JWA PTY LTD
Ecological Consultants
ABN 56 066 448 879

FLORA AND FAUNA ASSESSMENT

'The Glades'
(Lots 1 & 2 DP 725785)
Pacific Highway, Moonee

A Report Prepared for
Rothwell Boys Pty Ltd

FEBRUARY 2018

NEW SOUTH WALES
8/48 Tamar Street (PO Box 1465) Ballina NSW 2478
p 02 6686 3858 • **f** 02 6681 1659 • **e** ballina@jwaec.com.au

QUEENSLAND
Suite C, Building 21 Garden City Office Park, 2404 Logan Road, Eight Mile Plains QLD 4113
p 07 3219 9436 • **f** 07 3423 2076 • **e** brisbane@jwaec.com.au

www.jwaec.com.au

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1 INTRODUCTION

1.1 Background

JWA Pty Ltd have been engaged by Rothwell Boys Pty Ltd (Rothwell Boys) to complete a Flora and Fauna Assessment for part of 'The Glades' development site (Lots 1 & 2 DP 725785) at Moonee. The Subject site is a 1.75 ha of land within the central portion of The Glades development.

A Flora and Fauna Assessment was completed for The Glades site in 2007 (JWA 2007) to accompany a Development Application.

It is understood that Rothwell Boys propose to lodge an application (75W modification application) seeking to modify Project Approval 06-0143 issued by the Minister for Planning on 5th March 2009, to include additional residential subdivision over 1.75 ha of land within the central portion of The Glades development (i.e. the Subject site). The current report is an amended and updated version of the Flora and Fauna Assessment prepared by JWA in 2007 and includes additional field surveys and an impact assessment for the proposed additional allotment layout.

This assessment has involved the following:

- Mapping and ground truthing vegetation units and determining their conservation status with reference to the Comprehensive Regional Assessment completed for NSW Forest and Non-forest ecosystems as part of the Regional Forestry Agreement (RFA) process (CRA Unit 1999), and with reference to the vegetation of the Coffs Harbour City Council LGA (Fisher, Body and Gill 1996) and the Coffs Harbour Vegetation Management Strategy (Ecograph 2002);
- Searching for and recording Threatened (*TSC Act 1995*), ROTAP (Briggs & Leigh 1996) and regionally significant plant species (Sheringham & Westaway 1995), and assessing the occurrence of Endangered Ecological Communities (EECs);
- Determining the suite of Threatened fauna (*TSC Act 1995*) that occurs in the locality and assessing their potential occurrence on the Subject site;
- Completion of a detailed fauna survey program;
- Assessing habitat provided by the Subject site in relation to adjacent habitat and making an assessment of the corridor value of the Subject site; and
- Addressing statutory requirements including *State Environmental Planning Policy No. 44 (SEPP 44 – Koala Habitat Protection)*, Section 5A of the *Environmental Planning & Assessment Act (1979)* and the *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

1.2 Locality

1.2.1 Introduction

The Locality is defined as the area within a 10km radius of the Subject site. The Locality therefore extends from Coffs Harbour in the south to Woolgoolga in the north and from Mt Coramba in the west to the coastline in the east (**FIGURE 1**).

Prominent features in the locality include the towns of Coffs Harbour, Woolgoolga and Moonee Beach, the coastline, Moonee Creek and its tributaries and Moonee Beach Nature Reserve.

Dominant habitat types are eucalypt forest, swamp sclerophyll forest and intertidal communities. Land uses within the locality include forestry, tourism, grazing, conservation and agriculture.

There are four (4) dedicated conservation reserves in the locality:

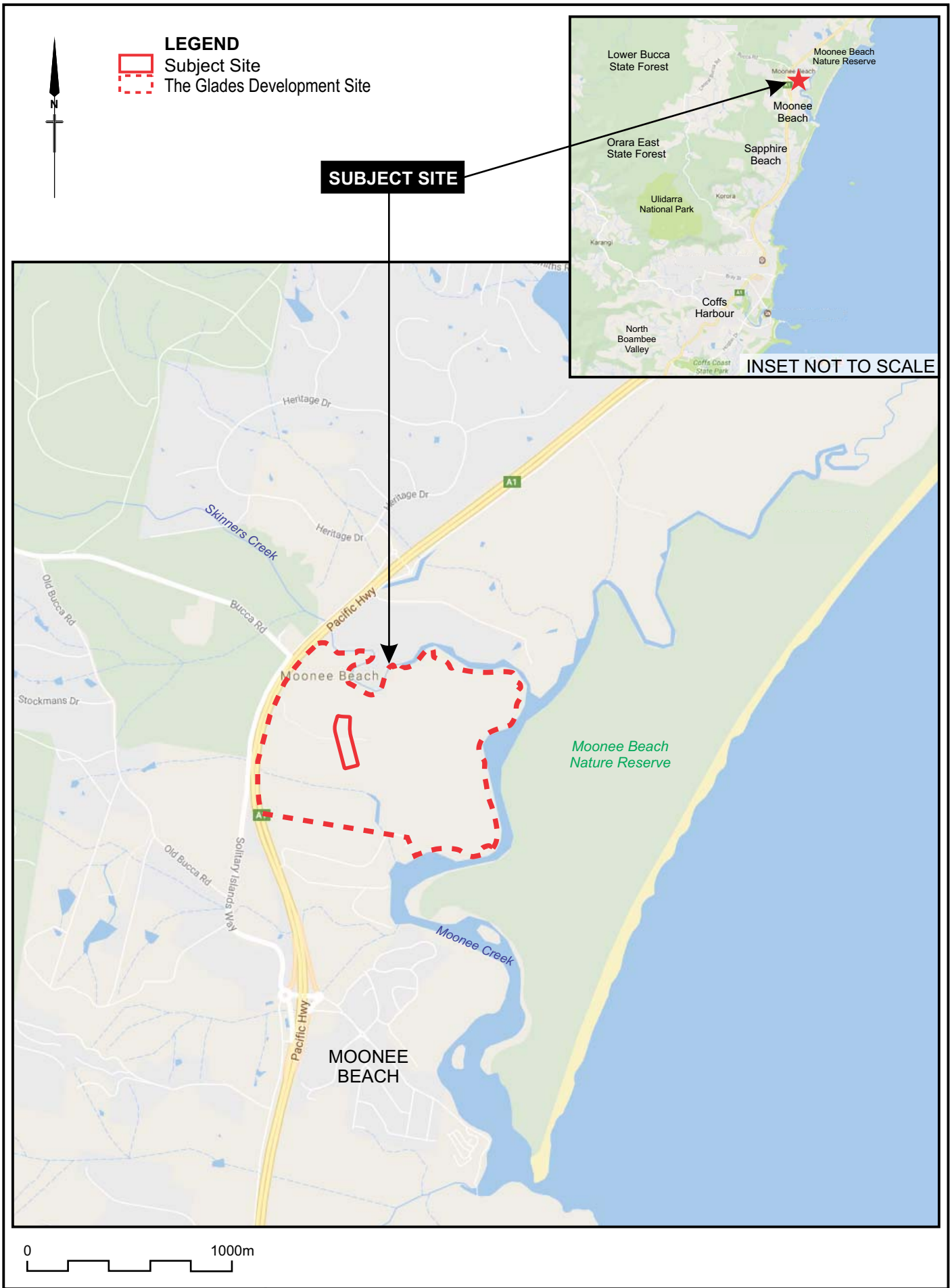
- Moonee Beach Nature Reserve, an area of 336 hectares immediately east of the Subject site;
- Ulidarra National Park, an area of 680 hectares to the south-west of the Subject site;
- Bruxner Park Flora Reserve, an area of 407 hectares adjoining Ulidarra National Park; and
- Kororo Nature Reserve, an area of 11 hectares south of the Subject site.

