species group):

- *Chalinolobus nigrogriseus* (Hoary wattled bat)
- *Falsistrellus tasmaniensis* (Eastern falsistrelle)
- *Miniopterus schreibersii oceanensis* (Eastern bentwing bat)
- *Mormopterus (Ozimops) ridei* (Eastern free-tailed bat)
- *Scoteanax rueppellii* (Greater broad-nosed bat)

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Bat Call Analysis
Bonny Hills, NSW

- *Scotorepens orion* (Eastern broad-nosed bat)
- *Vespadelus darlingtoni* (Large forest bat)
- *Vespadelus regulus* (Southern forest bat)
- *Vespadelus troughtoni* (Eastern cave bat)
- *Vespadelus vulturnus* (Little forest bat)

It should be noted that additional bat species may be present within the site but were not recorded by the detectors and habitat assessment should be used in conjunction with these results to determine the likelihood of occurrence of other bat species.

Table 3-1 below summarises the results of the bat call analysis.



Bat Call Analysis
Bonny Hills, NSW

Table 3-1: Results of bat call analysis (number of passes per site per night)

IDENTIFICATION	EM3 3/08/2015
DEFINITE	
<i>Miniopterus australis</i>	16
PROBABLE	
<i>Chalinolobus gouldii</i>	1
<i>Chalinolobus morio</i>	4
<i>Miniopterus australis</i>	5
<i>Vespadelus pumilus</i>	3
SPECIES GROUPS	
<i>Chalinolobus gouldii</i> / <i>Mormopterus (Ozimops) ridei</i>	1
<i>Chalinolobus morio</i> / <i>Vespadelus pumilus</i> / <i>Vespadelus vulturnus</i> / <i>Vespadelus troughtoni</i>	46
<i>Chalinolobus nigrogriseus</i> / <i>Falsistrellus tasmaniensis</i> / <i>Scotorepens orion</i>	1
<i>Falsistrellus tasmaniensis</i> / <i>Scotorepens orion</i> / <i>Scoteanax rueppellii</i>	2
<i>Miniopterus australis</i> / <i>Vespadelus pumilus</i>	16
<i>Miniopterus schreibersii oceanensis</i> / <i>Vespadelus darlingtoni</i> / <i>Vespadelus regulus</i>	2
<i>Vespadelus pumilus</i> / <i>Vespadelus vulturnus</i> / <i>Vespadelus troughtoni</i>	5
UNKNOWN	
'Noise' files	134
Unknown	7
TOTAL	243



Bat Call Analysis
Bonny Hills, NSW

4.0 SAMPLE CALLS

A sample of the calls actually identified from the site for each species is given below.



Figure 4-1: *Chalinolobus gouldii* probable call

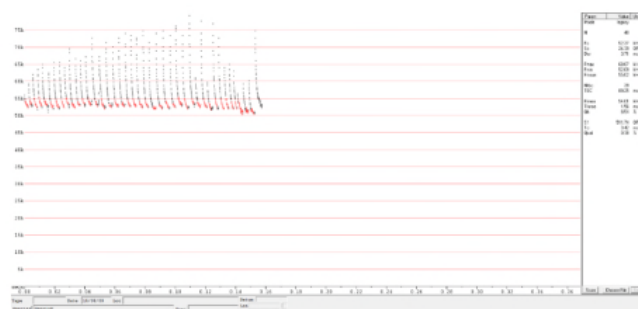


Figure 4-2: *Chalinolobus morio* probable call

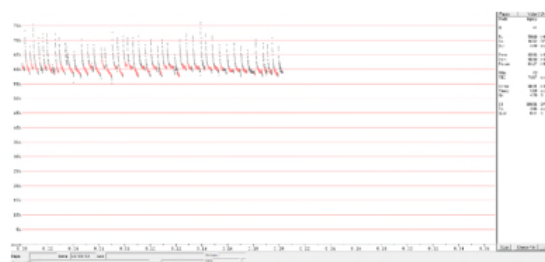


Figure 4-3: *Miniopterus australis* definite call

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Bat Call Analysis
Bonny Hills, NSW



Figure 4-4: *Vespadelus pumilus* probable call

5.0 REFERENCES

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15. Appendix F: Assessments of Significance

F1.1 Listed Threatened Species

Threatened species listed under the *Threatened Species Conservation Act 1995*, which have been recorded within the default 0.1 degree by 0.1 degree (approximately 10 km x 10 km) search area around the study area are shown below in Table F.1. Note the list excludes estuarine and marine species.

Table F.1: Threatened species listed under the TSC Act

Species	Habitat and Distribution	Potential Occurrence
Plantae		
<i>Cynanchum elegans</i> (White-flowered Wax Plant)	Recorded from rainforest gullies scrub and scree slopes (rare); From Wollongong, north to southeast Queensland and west to Mt Danger; Most common in the Kempsey region	Unlikely
<i>Eucalyptus nicholii</i> (Narrow-leaved Black Peppermint)	Sparsely distributed but widespread on the New England Tablelands from Nundle to north of Tenterfield, being most common in central portions of its range. Found largely on private property and roadsides, and occasionally in conservation reserves. Planted as urban trees, windbreaks and corridors; Typically grows in dry grassy woodland, on shallow soils of slopes and ridges	Unlikely
<i>Diuris</i> sp. aff. <i>chrysantha</i> (Byron Bay Diuris)	Known from a single location only, at Byron Bay in north-east NSW where only about 20 plants	Unlikely
Amphibia		
<i>Crinia tinnula</i> (Wallum Froglet)	Found along the coastal margin from Litabella National Park in south-east Queensland to Kurnell in Sydney; Occurs in a range of habitats, usually associated with acidic swamps on coastal sand plains	Unlikely
<i>Litoria aurea</i> (Green and Golden Bell Frog)	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (<i>Typha</i> spp.) or spikerushes (<i>Eleocharis</i> spp.)	Possible
Aves		
<i>Ptilinopus magnificus</i> (Wompoo Fruit-Dove)	Occurs in or near rainforest, low elevation moist eucalypt forest and brush box forests	Unlikely
<i>Ephippiorhynchus asiaticus</i> (Black-necked Stork)	Key habitat in NSW includes floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers; Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries	Possible
<i>Hieraaetus morphnoides</i> (Little Eagle)	Occupies open eucalypt forest and woodland. Sheoak or <i>Acacia</i> woodlands and riparian woodlands of interior NSW are also used; Nests in tall living trees within a remnant patch	Unlikely
<i>Lophoictinia isura</i> (Square-tailed Kite)	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a preference for timbered watercourses; Is a specialist hunter of passerines; Appears to occupy large hunting ranges of more than 100km ²	Possible