State Environmental Planning Policy (SEPP) 14 wetland number 318 occurs to the north of the Subject site, while SEPP 14 wetland number 319 is located about 2km to the south-east of the Subject site, to the south of the Moonee Creek estuary (**FIGURE 2)**.

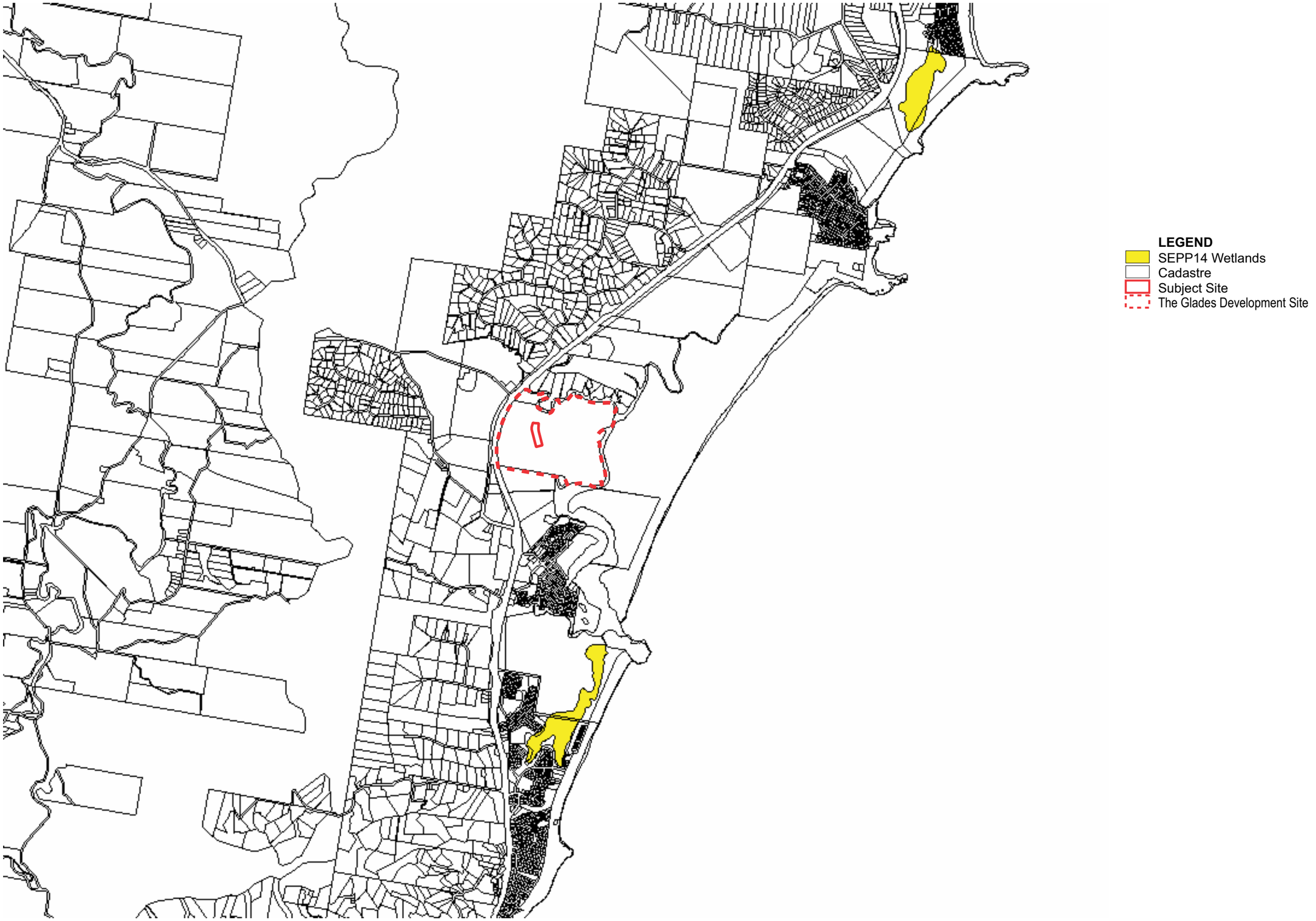
A small area of SEPP (State Environmental Planning Policy) 26 Littoral Rainforest occurs to the south of the Subject site between Digger's Head and White Bluff as SEPP 26 number 68B (**FIGURE 3**).

1.2.2 The Subject Site

The Subject site consists of part of Lots 1 & 2 in DP 725785 Pacific Highway, Moonee. The Subject site, in accordance with the definition provided in the Threatened Biodiversity Survey Assessment (TBSA) Guidelines (DECC 2004a), represents areas that are directly affected by the proposed development. The Subject site therefore covers an area of approximately 1.75 hectares, much of which is comprised of advanced native regrowth vegetation (**FIGURE 4**). The subject site occurs as a narrow finger of vegetation that extends along the ridgeline in the central part of The Glades development. The Subject site was originally apart of the approved The Glades development as a retained open space area.



SOURCE: Google Maps SCALE: 1 : 25 000 @ A4 JWA PTY LTD Ecological Consultants	CLIENT Rothwell Boys Pty Ltd PROJECT Flora & Fauna Assessment Lots 1 & 2 DP725785 Pacific Highway, Moonee NSW Coffs Harbour City Council LGA	**FIGURE 1** PREPARED: BW DATE: 16 October 2017 FILE: N02066_Locality.cdr	TITLE **LOCALITY PLAN**



SOURCE: Coffs Harbour City Council Online Mapping Tool accessed 05/04/17

SCALE: 1 : 40 000 @ A3

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FIGURE 2

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TITLE

SEPP 14 WETLANDS

SOURCE: Coffs Harbour City Council Online Mapping Tool accessed 05/04/17

SCALE: 1 : 40 000 @ A3

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FIGURE 3

PREPARED: BW
DATE: 16 October 2017
FILE: N02066_SEPP26.cdr

TITLE

SEPP 26 LITTORAL RAINFOREST

LEGEND
Subject Site
The Glades Development Site

0 150m
1 : 5000

SOURCE: Google Earth June 2016 Aerial Photo

SCALE: 1 : 5000 @ A3

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FIGURE 4

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AERIAL PHOTOGRAPH

The Subject site and the adjoining approved development is bordered by Moonee Creek to the east and the Pacific Highway to the west. Land to the north of the Subject site is generally cleared but includes isolated trees and vegetation. Land to the south is characterised by open eucalypt forest with a largely cleared midstorey. The Subject site is shown in **FIGURE 4**.

1.3 Soils and Geology

Soils on the Subject site are part of the Newports Creek type, characterised by low, level to gently undulating coastal back barrier floodplains on Pleistocene estuarine sediments. Soils are deep, poorly drained Yellow Podzolics and Humic Gleys (DLWC 1999).

1.4 The Proposed Development

The approved development (Project Approval 06-0143) issued by the Minister for Planning on 5th March 2009 (**FIGURE 5**) consists of a fifteen (15) stage residential development with a total of 524 lots. Rothwell Boys now propose to lodge an application to modify the Project Approval to remove an open space area located between residential precincts 1 and 2 (**FIGURE 5**) (i.e. the Subject site), which covers a total of 1.747 ha, in order to create an additional thirty-one (31) residential allotments (**FIGURE 5**).

1.5 Literature Review

A number of Flora and Fauna Reports and other sources of information were reviewed in the course of this assessment. These include:

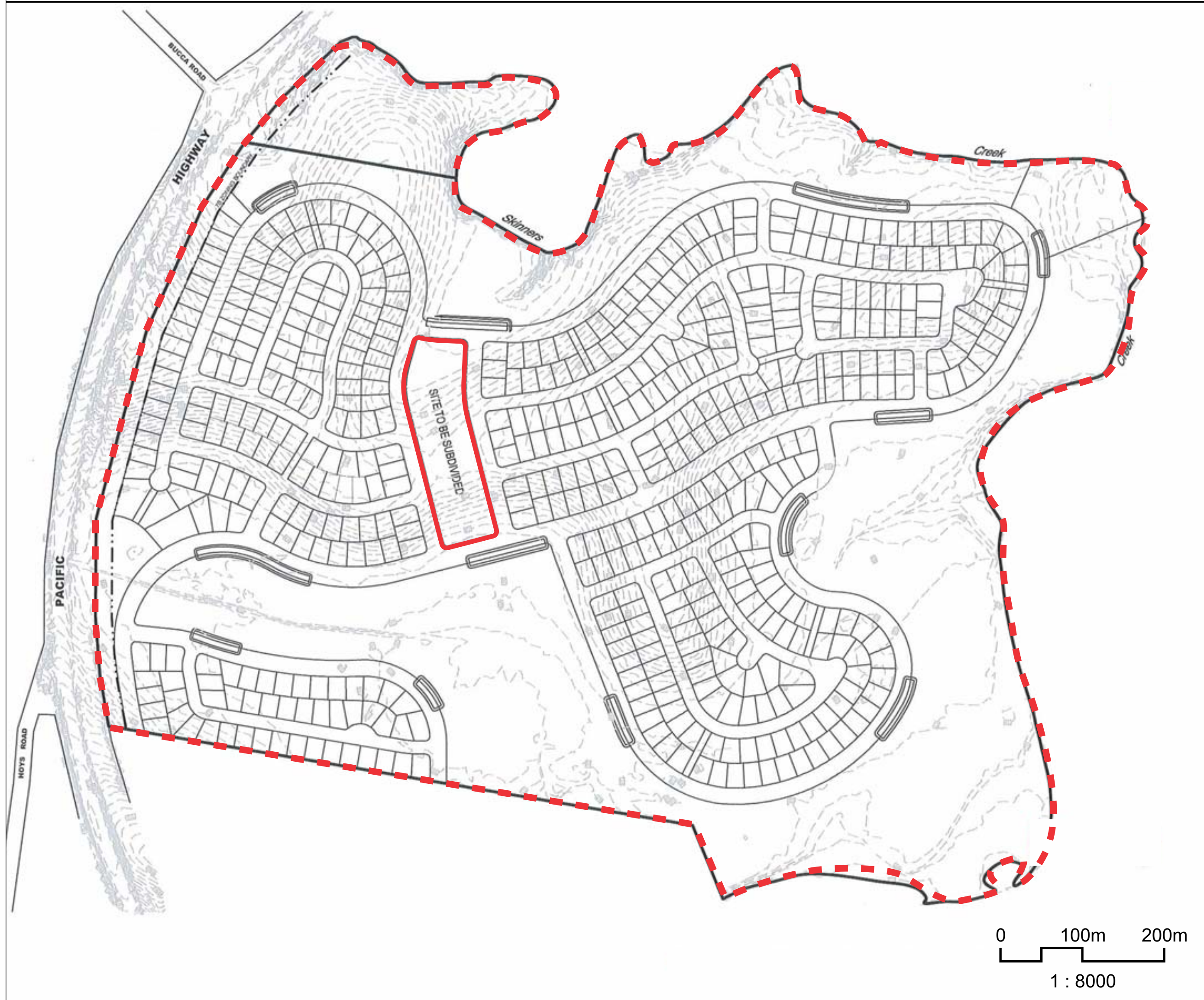
- Anne Harrison (2005) Landscape Concept & Open Space Management Plan for Lot 1 & 2 DP725785 Pacific Highway Moonee.
- Clancy, G.P. & V.A. (1998) Flora and Fauna Assessment Moonee Release Area. A report prepared for Coffs Harbour City Council.
- DLWC (1999) Soil landscape series sheet 9537 Coffs Harbour.
- JWA (2000) Flora and Fauna Assessment. Heritage Park, Moonee.
- JWA (2003a) Preliminary study. Lots 1 & 2 DP 725785, Pacific Highway, Moonee.
- JWA (2003b) Flora and Fauna Assessment. Lot 122 DP 1052566 Moonee Beach Road, Moonee.
- JWA (2004a) Wallum Froglet Assessment. Lots 1 & 2 DP 725785, Pacific Highway, Moonee.
- JWA (2004b) Flora and Fauna Assessment. Lots 6 & 7 DP 252223, Pacific Highway, Moonee.
- Moonee Development Control Plan (2004) Coffs Harbour City Council.
- NPWS Atlas of NSW Wildlife records. Moonee Beach Nature Reserve.
- NPWS Atlas of NSW Wildlife records. Coffs Harbour Local Government Area.
- WBM Oceanics (2005) Moonee Creek Estuary Processes Study.