<i>Pandion cristatus</i> (Eastern Osprey)	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes; Feed on fish over clear, open water; Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea	Unlikely
<i>Calyptrorhynchus lathamii</i> (Glossy Black-Cockatoo)	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of She-oak occur; <i>Allocasuarina littoralis</i> (Black She-oak) and <i>A. torulosa</i> (Forest Oak) are important food sources	Unlikely
<i>Ninox strenua</i> (Powerful Owl)	Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest; Roosts by day in dense vegetation; Nest in large tree hollows	Unlikely
<i>Tyto novaehollandiae</i> (Masked Owl)	Lives in dry eucalypt forests and woodlands from sea level to 1100 metres; A forest owl, but often hunts along the edges of forests, including roadsides; Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting	Unlikely
<i>Tyto tenebricosa</i> (Sooty Owl)	Occurs in rainforest as well as moist eucalypt forests; Roosts by day in the hollow of a tall forest tree or in heavy vegetation; Nests in very large tree-hollows	Unlikely
<i>Anthochaera phrygia</i> (Regent Honeyeater)	In NSW, the Regent Honeyeater has an area of occupancy of less than 200 km ² (NSW SC 2010) and is now largely absent from many areas where it was formerly recorded. This is most notably the Riverina and South-West Slopes, but also in many areas of the Central-West and North-West Slopes, and on the Central Coast around Sydney; Mostly occur in dry Box-Ironbark eucalypt woodland and dry sclerophyll forest associations in areas of low to moderate relief, wherein they prefer moister, more fertile sites available	Unlikely
<i>Daphoenositta chrysoptera</i> (Varied Sittella)	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and <i>Acacia</i> woodland	Unlikely
<i>Petroica boodang</i> (Scarlet Robin)	Found from southeast Queensland to southeast South Australia, also Tasmania and southwest Western Australia. In NSW, it occurs from the coast to the inland slopes. After breeding, some Scarlet Robins disperse to the lower valleys and plains of the tablelands and slopes; Lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs	Unlikely
Mammalia		
<i>Dasyurus maculatus</i> (Spotted-tailed Quoll)	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest; Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites	Unlikely

<i>Phascogale tapoatafa</i> (Brush-tailed Phascogale)	Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter; Also inhabit heath, swamps, rainforest and wet sclerophyll forest; Agile climber foraging preferentially in rough barked trees of 25 cm DBH or greater	Unlikely
<i>Planigale maculata</i> (Common Planigale)	Inhabits rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water; A fierce carnivorous hunters and agile climbers, preying on insects and small vertebrate	Unlikely
<i>Phascolarctos cinereus</i> (Koala)	Inhabit eucalypt woodlands and forests; Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species	Possible
<i>Petaurus australis</i> (Yellow-bellied Glider)	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils; Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein; Den, often in family groups, in hollows of large trees	Possible
<i>Petaurus norfolcensis</i> (Squirrel Glider)	Inhabits dry sclerophyll forest and woodland, generally absent from rainforest and closed forest; Recorded in a range of vegetation communities, including Blackbutt, Forest Red Gum and Red Bloodwood forests, Coastal Banksia heathland and Grey Gum/Spotted Gum/ Grey Ironbark dry hardwood forests of the Central NSW Coast	Possible
<i>Pteropus poliocephalus</i> (Grey-headed Flying-fox)	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops	Possible
<i>Mormopterus norfolkensis</i> (Eastern Freetail-bat)	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	Possible
<i>Kerivoula papuensis</i> (Golden-tipped Bat)	Found in rainforest and adjacent wet and dry sclerophyll forest up to 1000 m; Also recorded in tall open forest, <i>Casuarina</i> -dominated riparian forest and coastal <i>Melaleuca</i> forest	Possible
<i>Miniopterus australis</i> (Little Bentwing-bat)	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub; Usually in well-timbered areas; Roosts in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings	Possible
<i>Miniopterus schreibersii</i> (Eastern Bentwing-bat)	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures; Hunts in forested areas	Possible
<i>Myotis macropus</i> (Southern Myotis)	Generally, roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface	Possible

<i>Scoteanax rueppellii</i> (Greater Broad-nosed Bat)	Commonly found in tall wet forest but utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest; Usually roosts in tree hollows but it has also been found in buildings	Possible
<i>Vespadelus troughtoni</i> (Eastern Cave Bat)	Very little is known about the biology of this uncommon species; Cave-roosting species that is usually found in dry open forest and woodland	Possible
<i>Pseudomys gracilicaudatus</i> (Eastern Chestnut Mouse)	Mostly found, in low numbers, in heathland (usually dense, wet heath and swamps); Optimal habitat appears to be regenerating heathland burnt from 18 months to four years previously	Unlikely

The list of threatened species returned in the EPBC Act Protected Matters Report where the species or the species habitat is known to occur within the area 10 km buffer around the subject site) is provided below in Table F.2. Note: the list excludes all marine species.

Table F.2: Threatened species returned in the Protected Matters Search Tool Report

Species	Habitat and Distribution	Potential Occurrence
Plantae		
<i>Cynanchum elegans</i> (White-flowered Wax Plant)	Recorded from rainforest gullies scrub and scree slopes (rare); From Wollongong, north to southeast Queensland and west to Mt Danger; Most common in the Kempsey region	Unlikely
<i>Allocasuarina defungens</i> (Dwarf Heath Banksia)	Confined to the north coast region of NSW, between Raymond Terrace and Port Macquarie; Two-thirds of the 31 000 plants known are found near Nahiic; In tall heath on sand, in Nahiic area and farther north in the North Coast region	Unlikely
<i>Acacia courtii</i> (North Brother Wattle)	Usually grows on steep, dry, rocky slopes and in mixed dry forest on shallow soils, often under a canopy of White Mahogany and Grey Gum	Unlikely
<i>Callistemon pungens</i>	Grows in or near rocky watercourses, usually in sandy creek beds on granite or sometimes on basalt; From near Inverell to the eastern escarpment at New England National Park	Unlikely
<i>Hakea archaeoides</i> (Big Nellie Hakea)	Restricted to the hinterland between Kempsey and Taree, around Mt Boss, Broken Bago and Lansdowne; Found on steep, rocky, sheltered slopes and in deep gullies in open eucalypt forest	Unlikely
<i>Melaleuca biconvexa</i> (Biconvex Paperbark)	Generally, grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects; Coastal districts and adjacent tablelands from Jervis Bay north to the Port Macquarie district	Unlikely
<i>Cryptostylis hunteriana</i> (Leafless Tongue-orchid)	Grows in swamp-heath on sandy soils, chiefly in coastal districts, south from the Gibraltar Range; Soils are generally considered to be moist and sandy, however this species is also known to grow in dry or peaty soils	Unlikely