LEGEND

Subject Site

The Glades Development Site

INSET - APPROVED GLADES DEVELOPMENT SITE



SOURCE: RDM dwg no. 16083-1 & 16083-2 dated 12/10/17 (Ref: 20171013070442509.pdf)

SCALE: 1 : 1250 @ A3

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FIGURE 5

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TITLE

PROPOSED DEVELOPMENT LAYOUT

2 FLORA ASSESSMENT

2.1 Introduction

This section discusses the methods used in the vegetation assessment and presents the results of the assessment.

2.2 Methods

2.2.1 Desktop Review

The following databases were reviewed as part of the desktop assessment to find records of State and Commonwealth Threatened species[1] within 10km of the Subject Site:

- the Commonwealth *Environment Protection Biodiversity and Conservation (EPBC) Act* (*1999*) Protected Matters Search Tool (PMST) (Dept. Environment 2013); and
- Atlas of NSW Wildlife (OEH 2016) database.

2.2.2 Site Surveys

2.2.2.1 Introduction

This section describes the methodology used during the site surveys, including identification of vegetation communities, assessing weed status and conservation value of vegetation communities and mapping of threatened flora species and Endangered Ecological Communities (EECs).

The Glades development, including the Subject site, was originally inspected between the 10th and 14th of May 2004 when it was comprehensively surveyed and a general plant species list was compiled. An additional survey was completed on the 23rd and 24th of September 2004 to target Threatened orchid species considered possible occurrences on The Glades development site.

The previously mapped vegetation communities (JWA 2007) were ground-truthed on the 29th March 2017, and 14th and 15th November 2017, and the mapping updated to reflect the current vegetation composition and status.

An assessment of the impact site and potential revegetation/offset sites utilising the BioBanking Assessment Methodology (BBAM) was completed at the Subject site between the 14th and 15th November 2017.

2.2.2.2 Rationale

The Department of Environment and Conservation (NSW) (now OEH) prepared a Working Draft of the Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities in 2004 (Draft Guidelines). The Draft Guidelines provide suggested survey

[1] As listed within schedules of the *TSC Act (1995)* and *EPBC Act (1999).*

methods and effort when undertaking flora and fauna surveys in NSW. In relation to vegetation surveys the Draft Guidelines note that:

> *"To survey the vegetation of a study area[2] several different techniques can be employed – which techniques are employed may depend on the size and characteristics of the study area."*

These techniques may include:

- Transects - Transects (or traverses) are valuable for obtaining an understanding of the vegetation communities in the area, identifying community boundaries and recording species (Forest Animal Surveys *et al*. 1997). A variation on the transect type survey is the random meander method (discussed below); and
- Plot-based (or Quadrat) Surveys - The typical dimensions of a plot are 20 metres by 20 metres, however where vegetation occupies a linear space, the plot shape can be changed to fit within the vegetation type as long as the total area remains the same.

The DRAFT Guidelines also state that:

> *"Defining a minimum level of survey effort is complicated by factors such as individual characteristics of the area or vegetation communities, and the time and budget of studies".*

In relation to Threatened flora species, the DRAFT Guidelines note that:

> *"In conducting a vegetation survey, threatened biodiversity may be identified during transect or plot surveys or by opportunistic observations such as walking or driving between sampling sites. Depending on the aims of the study, targeted surveys may be conducted for threatened biodiversity considered likely to occur in the locality. If this is the case, targeted searches should be carried out in areas of preferred habitat for these species".*

2.2.2.3 Vegetation Community Mapping

A survey plan showing the distribution of the vegetation communities was produced by surveying the drip line of all vegetation occurring on The Glades development site, with the assistance of aerial photography, during the 2004 surveys. The plan was then ground truthed by JWA during the 2017 surveys, with a particular focus on the Subject site. The vegetation communities were identified and described with reference to the Walker & Hopkins (1990) vegetation classification system. All vegetation was assessed, with particular attention given to areas of high diversity and structural complexity (i.e. rainforest and swamp sclerophyll communities). Rare and threatened flora, known to occur in the area were targeted and mapped during the site assessments. The vegetation community number/description for The Glades development were retained for the Subject site for consistency.

[2] The "study area" for this assessment included the entire Subject site.

2.2.2.4 Identification of Endangered Ecological Communities (EECs)

Endangered Ecological Communities (EECs) were identified by JWA with reference to the EEC listings for the North Coast Bio-region and the final determinations from the scientific committee (OEH 2016).

2.2.2.5 Weed Status

The status of weed infestation, within each vegetation community, was assessed during the 2004 and 2017 surveys. The condition was based on the percentage cover of exotic species to total cover, in the canopy, mid-storey and ground cover. Weed status was categorised as follows:

- 0-30% cover of exotics - weed status was categorised as low;
- 30-50% cover of exotic species - weed status was categorised as medium; and
- exotic species exceeding 50% cover - weed status was categorised as high.

2.2.2.6 Assessment of Conservation Value

The conservation value of plant communities on the Subject site was determined with reference to:

- Regional Forestry Agreement (RFA). A Comprehensive Regional Assessment completed of NSW Forest and Non-forest ecosystems (CRA Unit 1999). The RFA establishes the framework for the management of the forests of upper northeast and lower northeast regions. The RFA document sets out percentage reservation status of forest and non-forest ecosystems in the CRA Reserve System based on vegetation modelling to establish the pre-1750 extent of forest ecosystems in the region; and
- Threatened Species Conservation Act (TSC 1995). This act provides protection for the listed Endangered Ecological Communities and threatened flora.

Conservation value categories and the criteria used to determine these categories are summarised in **TABLE 1**.

TABLE 1
CONSERVATION VALUE CATEGORIES AND CRITERIA

Conservation value	Criteria
Low	Generally pasture grassland, highly disturbed/exotic vegetation, crops
Low - Medium	Scattered native trees within grassland, disturbed/exotic vegetation
Medium	Disturbed/fragmented native vegetation with a Medium presence of Camphor laurel

Conservation value	Criteria
Medium - High	Native vegetation with a lower occurrence of Camphor laurel, tending to be larger and less disturbed, containing ROTAP or threatened flora species. Potential to be categorised as an Endangered Ecological Community.
High	Larger areas of native vegetation with little Camphor laurel, containing threatened species and/or containing characteristics indicative of an Endangered Ecological Community (EECs).