<i>Phaius australis</i> (Lesser Swamp-orchid)	Grows in <i>Melaleuca quinquenervia</i> swamps & in sclerophyll forest, on the coast, at or near sea level; Reported north from Lake Cathie, but chiefly north from the Evans Head district	Possible
<i>Euphrasia arguta</i>	Grows in grassy areas near rivers, recorded from Bathurst to Walcha area (possibly extinct). Historical information suggests the species could be found in open forest in subhumid places or on the grassy country near Bathurst	Unlikely
<i>Arthraxon hispidus</i> (Hairy-joint Grass)	Occurs over a wide area in south-east Queensland and on the northern tablelands and north coast of NSW; uncommon; grows in rainforest	Unlikely
<i>Thesium australe</i> (Austral Toadflax)	Grows in grassland or woodland, often in damp sites; widespread but rare; The species is semi-parasitic on roots of a range of grass species most notably <i>Themeda triandra</i> (Kangaroo Grass)	Unlikely
Amphibia		
<i>Mixophyes balbus</i> (Stuttering Frog)	Typically found in association with permanent streams through temperate and sub-tropical rainforest and wet sclerophyll forest, rarely in dry open tableland riparian vegetation, and in moist gullies in dry forest	Unlikely
<i>Mixophyes iterates</i> (Giant Barred Frog)	Found along freshwater streams with permanent or semi-permanent water, generally (but not always) at lower elevation; Moist riparian habitats such as rainforest or wet sclerophyll forest are favoured for the deep leaf litter that they provide for shelter and foraging, as well as open perching sites on the forest floor	Unlikely
<i>Litoria aurea</i> (Green & Golden Bell Frog)	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (<i>Typha</i> spp.) or spikerushes (<i>Eleocharis</i> spp.)	Unlikely
Aves		
<i>Botaurus poiciloptilus</i> (Australasian Bittern)	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (<i>Typha</i> spp.) and spikerushes (<i>Eleocharis</i> spp.)	Unlikely
<i>Dasyornis brachypterus</i> (Eastern Bristlebird)	Currently confined to three disjoint areas of south-eastern Australia including the NSW/Queensland border, the Illawarra and the NSW/Victorian border; Favours dense low vegetation	Unlikely
<i>Anthochaera phrygia</i> (Regent Honeyeater)	In NSW, the Regent Honeyeater has an area of occupancy of less than 200 km ² (NSW SC 2010) and is now largely absent from many areas where it was formerly recorded. This is most notably the Riverina and South-West Slopes, but also in many areas of the Central-West and North-West Slopes, and on the Central Coast around Sydney; Mostly occur in dry Box-Ironbark eucalypt woodland and dry sclerophyll forest associations in areas of low to moderate relief, wherein they prefer moister, more fertile sites available	Unlikely

<i>Lathamus discolor</i> (Swift Parrot)	Endemic to south-eastern Australia, breeds only in Tasmania and migrates to mainland Australia in autumn; Key habitats for the species on the coast and coastal plains of New South Wales include <i>Corymbia maculata</i> (Spotted Gum), <i>Eucalyptus robusta</i> (Swamp Mahogany), <i>Eucalyptus gummifera</i> (Red Bloodwood) and <i>Eucalyptus tereticornis</i> (Forest Red Gum) forests	Possible
<i>Rostratula australis</i> (Australian Painted Snipe)	The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire	Unlikely
Mammalia		
<i>Dasyurus maculatus</i> (Spotted-tailed Quoll)	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest; Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites	Unlikely
<i>Pseudomys novaehollandiae</i> (New Holland Mouse)	The species is now largely restricted to the coast of central and northern NSW; Deeper top soils and softer substrates being preferred for digging burrows; Inhabit open heathland, open woodland with a heathland understorey and vegetated sand dunes	Unlikely
<i>Phascolarctos cinereus</i> (Koala)	Inhabit eucalypt woodlands and forests; Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species	Possible
<i>Petauroides Volans</i> (Greater Glider)	Occurs in eucalypt forests and woodlands along the east coast of Australia from north east Queensland to the Central Highlands of Victoria; Feeds exclusively on eucalypt leaves, buds, flowers and mistletoe; Shelter during the day in tree hollows and will use up to 18 hollows in their home range; Occupy a relatively small home range with an average size of 1 to 3 hectares	Unlikely
<i>Pteropus poliocephalus</i> (Grey-headed Flying-fox)	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops	Possible
<i>Chalinolobus dwyeri</i> (Large-eared Pied Bat)	The species current distribution is poorly known; Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin; Found in well-timbered areas containing gullies	Unlikely

F1.2 Threatened Species for Consideration

The following Assessment of Significance (Seven-Part Test) relies on the ecological assessment provided in Section 4 and 5 of this report. Based on the plant community and habitat assessment, it is considered that the land within the study area constitutes potential habitat for the following fifteen (15) threatened species (Table F.3). Note: Threatened species of flora have also been considered separately under Section 5.4.

Table F.3: Subject species for Section 5A Assessment (see key below for listings)

Family	Scientific Name	Common Name
Plantae		
Orchidaceae	<i>Phaius australis</i>	Lesser Swamp-orchid
Amphibia		
Hylidae	<i>Litoria aurea</i>	Green and Golden Bell Frog
Aves		
Ciconiidae	<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork
Accipitridae	<i>Lophoictinia isura</i>	Square-tailed Kite
Psittacidae	<i>Lathamus discolor</i>	Swift Parrot
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella
Mammalia		
Phascolarctidae	<i>Phascolarctos cinereus</i>	Koala
Petauridae	<i>Petaurus australis</i>	Yellow-bellied Glider
	<i>Petaurus norfolkensis</i>	Squirrel Glider
Pteropodidae	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox
Molossidae	<i>Mormopterus norfolkensis</i>	Eastern Freetail Bat
Vespertilionidae	<i>Miniopterus australis</i>	Little Bentwing-bat
	<i>Miniopterus schreibersii</i>	Eastern Bentwing-bat
	<i>Myotis macropus</i>	Southern Myotis
	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat
	<i>Vespadelus troughtoni</i>	Eastern Cave Bat

Assessment of Significance

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable population of the species is likely to be placed at risk of extinction:

Plantae

Lesser Swamp Orchid (*Phaius australis*)

The lesser Swamp Orchid has flower stems up to 2 m tall and large broad leaves with a pleated appearance, both arising from a fleshy bulb near ground level. The large, showy flowers, with up to 20 per stem, have four petals which are white on the outside and brown with white or yellow veins on the inside. The central tongue of the flower is pink and yellow with lobes slightly curved inwards.

The species occurs in Queensland and north-east NSW as far south as Coffs Harbour. Historically, it extended farther south, to Port Macquarie. The preferred habitat is swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest,

mostly in coastal areas. The species can only be distinguished from other swamp orchids by characteristics of its flowers. Therefore, surveys for the species can only be undertaken during spring when the Southern Swamp Orchid is flowering.

The Lesser Swamp Orchid is listed as endangered in NSW under the *Threatened Species Conservation Act 1995*. There are no records of the species listed under the Atlas of NSW Wildlife within a 0.1 degree by 0.1 degree search area around the study area.

The remnant swamp forest community within the study area may be suitable habitat for the Lesser Swamp Orchid. The species can only be distinguished from other swamp orchids by characteristics of its flowers, which are present during spring. As the study was conducted during winter it was unlikely that the species could be detected by direct observation of flowers. However, it was possible to target Swamp-orchid species generally, which could inform as to whether further surveys targeting *Phaius australis* would be warranted. Following the targeted survey, it was concluded that the species was unlikely to be present within the study area. Therefore, the action proposed is unlikely to have an adverse effect on the life cycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

Amphibia

Green and Golden Bell Frog

The Green and Golden Bell Frog is a relatively large ranging in size from approximately 45 mm to approximately 100 mm snout to vent length. Diagnostic features are a gold or creamish white stripe running along the side, extending from the upper eyelids almost to the groin, with a narrow dark brown stripe beneath it, from nostril to eye. It also has blue or bluish-green colour on the inside of the thighs. The colour of the body varies. Usually a vivid pea-green, splotted with an almost metallic brassy brown or gold. The backs of some individuals may be almost entirely green; in other individuals golden-brown markings may dominate.

The species was formerly distributed from the NSW north coast near Brunswick Heads, southwards along the NSW coast to Victoria where it extended into east Gippsland with records from west to Bathurst, Tumut and the ACT region. Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range; however, they are widely separated and isolated. Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid-north coast (one an island population). There is only one known population on the NSW Southern Tablelands.