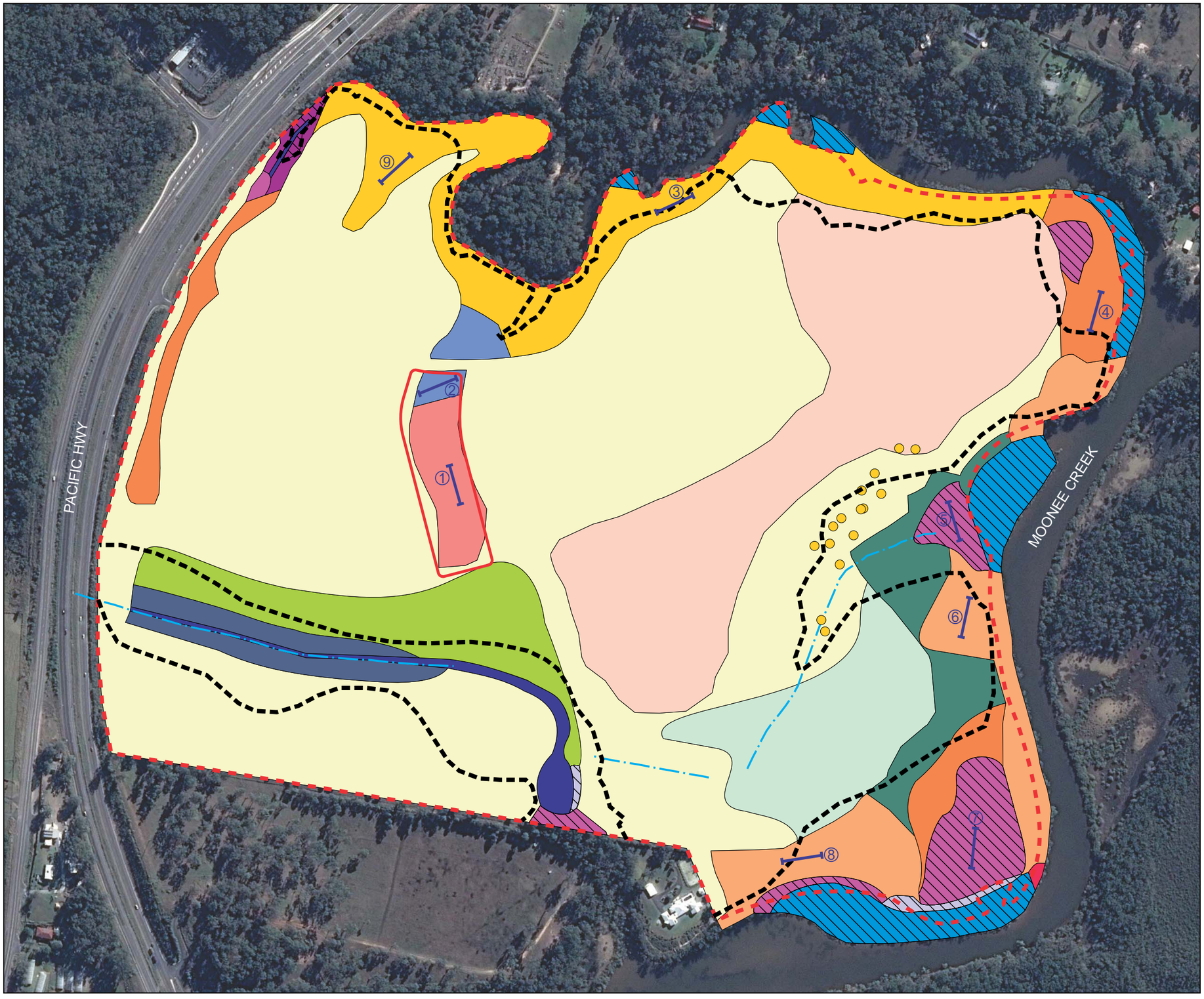
2.2.2.7 Quadrat (plot-based) Surveys

During the November 2017 site surveys, plot-based surveys were undertaken at nine (9) locations over The Glades development site in accordance with the BioBanking Assessment Methodology (BBAM) (OEH 2014) (**FIGURE 6**). The BBAM is used to assess the biodiversity values of a development site for the purpose of obtaining a biobanking statement, or a biobank site for the purpose of entering into a biobanking agreement.

Surveys in accordance with the BBAM focussed on impact areas and potential revegetation/offset sites. Vegetation occurring in the study area were stratified by identifying the distribution of Plant Community Types (PCTs) according to the NSW PCT classification as described in the VIS Classification Database, and then mapping the area of each PCT into a vegetation zone. A vegetation zone is defined in the BBAM an area of native vegetation on a development site or biobank site that is the same PCT and has a similar broad condition state (i.e. low condition or moderate to good condition). In identifying areas that are in a similar broad condition state, consideration is given to areas of the PCT that have a similar over-storey cover, mid-storey cover, ground cover, weediness, or combinations of these.

The following attributes were assessed at each survey site:

a) Native plant species richness;
b) Native overstorey cover;
c) Native midstorey cover;
d) Native ground cover (grasses);
e) Native ground cover (shrubs);
f) Native ground cover (other);
g) Exotic plant cover (calculated as percentage of total ground and midstorey cover);
h) Number of trees with hollows;
i) Proportion of overstorey species occurring as regeneration; and
j) Total length of fallen logs.



LEGEND

- Subject Site
- The Glades Development Site
- BBAM Transect (50m)
- Individual *Melaleuca sieberi*
- Endangered Ecological Community
- Drainage line
- Q100 Flood Line (Auspacific Engineers)

N

Dry Sclerophyll Forest/Woodland Communities

- Community 1a - Tall open/closed forest (*Eucalyptus pilularis* +/- mixed species)
- Community 1b - Tall mid-dense forest (*Eucalyptus planchoniana*, *Syncarpia glomulifera*, *Corymbia intermedia*)
- Community 1d - Tall mid-dense forest (*Eucalyptus planchoniana*, *Eucalyptus tindaliae, Eucalyptus pilularis, Syncarpia glommulifera)*
- Community 1e - Tall open forest (*Eucalyptus siderophloia*)
- Community 1f - Tall closed forest (*Eucalyptus planchoniana*, *Syncarpia glomulifera*, *Eucalyptus pilularis*)
- Community 1g - Tall open woodland (*Eucalyptus pilularis*, *Eucalyptus planchoniana*, *Syncarpia glomulifera* +/- *Angophora costata*)

Swamp Sclerophyll Communities

- Community 2a - Mid-high swamp sclerophyll forest (*Melaleuca quinquenervia*)
- Community 2b - Mid-high swamp sclerophyll forest (*Melaleuca sieberi*)
- Community 2c - Mid-high swamp sclerophyll woodland (*Melaleuca quinquenervia*, *Melaleuca linariifolia*)
- Community 2d - Mid-high Swamp she-oak woodland (Casuarina glauca)
- Community 2e - Tall mid-dense forest (*Lophostemon suaveolens, Callistemon salignus*, *Syncarpia glomulifera* +/- *Melaleuca quinquenervia*)

Heathland Communities

- Community 3a - Mid-high to tall closed heath *(Ochrosperma leneare, Leptospermum polygalifolium*, *Leucopogon parviflorus)*
- Community 3b - Slashed heath (Mixed species)

Grassland Communities

- Community 4a - Low closed grassland (*Andropogon virginicus*, *Themeda triandra)* with scattered trees
- Community 4b - Low closed grassland (*Themeda triandra*, *Juncus* sp.*)*