The Green and Golden Bell Frog inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available. The species is active by day and usually breeds during summer when conditions are warm and wet. The Green and Golden Bell Frog is listed as endangered in NSW under the *Threatened Species Conservation Act 1995* and as

vulnerable nationally under the *Environment Protection and Biodiversity Conservation Act 1999*. The Atlas of NSW Wildlife database search indicated two (2) records of the species within a 0.1 degree by 0.1 degree search area around the study area.

The aquatic habitat may provide potential habitat for the Green and Golden Bell Frog, however a population of the alien predatory fish species *Gambusia holbrooki* (Eastern Gambusia or Plague Minnow) was recorded in all components of the aquatic habitat. The presence of Eastern Gambusia is likely to reduce viability of the habitat for amphibian species, particularly for breeding purposes as Eastern Gambusia is known to prey on tadpoles. The Green and Golden Bell Frog was a targeted species in the amphibian survey but was not detected. However, it is noted that although recent rainfall produced conditions that might encourage amphibian species to be active, the cool winter temperatures at the time of the survey are likely to have prevented many amphibians from becoming active.

The aquatic habitat comprised four (4) dams of which three (3) including the large dam located in the southern part of the site will be retained within either the proposed E2/E3 Environmental zone or the vegetated buffer adjacent to the eastern boundary. The dam that is within the development footprint is small and could be readily investigated prior to its removal during appropriate weather/climatic conditions to confirm the presence or absence of the Green and Golden Bell Frog as well as other amphibian species. On this basis, it is unlikely that the action will have an adverse effect on the life cycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

Aves

Black-necked Stork (*Ephippiorhynchus asiaticus*)

The Black-necked Stork is the only species of stork found in Australia. It is a distinctive tall black and white waterbird that is usually seen as a lone individual or in loose pairs. Adults stand 1.3 metres high, with a wingspan of approximately 2 metres and have a massive powerful black beak. The head and neck are black with an iridescent green and purple gloss. The rest of the body is white but the folded wings, which are mostly black largely, cover this. The tail is short and black, and the long legs are orange-red to red. Females have yellow eyes, whereas males have dark-brown eyes.

The Black-necked Stork is widespread in coastal and sub-coastal northern and eastern Australia, although vagrants have been recorded well away from the coast. The species is mainly found on shallow, permanent, freshwater terrestrial wetlands and surrounding marginal vegetation including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters, as well as extending into adjacent grasslands, paddocks and open savannah woodlands. They also forage within or around estuaries and along intertidal shorelines, such as saltmarshes, mudflats and sandflats, and mangrove vegetation. The species mainly forages in shallow, still water preferring open wetlands and taking a variety of prey including fish, frogs, turtles, snakes and small invertebrates such as crabs and insects. In NSW, Black-necked Storks breed in late spring-summer.

The Black-necked Stork is listed as vulnerable in NSW under the *Threatened Species Conservation Act 1995* and nationally under the *Environment Protection and*

Biodiversity Conservation Act 1999. The Atlas of NSW Wildlife database search indicated twenty-two (22) records of the species within a 0.1 degree by 0.1 degree search area around the study area.

The habitat within and adjacent to the larger water body (dam) situated at the eastern perimeter in the southern part of the study area is potential foraging habitat for the Black-necked Stalk. This is part of the proposed residue Lot to be zoned Environmental (E2/E3) and is situated well clear of the proposed development footprint. As there is no direct impact on this part of the study area associated with the proposed development it is unlikely that the action will have an adverse effect on the life cycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

Square-tailed Kite (*Lophoictinia isura*)

The Square-tailed Kite is a medium sized long-winged raptor with a square tail and upturned wings when in flight. Adults have a white face with thick black streaks on the crown and finer streaks elsewhere. The saddle, rump and central upper tail-coverts are blackish with grey-brown barring. The underparts are predominately grey-brown with black tips on the grey tail and wings. There is an obscure bullseye on the wings and when sitting the legs are barely visible. The species is usually silent; however, it may utter a hoarse or plaintive yelp and a weak twitter near its nest.

The species is found in a variety of habitats including open forest, and shows a preference for timbered watercourses. The species is a specialist hunter of passerine birds, especially honeyeaters and appears to occupy large hunting ranges of more than 100 km². Nesting occurs between July and October, with birds constructing a large stick nest lined with eucalypt leaves generally located on a large horizontal branch of a eucalypt 12-26 metres above the ground.

The Square-tailed Kite is listed as vulnerable in NSW under the *Threatened Species Conservation Act 1995*. The Atlas of NSW Wildlife database search indicated eight (8) records of the species within a 0.1 degree by 0.1 degree search area around the study area.

There is limited foraging habitat is available to this species within the study area due its cleared condition and existing development with better quality habitat present on the adjacent land to the west. Therefore, the action proposed is unlikely to have an adverse effect on the life cycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

Swift Parrot (*Lathamus discolor*)

The Swift Parrot is a small parrot about 25 cm long. It is bright green with red around the bill and forehead, red with a yellow edge on the throat, a blue crown and bright red patches under the wing. The species most distinguishing feature however, is its dark red, long thin tail. The Swift Parrot breeds in Tasmania during spring and summer, migrating in the autumn and winter to south-eastern Australia. In NSW, it mainly occurs on the coast and south west slopes.

On the mainland, the Swift Parrot inhabits areas where eucalypts are flowering profusely or where there are abundant lerp infestations. The favoured feed trees are winter flowering species including local species such as *Eucalyptus robusta* (Swamp Mahogany), *Corymbia maculata* (Spotted Gum) and *C. gummifera* (Red Bloodwood). Commonly favoured lerp infested tree species include *E. pilularis* (Blackbutt).

The Swift Parrot is listed as endangered in NSW under the *Threatened Species Conservation Act 1995* and nationally under the *Environment Protection and Biodiversity Conservation Act 1999*. There are no records of the species listed under the Atlas of NSW Wildlife within a 0.1 degree by 0.1 degree search area around the study area.

There is limited foraging habitat available to this species in the canopy of the remnant trees located within the study area. The proposed development will result in a net increase in habitat for this species through revegetation and conservation of the land within the proposed residue lot, which will be zoned Environmental (E2/E3). On this basis it is considered that the action proposed is unlikely to have an adverse effect on the life cycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

Mammalia

Koala (*Phascolarctos cinereus*)

The Koala is an arboreal marsupial that feeds almost exclusively on the foliage of specific Eucalypts. The species has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In NSW, the species mainly occurs on the central and north coast areas. The Koala inhabits eucalypt woodland and forest and are known to feed on the foliage of 70 eucalypts and 30 non-eucalypt species, but typically select preferred browse species, which varies from one area to another. The species is inactive during the day, foraging and feeding by night and occupies a variable home range from less than two hectares up to several hundred hectares in size.

The Koala is listed as vulnerable in NSW under the *Threatened Species Conservation Act 1995* and the Koala (Combined populations of Queensland, New South Wales and the Australian Capital Territory) is listed as a vulnerable species nationally under the *Environment Protection and Biodiversity Conservation Act 1999*. The Atlas of NSW Wildlife database search indicated 463 records of the species within a 0.1 degree by 0.1 degree search area around the study area.

The search results of the Atlas of NSW Wildlife database show a cluster of records near within the Queens Lake State Conservation Area to the west of the site as well as a few records on the land to the north of Houston Mitchell Drive. The survey work undertaken by Phillips et al (2009) in relation to the Area 14 Koala Plan of Management, which was wider ranging than other individual surveys shows clusters of records immediately to the north and southwest of the site and further to the southeast around the Seafront Circuit/Beach Street area. Aerial imagery indicates that the study area is contiguous with forest habitat within the Queens Lake State

Conservation Area, the Queens Lake Nature Reserve and the Queens Lake State Forest.

Six (6) species of trees recorded within the study area are listed as Koala food trees in Table 2.6.1 of the DCP. These included *Eucalyptus microcorys* (Tallowwood), *Eucalyptus robusta* (Swamp Mahogany) and *Eucalyptus tereticornis* (Forest Red Gum), which are listed as primary browse species, *Eucalyptus propinqua* (Small-fruited Grey Gum) and *Eucalyptus globoidea* (White Stringybark), which are listed as secondary/supplementary browse species and *Melaleuca quinquenervia* (Broad-leaved Paperbark), which is listed as other browse species. Many these trees are isolated 'paddock' trees except for the remnant patch of trees located in the northern part of the site, most which will be retained within a proposed public reserve that will be subject to less disturbance associated with human activities than the current situation. Several Koala food trees that are situated in the proposed development footprint however will need to be removed. The removal of these trees will be mitigated through planting replacement trees at a 2:1 ratio within the proposed residue lot in the southern part of the site, which will be zoned Environmental (E2/E3). On this basis, it is considered that the action proposed is unlikely to have an adverse effect on the life cycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

Yellow-bellied Glider (*Petaurus australis*)

The Yellow-bellied Glider is a large, active, sociable and vocal glider. Adults weigh 450 - 700 grams and have a head and body length of about 30 cm with a large bushy tail that is about 45 cm long. The species has grey to brown fur above with a cream to yellow belly, which is paler in young animals. The dark stripe down the back is characteristic of the group. It has a large gliding membrane that extends from the wrist to the ankle. It has a loud, distinctive call, beginning with a high-pitched shriek and subsiding into a throaty rattle.

The Yellow-bellied Glider is found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. The species occurs in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. The Yellow-bellied Glider feeds primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. It extracts sap by incising (or biting into) the trunks and branches of favoured food trees, often leaving a distinctive 'V'-shaped scar. The species lives in small family groups of 2-6 individuals and are nocturnal and usually den in family groups, in hollows of large living trees. The species is very mobile and occupy large exclusive home ranges of 20 – 85 hectares to encompass dispersed and seasonally variable food resources. The Yellow-bellied Glider is listed as vulnerable in NSW under the *Threatened Species Conservation Act 1995*. The Atlas of NSW Wildlife database search indicated that twenty-four (24) records of the species within a 0.1 degree by 0.1 degree search area around the study area including some in the immediate vicinity of the site.

There is limited foraging habitat and some potential denning sites available to the Yellow-bellied Glider in the canopy of the study area. However, the habitat and potential denning sites are unlikely to be utilised by the species due to the site's position in the landscape and the extent of disturbance associated with human activities both within the site and on the adjacent land. Within the site the habitat is highly modified through land clearing. There is also ongoing disturbance occurring in conjunction with management of the site to maintain the derived grassland, and in association with an existing dwelling and trucking operation in the northern part of the site. The site adjoins two (2) major roads; Houston Mitchell Drive in the north and Ocean Drive in the east. The intersection of these roads located adjacent to the northeast corner of the study area has recently been upgraded and is now provided with artificial lighting that spills across the site throughout the night. The recently constructed public school on the land to the east of the site also involved the provision of significant infrastructure, including road upgrading and street lighting, which spills across the study area throughout the night. This development and increasing human activities is likely to discourage the Yellow-bellied Glider and other nocturnal species from utilising the habitat within the study area. It is proposed to mitigate the proposed development of the site by improving the habitat within the residue allotment situated in the southern part of the site through offset planting and revegetation. This will be given certainty in the long-term through zoning the residue lot Environmental (E2/E3). Therefore, it is considered that the action proposed is unlikely to have an adverse effect on the life cycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

Squirrel Glider (*Petaurus norfolcensis*)

The Squirrel Glider is widely, though sparsely, distributed in eastern Australia from northern Queensland to western Victoria. West of the Great Dividing Range, the Squirrel Glider inhabits mature or old growth Box, Box-Ironbark and River Red Gum forest, while in coastal areas the species inhabits Blackbutt-Bloodwood forest with heath understorey, with a preference for mixed species stands having a shrub or Acacia mid-storey. Squirrel gliders live in family groups of a single male, one or more adult females and their offspring. The diet varies seasonally and consists of Acacia gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein. Abundant tree hollows are required for refuge and nest sites. Evidence of gliders utilising the site for foraging purposes was not observed during the site survey. The Squirrel Glider is listed as vulnerable in NSW under the *Threatened Species Conservation Act 1995*. The Atlas of NSW Wildlife database search indicated twelve (12) records of the species within a 0.1 degree by 0.1 degree search area around the study area.

There is limited foraging habitat and some potential denning sites available to the Squirrel Glider in the canopy of the study area. However, the habitat and potential denning sites are unlikely to be utilised by the species due to the site's position in the landscape and the extent of disturbance associated with human activities both within the site and on the adjacent land. Within the site the habitat is highly modified through land clearing. There is also ongoing disturbance occurring in conjunction with management of the site to maintain the derived grassland, and in association with an existing dwelling and trucking operation in the northern part of the site. The site adjoins two (2) major roads; Houston Mitchell Drive in the north and Ocean Drive in the east.

The intersection of these roads located adjacent to the northeast corner of the study area has recently been upgraded and is now provided with artificial lighting that spills across the site throughout the night. The recently constructed public school on the land to the east of the site also involved the provision of significant infrastructure, including road upgrading and street lighting, which spills across the study area throughout the night. This development and increasing human activities is likely to discourage the Squirrel Glider and other nocturnal species from utilising the habitat within the study area. It is proposed to mitigate the proposed development of the site by improving the habitat within the residue allotment situated in the southern part of the site through offset planting and revegetation. This will be given certainty in the long-term through zoning the residue lot Environmental (E2/E3). Therefore, it is considered that the action proposed is unlikely to have an adverse effect on the life cycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

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

The Grey-headed Flying-fox is the largest Australian bat species and is found within 200km of the eastern coast of Australia from Bundaberg in Queensland to Melbourne, Victoria. The species occurs in subtropical and temperate rainforest, tall sclerophyll forest and woodland and individuals travel up to 50 km to feed on the nectar and pollen of native trees, particularly eucalypts, *Melaleuca spp.* and *Banksia spp.* and the fruits of rainforest trees and vines. The Grey-headed Flying-fox is listed as endangered in NSW under the *Threatened Species Conservation Act 1995* and as vulnerable nationally under the *Environment Protection and Biodiversity Conservation Act 1999*. The Atlas of NSW Wildlife database search indicated twenty-eight (28) records of the species within a 0.1 degree by 0.1 degree search area around the study area.