Intertidal Communities

- Community 5a - Low open mangrove forest/ Saltmarsh (*Aegicerus corniculatum*, *Juncus kraussii, Sporobolus virginicus)*

Wetland Communities

- Community 6a - Wetland *(Nymphaea* sp., *Eleocharis* sp., *Philydrum lanuginosum)*

0 150m

1 : 5000

SOURCE: JWA Site Investigations 2004 & 2017; Auspacific Engineers (04-1600-P1-C.pdf & 04-1600 -P5C.pdf) Google Earth June 2016 Aerial Photo

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FIGURE 6

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TITLE

VEGETATION COMMUNITIES

The plot-based full floristic survey was based on a 20 m × 20 m quadrat (or 400 m^2 equivalent for linear areas). Line transects were also used to assess site attributes that can be measured by percent foliage cover. Native plant species richness was assessed within a 20 m × 20 m plot. The number of trees with hollows and the total length of fallen logs was assessed within a 50 m × 20 m plot. The floristic data in **TABLE 2** below was collected within a 20 m × 20 m plot. The number of trees with hollows was estimated by counting the number of trees with hollows visible from the ground in a 50 m × 20 m plot. The total length of fallen logs was the total length of woody material greater than 10 cm in diameter that was observed on the ground in the 50 m × 20 m plot. Regeneration was measured as the proportion of over-storey species that were observed to be regenerating and was assessed across the entire vegetation zone.

TABLE 2
FLORISTIC SURVEY DATA COLLECTED

Attribute	Survey Requirement (OEH 2014)
Stratum (& layer)	Stratum and layer in which each species occurs
Growth form	Growth form for each recorded species
Species name	Scientific name and common name
Cover	A measure or estimate of the appropriate cover measure for each recorded species; recorded from 1–5% and then to the nearest 5%. If the cover of a species is less than 1% and the species is considered important, then the estimated cover should be entered (e.g. 0.4)
Abundance rating	A relative measure of the number of individuals or shoots of a species within the plot.

2.3 Results

2.3.1 Database Search

OEH database searches revealed ten (10) Threatened Flora species that may occur within 10km of the subject site. The Commonwealth PMST identified twenty-five (25) threatened flora species that may occur within 10km of the subject site based on the availability of suitable habitat within the locality.

Threatened flora species detected in the database searches are listed in **TABLE 3**. The conservation status of each species listed in **TABLE 3** is shown in accordance with the Commonwealth *EPBC Act* (*1999*) and *TSC Act (1995)*.

TABLE 3
DATABASE RECORDS OF THE THREATENED FLORA SPECIES WITHIN 10KM OF THE SITE

Botanical name	Common name	TSC Act*	EPBC Act#
Acronychia littoralis	Scented acronychia	(E)	E
Allocasuarina defungens	Dwarf heath casuarina	(E)	E
Allocasuarina thalassoscopica		-	E
Arthraxon hispidus	Hairy-joint grass	(V)	V
Boronia umbellata	Orara boronia	(V)	V
Chamaesyce psammogeton	Sand spurge	E1	-
Cryptostulis hunteriana	Leafless tongue orchid	(V)	V
Cynanchum elegans	White-flowered wax plant	(E)	E
Diospyros mabacea	Red-fruited ebony	(E)	E
Diploglottis campbellii	Small-leaved tamarind	(E)	E
Endiandra floydii	Floyd's walnut	(E)	E
Endiandra hayesii	Rusty rose walnut	(V)	V
Haloragis exalata subsp. velutina	Tall velvet sea-berry	(V)	V
Hicksbeachia pinnatifolia	Red boppel nut	V	V
Lindsaea incisa	Slender screw fern	E1	-
Macadamia integrifolia	Macadamia nut	-	V
Macadamia tetraphylla	Rough-shelled bush nut	(V)	V
Marsdenia longiloba	Slender marsdenia	E1	V
Myrsine richmondensis	Purple-leaf muttonwood	(E)	E
Niemeyera whitei	Rusty plum	V	-
Phaius australis	Lesser swamp-orchid	(E)	E
Pultenaea maritima	Coast Headland pea	V	-
Quassia sp. 'Moonee Creek'	Moonee Quassia	E1	(E)
Samadera sp. Moonee Creek		(E)	E
Sarcochilus fitzgeraldii	Ravine orchid	(V)	V
Sarcochilus hartmannii	Waxy sarchochilus	(V)	V
Sophora tomentosa	Silverbush	E1	-
Thesium australe	Australian toadflax	V	V
Tylophora woollsii			E
Zieria prostrata	Headland zieria	E1	E

* NSW Threatened Species Conservation Act 1995 (TSC Act)
# Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)
E1 – Endangered (state), E2 – Endangered Population, E4 – Critically Endangered (state), E – Endangered (national), V – Vulnerable, CE – Critically Endangered (national)

2.3.2 Threatened Flora Known from the Locality

The Clancy report (1998) on the Moonee Release Area recorded Rusty plum (*Amorphospermum whitei*) to the south of the Subject site, and notes that *Quassia* sp. B (Moonee Creek) is also known from the area. A JWA survey to the south of Moonee village (2004) also recorded Quassia sp. 'Moonee Creek'.

There has also been an unverified record of the Threatened species Dwarf heath casuarina (*Allocasuarina defungens*) on the Subject site (Mark Graham *pers comm*. 2004).

2.3.3 Site Surveys

One hundred and sixty-eight (168) flora species were recorded over The Glades development site (JWA 2007). None of these are Threatened or ROTAP (Briggs & Leigh 1995) species. A full list of flora species recorded at the Subject site is included as **APPENDIX 1**. Weed species are indicated by the use of an asterisk*.

Two (2) regionally significant (Sheringham & Westaway 1995) flora species were recorded within The Glades development site: White stringybark (*Eucalyptus globoidea*) and Christmas bells (*Blandfordia grandiflora*). Both these species were also recorded by Clancy (1998) within The Glades development site.

Three (3) broad vegetation types, consisting of distinct vegetation communities were identified on the Subject site during the 2004 surveys (JWA 2007). The boundaries and vegetation community descriptions were slightly modified in 2017 to reflect the current condition of these communities. These updated communities are described in **SECTION 2.3.4** and are shown in **FIGURE 6**.

No Endangered Ecological Communities (EECs) occur on the Subject site (**FIGURE 6)**:

2.3.4 Vegetation Community Descriptions

Three (3) vegetation communities were recorded within the Subject site (**FIGURE 6**). The vegetation communities are shown in **TABLE 4**. The numbering of these vegetation communities follows that utilised during previous vegetation mapping over the site (JWA 2007).

The conservation status of these communities are discussed with reference to the Comprehensive Regional Assessment completed for NSW Forest and Non-forest ecosystems as part of the Regional Forestry Agreement (RFA) process (CRA Unit 1999).

Vegetation communities are also described at a local level with reference to the following documents:

- Fisher, Body and Gill (1996) The vegetation of the Coffs Harbour City Council LGA
- Ecograph (2002) Coffs Harbour Vegetation Management Strategy

- NSW Office of Environment and Heritage (OEH 2012) Vegetation community profiles of the Coffs Harbour, LGA.

TABLE 4
VEGETATION COMMUNITIES PRESENT ON THE SUBJECT SITE

Community		Short Description
1	**Dry Sclerophyll forest/woodland communities**	
	1f	Tall closed forest (*Eucalyptus planchoniana*, *Syncarpia glomulifera*, *Eucalyptus pilularis*)
2	**Swamp sclerophyll communities**	
	2b	Mid-high swamp sclerophyll forest (*Melaleuca sieberi* +/- *Melaleuca quinquenervia*)
4	**Grassland/sedgeland communities**	
	4a	Low closed grassland (**Andropogon virginicus* (Whiskey grass), *Themeda triandra* (Kangaroo grass)) with scattered trees.

*Introduced species

2.3.4.1 Community 1(f) – Tall closed forest (*Eucalyptus planchoniana, Syncarpia glomulifera, Eucalyptus pilularis*)

Location and area
This community occurs over the majority of the Subject site.

Description
This community has a mixed composition with numerous species present in the canopy, and appears to be relatively mature regrowth. Needlebark stringybark (*Eucalyptus planchoniana*) is the dominant canopy species, along with secondary occurrences of Turpentine (*Syncarpia glomulifera*), Blackbutt (*Eucalyptus pilularis*), and Tindale's stringybark (*Eucalyptus tindaliae*). Other species present include the occasional Tallowwood (*Eucalyptus microcorys*) and Rusty gum (*Angophora costata*).

The midstorey in this community is relatively dense in areas with immature Turpentine, along with Hopbush (*Dodonaea triquetra*), Mock olive (*Notelaea ovata*) and some Black she-oak (*Allocasuarina littoralis*). The ground layer is generally sparse, consisting of scattered occurrences of Blady grass (*Imperata cylindrica*), *Juncus* sp., Flax lilly (*Dianella caerulea*) and Gahnia (*Gahnia sp.*), along with regenerating Mock olive and Turpentine. Some occasional Egg and bacon peas (*Pultenaea villosa*) also occur, while some Hairpin banksia (*Banksia spinulosa*) occurs in the more open northern portion of the community.

Conservation status
The most relevant Forest Ecosystem type considered in the CRA report (1999) is Forest Ecosystem 20 (Clarence Lowland Needlebark Stringybark) (CRA Unit 1999). The Regional Forestry Agreement document provides the following data on this ecosystem:

- Pre 1750 there was 12496 hectares of this ecosystem type in the upper north-east section of the NSW North Coast Bioregion. 10817 hectares (86.6%) remains.
- The ecosystem is not considered to be Vulnerable, Rare, or Endangered.

- 55.4% of the total forest ecosystem area is within the Comprehensive, Adequate & Representative (CAR) reserve system, including 26.6% in dedicated reserves and 21.9% in informal reserves. A further 6.9% is protected by tabulated prescriptions.

The closest description of this community under the Fisher, Body & Gill (1996) classification system for vegetation in the Coffs Harbour LGA is Map Unit N42a – Needlebark stringybark (*Eucalyptus planchoniana*, *Corymbia intermedia*), which is considered Locally Significant.

The Coffs Harbour Vegetation Management Strategy (CHVMS) (Ecograph 2002) notes that there is 15 hectares of Map Unit N42a within the Coffs Harbour LGA, comprising 0.06% of mapped bushland within the Coffs Harbour LGA.

Under the Vegetation Mapping of the Coffs Harbour LGA (VMCH – OEH 2012) the vegetation aligns closest with the vegetation of CH_D0F02: Sandstone bloodwood – Needlebark stringybark heathy forest.

It should be noted that the mixed composition of this community is not adequately represented by Forest Ecosystem 20. Conservation value is considered to be moderate.

2.3.4.2 Community 2(b) - Paperbark (*Melaleuca sieberi +/- Melaleuca quinquenervia*)

Location and area
This community occurs as a small area in the north of the Subject site.

Description
This community occurs in moist, low-lying areas of the site, and consists of Broad-leaved paperbark, mostly to the exclusion of other species. Some emergent Swamp mahogany (*Eucalyptus robusta*) occurs sporadically throughout. Some Broad-leaved paperbark (*Melaleuca quinquenervia*) also occurs along with an understorey of Saw sedge (*Ghania spp.*) and sedges (*Cypress spp.*).

Conservation status
This community is best described by *Forest Ecosystem 112 (Paperbark)* (CRA Unit 1999). The Regional Forestry Agreement document provides the following data on this ecosystem:

- 28577 hectares of this ecosystem type remains within the upper north east section of the NSW North Coast Bioregion. The original extent (ie. Pre 1750) has not been calculated.
- The ecosystem is considered to be **Vulnerable**.
- The extent present in the Comprehensive, Adequate and Representative (CAR) reserve system has not been determined. However, NPWS (1995) note that analogous communities have been reserved in a number of conservation areas in upper North East NSW.

- Paperbark communities have been identified as a priority for conservation on private land.

The closest description of this community under the Fisher, Body & Gill (1996) classification system for vegetation in the Coffs Harbour LGA is Map Unit N50 – Paperbark (*Melaleuca* sp., *Casuarina glauca*, *Eucalyptus robusta*), which is considered Ecologically Significant (comprising tree species utilised by Koalas).

The Coffs Harbour Vegetation Management Strategy (CHVMS) (Ecograph 2002) notes that there is 475 hectares of Map Unit N50 within the Coffs Harbour LGA, comprising 2.03% of mapped bushland within the Coffs Harbour LGA.

Under the Vegetation Mapping of the Coffs Harbour LGA (VMCH – OEH 2012) the vegetation aligns closest with the vegetation of CH_FrW04: Coastal paperbark – Sedgeland dominated forest.

Portions of this community that occur below the 1 in 100 flood line are considered to be representative of the Endangered Ecological Community (EEC) Swamp sclerophyll forest on coastal floodplains, and has a high conservation value. However, the Subject site occurs above the 1 in 100 flood line, therefore areas of this community within the Subject site is not considered to be representative of the EEC and the conservation value of this vegetation is considered to be moderate.

2.3.4.3 Community 4(a) - Low open grassland (*Andropogon virginicus*, *Themeda triandra*) with scattered trees

Location and area
This community occurs along the boundaries of the Subject site.

Description
Grassland on the Subject site is comprised mostly of Whisky grass (*Andropogon virginicus*) and Kangaroo grass (*Themeda triandra*), along with Blady grass (*Imperata cylindrica*) and some Parramatta grass (*Sporobolus indicus var indicus**). Other species such as Spiny-headed mat rush (*Lomandra longifolia*), Native violet (*Viola hederacea subsp. hederaceae*), Bracken (*Pteridium esculentum*) and Pennywort (*Centella asiatica*) occur patchily throughout the community. Some small patches of sedgeland (*Juncus planifolius*, *Juncus usitatus*) also occur, within low-lying areas.