The Grey-headed Flying-fox was observed foraging when the remnant trees in the canopy during the spotlighting survey. Grey-headed Flying-foxes congregate in large numbers at roosting sites (camps) that may be found in rainforest patches, *Melaleuca* stands, mangroves, riparian woodland or modified vegetation in urban areas. However, there were no signs of a camp within the site. The proposed development will result in a net increase in foraging habitat for this species through revegetation and conservation of the land within the proposed residue lot, which will be zoned Environmental (E2/E3). On this basis, it is considered that the action proposed is unlikely to have an adverse effect on the life cycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

Eastern Freetail-bat (*Mormopterus norfolkensis*)

The Eastern Freetail-bat is uniformly rich brown in colour, has a body length of 50-55 mm, a tail length of 35-45 mm and weighs 7-10 grams. The species habitat is poorly known but is believed to occur in a variety of habitats including wet sclerophyll forest, dry sclerophyll forest and woodland east of the Great Dividing Range. The species is believed to be solitary, feeding mostly on insects and roosting mainly in tree hollows.

The Eastern Freetail-bat is listed as vulnerable in NSW under the *Threatened Species Conservation Act 1995*. The Atlas of NSW Wildlife database search indicated three

(3) records of the species within a 0.1 degree by 0.1 degree search area around the study area.

Potential foraging habitat and roosting habitat comprising several hollow-bearing trees is available to this species within study area. Several trees, including one hollow-bearing trees located within the proposed development footprint will need to be removed. It is proposed to mitigate the proposed development of the site by improving the habitat within the residue allotment situated in the southern part of the site through offset planting and revegetation. This will be given certainty in the long-term through zoning the residue lot; Environmental (E2/E3). It is also proposed to offset removal of the hollow-bearing tree by provision of nest boxes specifically targeting Microchiropteran Bats within the Environmental (E2/E3) zoned land as detailed in Section 7 of the report. Therefore, it is considered that the action proposed is unlikely to have an adverse effect on the life cycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

Golden-tipped Bat (*Kerivoula papuensis*)

The Golden-tipped Bat has dark brown, curly fur with bright golden tips that extends along the wings, legs and tail. It has a short, pointed, over-hanging muzzle and pointy, funnel-shaped ears. Adults weigh about 6 grams and have a wingspan of about 25 cm.

The Golden-tipped Bat is distributed along the east coast of Australia in scattered locations from Cape York Peninsula in Queensland to south of Eden in southern NSW and is also found in New Guinea. The species is found in rainforest and adjacent wet and dry sclerophyll forest up to 1000 metres. It is also recorded in tall open forest, *Casuarina*-dominated riparian forest and coastal *Melaleuca* forests. It roosts mainly in abandoned hanging Yellow-throated Scrubwren and Brown Gerygone nests, as well as in tree hollows, dense foliage and epiphytes; located in rainforest gullies on small first-order and second-order streams. The species will fly up to two kilometres from roosts to forage in rainforest and sclerophyll forest on mid and upper-slopes, where it feeds on small web-building spiders. The Golden-tipped Bat is listed as vulnerable in NSW under the *Threatened Species Conservation Act 1995*. The Atlas of NSW Wildlife database search indicated one (1) record of the species within a 0.1 degree by 0.1 degree search area around the study area.

Potential foraging habitat and roosting habitat comprising several hollow-bearing trees is available to this species within study area. Several trees, including one hollow-bearing trees located within the proposed development footprint will need to be removed. It is proposed to mitigate the proposed development of the site by improving the habitat within the residue allotment situated in the southern part of the site through offset planting and revegetation. This will be given certainty in the long-term through zoning the residue lot E3 – Environmental Management. It is also proposed to offset removal of the hollow-bearing tree by provision of nest boxes specifically targeting Microchiropteran Bats within the Environmental (E2/E3) zoned land as detailed in Section 7 of the report. Therefore, it is considered that the action proposed is unlikely to have an adverse effect on the life cycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

Little Bentwing-bat (*Minopterus Australia*)

The Little Bentwing-bat occurs along the east coast of Australia from north-eastern Queensland to the central coast of New South Wales. The species mainly forages for insects between the canopy and understorey of well-timbered habitats including wet and dry sclerophyll forest, woodland, rainforest and coastal swamp forest. The Little Bentwing-bat is regarded as a cave-obligate species that roosts by day in caves, tunnels and mine shafts. Maternity colonies are formed during summer in roost sites with high humidity, which are often shared with the Eastern Bentwing-bat. The Little Bentwing-bat is listed as vulnerable in NSW under the *Threatened Species Conservation Act 1995*. The Atlas of NSW Wildlife database search indicated twenty-five (25) records of the species within a 0.1 degree by 0.1 degree search area around the study area.

This species forages across a wide range of habitats but requires caves, tunnels and mine shafts for roosting. As these types of habitat features are not present within the study area it is unlikely that the species could utilise the habitat for roosting or shelter. The proposed development will result in the retention of foraging habitat for this species within the residue lot, zoned Environmental (E2/E3). It is proposed to mitigate the development of the site by improving the habitat within the residue lot through revegetation and offset planting. On this basis, it is considered that the action proposed is unlikely to have an adverse effect on the life cycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

Eastern Bentwing-bat (*Minopterus schreibersii*)

The Eastern Bentwing-bat occurs in eastern Australia from north Queensland to south-eastern South Australia. In New South Wales, the species is found along the coast and western slopes including high elevations of the Great Dividing Range. The Eastern Bentwing-bat forages for insects mainly above the tree canopy in a range of timbered habitats including rainforest, coastal swamp forest, heathland, woodland and sclerophyll forest. The species is regarded as a cave-obligate, roosting in caves, tunnels, mine shafts and closed stormwater drains. The Eastern Bentwing-bat is listed as vulnerable in NSW under the *Threatened Species Conservation Act 1995*. The Atlas of NSW Wildlife database search indicated three (3) records of the species within a 0.1 degree by 0.1 degree search area around the study area.

This species forages across a wide range of habitats but requires caves, tunnels and mine shafts for roosting. As these types of habitat features are not present within the study area it is unlikely that the species could utilise the habitat for roosting or shelter. The proposed development will result in the retention of foraging habitat for this species within the residue lot zoned Environmental (E2/E3). It is proposed to mitigate the development of the site by improving the habitat within the residue lot through revegetation and offset planting. On this basis, it is considered that the action proposed is unlikely to have an adverse effect on the life cycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

Southern Myotis (*Myotis macropus*)

The Southern Myotis has disproportionately large feet with widely-spaced toes, which are distinctly hairy and with long, curved claws. The species has dark-grey to reddish-

brown fur above and is paler below. It weighs up to 15 grams and has a wingspan of approximately 28 cm.

The Southern Myotis is found along the coastal strip from the northwest of Australia, across northern Australia and south to western Victoria. The species is rarely found more than 100 km inland, except along major rivers. It is always found close to water, from small creeks to large lakes and mangrove-lined estuaries. The species utilises a range of roost sites including caves, mineshafts, culverts, dense foliage and tree hollows in which it roosts in groups of 10-15 individuals. It forages low over water taking flying insects as well as aquatic insects and small fish, which it captures by raking the claws across the water surface. The Southern Myotis is listed as vulnerable in NSW under the *Threatened Species Conservation Act 1995*. The Atlas of NSW Wildlife database search indicated that four (4) records of the species within a 0.1 degree by 0.1 degree search area around the study area.