Conservation status
There is no appropriate CRA classification for this community. The community does not qualify as natural (native) grassland, due to the overall dominance of Whisky grass. The conservation status is therefore considered to be relatively low.

Grasslands are not adequately described under the Fisher, Body & Gill (1996) classification system for vegetation in the Coffs Harbour LGA.

The highly modified nature of the grassland community from a combination of slashing and grazing has resulted in a simplified grassland community without any structural characteristics which qualify as a forest community. The conservation value of this vegetation is considered to be low.

2.4 Coffs Harbour City Council Vegetation Mapping

2.4.1 Introduction

Vegetation mapping was originally assessed in 2007 under the Coffs Harbour City Council Draft Vegetation Management Plan (JWA 2008). A new Local Environment Plans (LEP) for most of the Coffs Harbour local government area (LGA) came into effect in September 2013 (LEP 2013). However, Council resolved to defer changing the zoning of several areas, including lands identified on Map 2 (Moonee), therefore LEP 2013 does not apply to this land and LEP 2000 continues to apply to the deferred lands of Moonee. The following sections discuss the vegetation mapping for the Subject site in terms of the Coffs Harbour Draft Vegetation Management Plan in the original report (JWA 2008) and the Coffs Harbour LEP 2000.

Furthermore, fine-scale vegetation mapping was completed across the Coffs Harbour LGA (OEH 2012a and b). The purpose of this fine-scale vegetation map was to enable more informed decision making with respect to the sustainable management of native vegetation within the LGA. Fine-scale vegetation mapping for the Subject site is also discussed in the following sections.

2.4.2 Coffs Harbour City Council Draft Vegetation Management Plan

The 2009 report (JWA 2009) referred to mapping of The Glades under the Coffs Harbour City Council Draft Vegetation Management Plan. Mapping of the Subject site under this plan has not identified any areas in the Subject site as being of "ecological value" (**FIGURE 7**). Under the Coffs Harbour Vegetation Management Study, ecosystem types that have met between 0-33% of their reservation target are considered of "very high ecological value". Areas of ecological value under the CHVMS in The Glades development site are shown in **FIGURE 7**.

2.4.3 Coffs Harbour LEP 2000

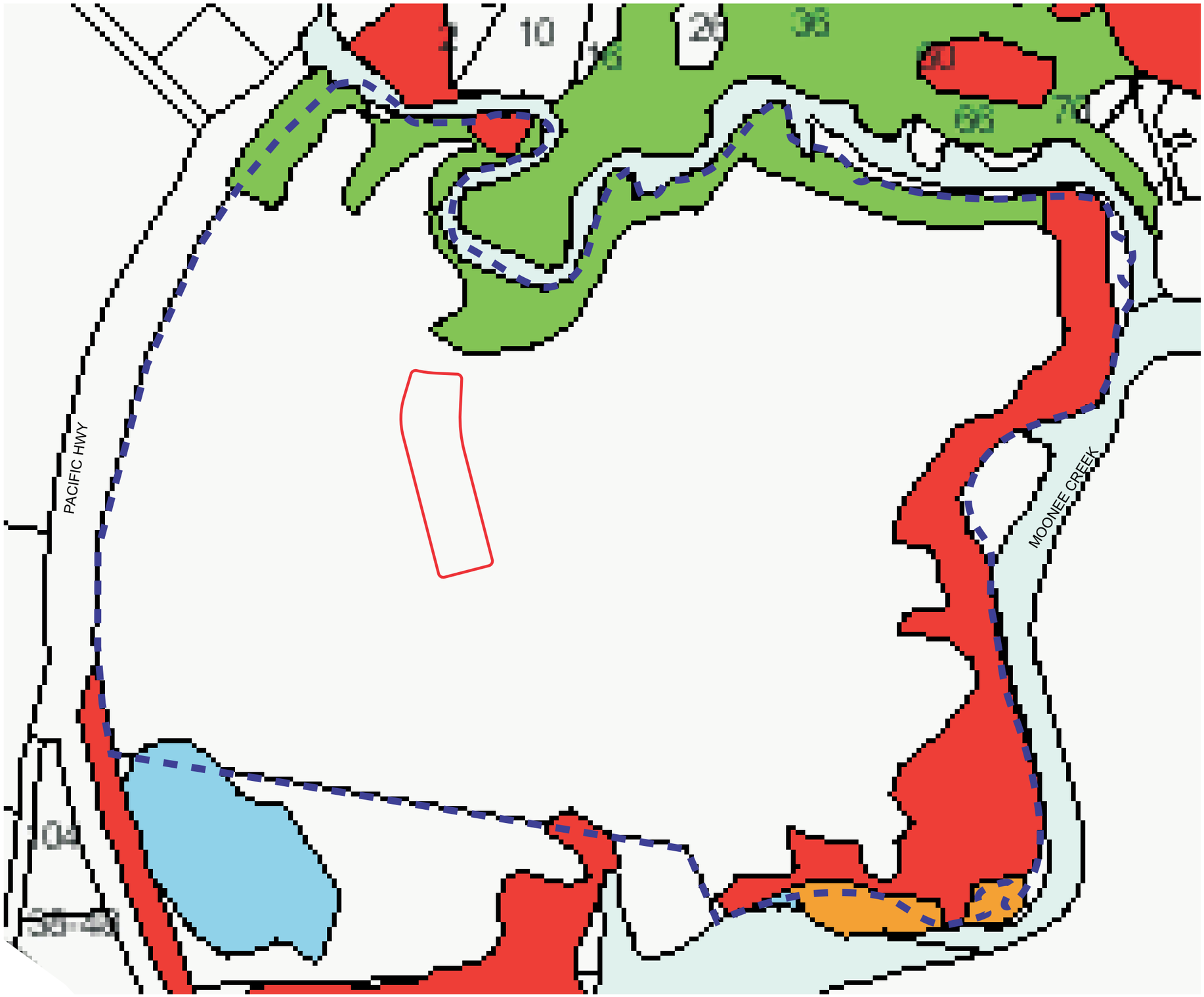
The subject site is mapped as Residential 2A – low density residential (**FIGURE 8**).

2.4.4 Coffs Harbour LGA Fine-scale Vegetation Mapping

The Coffs Harbour Fine-scale Vegetation mapping identifies the following vegetation types across the Subject site (**FIGURE 9**):

- Dry sclerophyll forests.

The fine-scale mapping does not map any Endangered Ecological Communities within the Subject site (**FIGURE 10**).



SOURCE: Coffs Harbour City Council Website (Accessed 14 July 2006)

SCALE: 1 : 5000 @ A3

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