Potential foraging habitat and roosting habitat comprising several hollow-bearing trees is available to this species within study area. Several trees, including one hollow-bearing trees located within the proposed development footprint will need to be removed. It is proposed to mitigate the proposed development of the site by improving the habitat within the residue allotment situated in the southern part of the site through offset planting and revegetation. This will be given certainty in the long-term through zoning the residue lot E3 – Environmental Management. It is also proposed to offset removal of the hollow-bearing tree by provision of nest boxes specifically targeting Microchiropteran Bats within the Environmental (E2/E3) zoned land as detailed in Section 7 of the report. Therefore, it is considered that the action proposed is unlikely to have an adverse effect on the life cycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

Greater Broad-nosed Bat (*Scoteanax rueppellii*)

The Greater Broad-nosed Bat is a large robust bat with a broad head and short, squarish muzzle. The ears are widely spaced, short and have a rounded apex with a concave rear edge immediately below the apex. The upper parts vary from mid-brown to dark cinnamon-brown and the underparts are tawny-olive in colour.

The species occurs in a range of habitats including cleared grazing land, heathland, coastal swamp forest, woodland, rainforest as well as wet sclerophyll forest and dry sclerophyll forest. The species usually roosts in tree hollows and forages after sunset, flying slowly along watercourses at an altitude of 3 metres to 6 metres. The Greater Broad-nosed Bat is listed as vulnerable in NSW under the *Threatened Species Conservation Act 1995*. The Atlas of NSW Wildlife database search indicated that three (3) records of the species within a 0.1 degree by 0.1 degree search area around the study area.

Potential foraging habitat and roosting habitat comprising several hollow-bearing trees is available to this species within study area. Several trees, including one hollow-bearing trees located within the proposed development footprint will need to be removed. It is proposed to mitigate the proposed development of the site by improving the habitat within the residue allotment situated in the southern part of the site through offset planting and revegetation. This will be given certainty in the long-term through

zoning the residue lot E3 – Environmental Management. It is also proposed to offset removal of the hollow-bearing tree by provision of nest boxes specifically targeting Microchiropteran Bats within the Environmental (E2/E3) zoned land as detailed in Section 7 of the report. Therefore, it is considered that the action proposed is unlikely to have an adverse effect on the life cycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

Eastern Cave Bat (*Vespadelus troughtoni*)

This species remains one of the least known members of its genus in eastern Australia. It is a cave-dweller, known to occur in drier forest and tropical woodland from the coast and Dividing Range to the semi-arid zone. It has been found roosting in small groups in sandstone overhangs, mine shafts and occasionally in buildings. The Eastern Cave Bat is listed as vulnerable in NSW under the *Threatened Species Conservation Act 1995*. The Atlas of NSW Wildlife database search indicated four (4) records of the species within a 0.1 degree by 0.1 degree search area around the study area.

This species forages across a wide range of habitats but requires caves, tunnels and mine shafts for roosting. As these types of habitat features are not present within the study area it is unlikely that the species could utilise the habitat for roosting or shelter. The proposed development will result in the retention of foraging habitat for this species within the residue lot zoned Environmental (E2/E3). It is proposed to mitigate the development of the site by improving the habitat within the residue lot through revegetation and offset planting. On this basis, it is considered that the action proposed is unlikely to have an adverse effect on the life cycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable population of the species is likely to be placed at risk of extinction:

The Koala (Combined populations of Queensland, New South Wales and the Australian Capital Territory)

This population has been listed as vulnerable under the EPBC Act as it has undergone a substantial decline over three generations due to a combination of several factors including loss and fragmentation of habitat, vehicle strike, disease and predation by dogs.

The Atlas of NSW Wildlife database search returned 463 records of the Koala within a 0.1 degree by 0.1 degree search area around the study area. This indicates that there is a local Koala population in the search area. The survey work undertaken by Phillips et al (2009) in relation to the Area 14 Koala Plan of Management, which was wider ranging than other individual surveys in the area shows clusters of records immediately to the north and southwest of the site and further to the southeast around the Seafront Circuit/Beach Street area. Aerial imagery indicates that the study area is contiguous with forest habitat within the Queens Lake State Conservation Area, the Queens Lake Nature Reserve and the Queens Lake State Forest. Advice received from the Koala Hospital at Port Macquarie indicates that there have been several Koala rescues

undertaken in the Bonny Hills area. Most these rescues were associated with vehicle strikes on Ocean Drive near the headland near the local fuel station/general store within the village to the south of the study area. There have also been a small number of rescues of sick Koalas from the Panorama Drive area as well.

The entire habitat within the study area was investigated. This included searching the site for actual Koala sightings as well as searching for Koala scats at the base of all trees within the study area and looking for other indicators such as scratch marks on tree trunks. No Koala scats were found; however, it was impossible to draw any conclusions from this alone given the recent heavy rain associated with the intense east coast low pressure system and extent of subsequent surface water within the site. Several trees showed signs of Koala activity, including scratches consistent with those made by Koalas on the trunk of a Forest Red Gum tree located near the eastern boundary adjacent to the larger dam within the site and disturbed bark on the trunks of four (4) Tallowwood trees located adjacent to the western boundary of the site. Five (5) species of Koala food tree as listed under the Recovery Plan for the Koala (DECC, 2008) were recorded within the study area. These included three (3) primary Koala food tree species; *Eucalyptus microcorys* (Tallowwood), *Eucalyptus robusta* (Swamp Mahogany) and *Eucalyptus tereticornis* (Forest red Gum), and two (2) secondary/supplementary Koala food tree species; *Eucalyptus propinqua* (Small-fruited Grey Gum) and *Eucalyptus globoidea* (White Stringybark)). An additional species; *Melaleuca quinquenervia* (Broad-leaved Paperbark) is listed as an 'other' browse species under the DCP.

Based on the EPBC Act Referral Guidelines Koala habitat assessment tool score of 8, the habitat within the study area may contain habitat critical to the species survival for the purposes of the EPBC Act. As per the DCP, removal of Koala food trees from the site will be offset by a compensatory replanting strategy at a ratio of two (2) replacement trees for each primary Koala food tree that is removed. All such replacement trees will be planted within the proposed E3 zoned residue lot located in the southern part of the site, resulting in a net increase in suitable habitat with direct connectivity to other suitable existing forest habitat within the Queens Lake Nature Reserve adjoining the western boundary of the site. On this basis, it is considered that the action is unlikely to have an adverse effect on the life cycle of this species such that a viable population of the species is likely to be placed at risk of extinction.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction;

Remnants comprising isolated 'paddock' trees situated within the central parts of the site were indicative of a swamp forest community that likely occurred prior to land clearing. However, this part of the site is essentially a derived grassland and is not mapped under the Port Macquarie-Hastings Council vegetation community mapping. On this basis, no endangered ecological community was recorded within the study area (proposed development site) during the field survey for the purposes of the assessment of significance.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;

Remnants comprising isolated 'paddock' trees situated within the central parts of the site were indicative of a swamp forest community that likely occurred prior to land clearing. However, this part of the site is essentially a derived grassland and is not mapped under the Port Macquarie-Hastings Council vegetation community mapping. On this basis, no endangered ecological community was recorded within the study area (proposed development site) during the field survey for the purposes of the assessment of significance.

d) In relation to the habitat of a threatened species, population or ecological community:

(i) The extent to which habitat is likely to be removed or modified as a result of the action proposed;

The habitat within the study area (proposed development site) is a highly disturbed habitat, largely comprising a derived grassland with remnant trees. The habitat to be removed or modified because of the proposed action comprises a small number of trees, which will be offset through compensatory plantings within an E3 zoned residue lot. Therefore, the habitat likely to be removed or modified because of the action proposed is not considered to be significant with respect to a threatened species, population or ecological community.

(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action;

The habitat within the study area (proposed development site) has been previously cleared of native for a considerable number of years. The proposed action is unlikely to fragment habitat areas or isolate habitat areas from other areas of habitat. The site is located adjacent to extensive areas of forest habitat reserved within the Queens Lake Nature Reserve adjoining the western boundary of the site. It is proposed to undertake revegetation of the land within an E3 zoned residue lot located in the southern part of the site, resulting in a net increase in natural habitat with direct connectivity to the Queens Lake Nature Reserve.

(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

The habitat within the study area (proposed development site) to be removed, modified, fragmented or isolated is a highly disturbed habitat, largely comprising a derived grassland with remnant trees. It is proposed to undertake revegetation of the land within an E3 zoned residue lot located in the southern part of the site, resulting in a net increase in natural habitat with direct connectivity to the Queens Lake Nature Reserve. Therefore, the habitat within the proposed development footprint is not considered to be important to the long-term survival of any species, population or ecological community in the locality.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly):

The EPBC Act Koala Guideline habitat assessment tool score indicated that the study area may contain habitat critical to the Koala's survival. However, further assessment under the Guideline indicated that the study area is unlikely to contain habitat critical to the species survival. The habitat within the study area contains food resources for the Koala, however as the amount of proposed clearing is less than two (2) hectares, referral to the Department of the Environment for adversely affecting habitat critical to the survival of the Koala is not required. As per the DCP, removal of Koala food trees from the site will be offset by a compensatory replanting strategy at a ratio of two (2) replacement trees for each Koala browse tree (as listed in Table 2.6.1 of the DCP) that is removed. All such replacement trees will be planted within the proposed E3 zoned residue lot located in the southern part of the site, resulting in a net increase in suitable habitat with direct connectivity to other suitable existing forest habitat within the Queens Lake Nature Reserve adjoining the western boundary of the site.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan:

There is a recovery plan in place for the Koala. Mitigation measures are proposed in Section 7 of this report to offset removal of the trees within the study area. As per the DCP, removal of Koala food trees from the site will be offset by a compensatory replanting strategy at a ratio of two (2) replacement trees for each Koala browse tree (as listed in Table 2.6.1 of the DCP) that is removed. All such replacement trees will be planted within the proposed E3 zoned residue lot located in the southern part of the site, resulting in a net increase in suitable habitat with direct connectivity to other suitable existing forest habitat within the Queens Lake Nature Reserve adjoining the western boundary of the site. On this basis, it is considered that the action proposed is consistent with the objectives or actions of the aforementioned recovery plan.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of a key threatening process:

Key threatening processes (KTPs) are listed in Schedule 3 of the TSC Act. Those considered to be applicable to the proposed development are:

Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners (Manorina melanocephala):

In NSW the Noisy Miner is found throughout the coastal plains, foothills, ranges and tablelands (up to 1200 metres), as well as on the inland slopes and plains of the semi-arid zone, favouring open, lightly timbered areas and habitat edges and so has benefitted from the large-scale vegetation changes that accompanied the European settlement of Australia. This includes clearing of forest and woodland, fragmentation of forest and woodland and reduction of understory vegetation by livestock grazing, invasion of exotic grasses, altered fire regimes and parkland clearing.

The removal of vegetation within the study area has the potential to create conditions that suite the Noisy Miner. However, it is noted that such conditions already exist in

association with the current residential use of the adjacent land and that a significant population of the species is already occupying the site. Therefore, this KTP is already in play. The revegetation of the E2/E3 environmental management zoned land in the southern part of the site and restoration of the understorey and groundcover within the proposed E2/E3 environmental management land in the northern part of the site will lead to the formation of a more natural forest habitat that is less likely to be suitable habitat for the Noisy Miner and will help to reduce its distribution within the local area.

Anthropogenic Climate Change:

The use of machinery and power tools during any future earthworks or mining activities will contribute to anthropogenic climate change through release of stored carbon from vegetation and greenhouse gas emissions associated with use of fossil fuels. However, the overall impact of the action is considered negligible in the context of other human activities in the region.

Clearing of native vegetation:

Clearing refers to the destruction of a sufficient proportion of one or more strata within native vegetation. There are numerous impacts because of clearing native vegetation, including:

- Destruction of habitat causing a loss of biological diversity, and may result in total extinction of species or loss of local genotypes;
- Fragmentation of populations resulting in limited gene flow between small isolated populations, reduced potential to adapt to environmental change and loss or severe modification of the interactions between species;
- Riparian zone degradation, such as bank erosion leading to sedimentation that affects aquatic communities;
- Disturbed habitat which may permit the establishment and spread of exotic species which may displace native species; and
- Loss of leaf litter, removing habitat for a wide variety of vertebrates and invertebrates.

Given the extent of clearing that currently exists within the development site and the proposed revegetation of the land within the E3 zoned residual lot it is considered unlikely that the proposed development will contribute significantly to this KTP.

Invasion, establishment and spread of Lantana (*Lantana camara*):

Lantana has significant adverse effects on biodiversity. It typically forms dense thickets, suppressing native vegetation and seedlings through shading, nutrient competition, smothering and allelopathy (chemically suppresses the germination and/or growth of other plant species). Lantana readily invades disturbed sites and communities, including edges and canopy breaks in dense forest communities. In open forests and woodlands Lantana often becomes a dominant understorey species. In warmer, moister areas Lantana often becomes dominant in regenerating pastures. In NSW, Lantana has been identified as a threat to numerous threatened species of flora, at least two threatened species of fauna and several endangered ecological communities. Lantana was recorded in low abundance within the study area. The proposed development is unlikely to significantly contribute to further invasion of the

site by Lantana. The proposed development of the site and recommended weed control will help to mitigate this KTP.

Invasion of native plant communities by (Chrysanthemoides monilifera):

Two subspecies are recognised:

- *Chrysanthemoides monilifera* subsp. *monilifera* (Boneseed); and
- *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush).

Both species are invasive and are known to invade and displace native plants. Boneseed is the less important of the two weeds in New South Wales but it has the potential to be a serious threat to inland areas in the future if it is left uncontrolled. Bitou Bush was first recorded in New South Wales in 1908 near Newcastle, and between 1946 and 1968 was planted for dune stabilisation at numerous locations along the New South Wales coastline. It has spread rapidly from these plantings and is now found along 80 % of the coastline, covering more than 900 kilometres. Neither species was recorded within the study area during the field survey but *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush) is common and widespread throughout the local area. While the proposed development is unlikely to significantly contribute to invasion of the site by these weeds, the presence of Bitou Bush in the local area means the habitat within the site is vulnerable. Weed control has been recommended in Section 7 of this report.

16. Appendix G: AHIMS Report



Office of
Environment
& Heritage

AHIMS Web Services (AWS) Search Result

Purchase Order/Reference : EA-2015-1611

Client Service ID : 230289

Steve Britt
PO Box 3212
West Kempsey New South Wales 2440
Attention: Steve Britt
Email: steve@florafauna.com.au

Date: 17 June 2016

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lot : 10, DP:DP615775 with a Buffer of 50 meters, conducted by Steve Britt on 17 June 2016.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *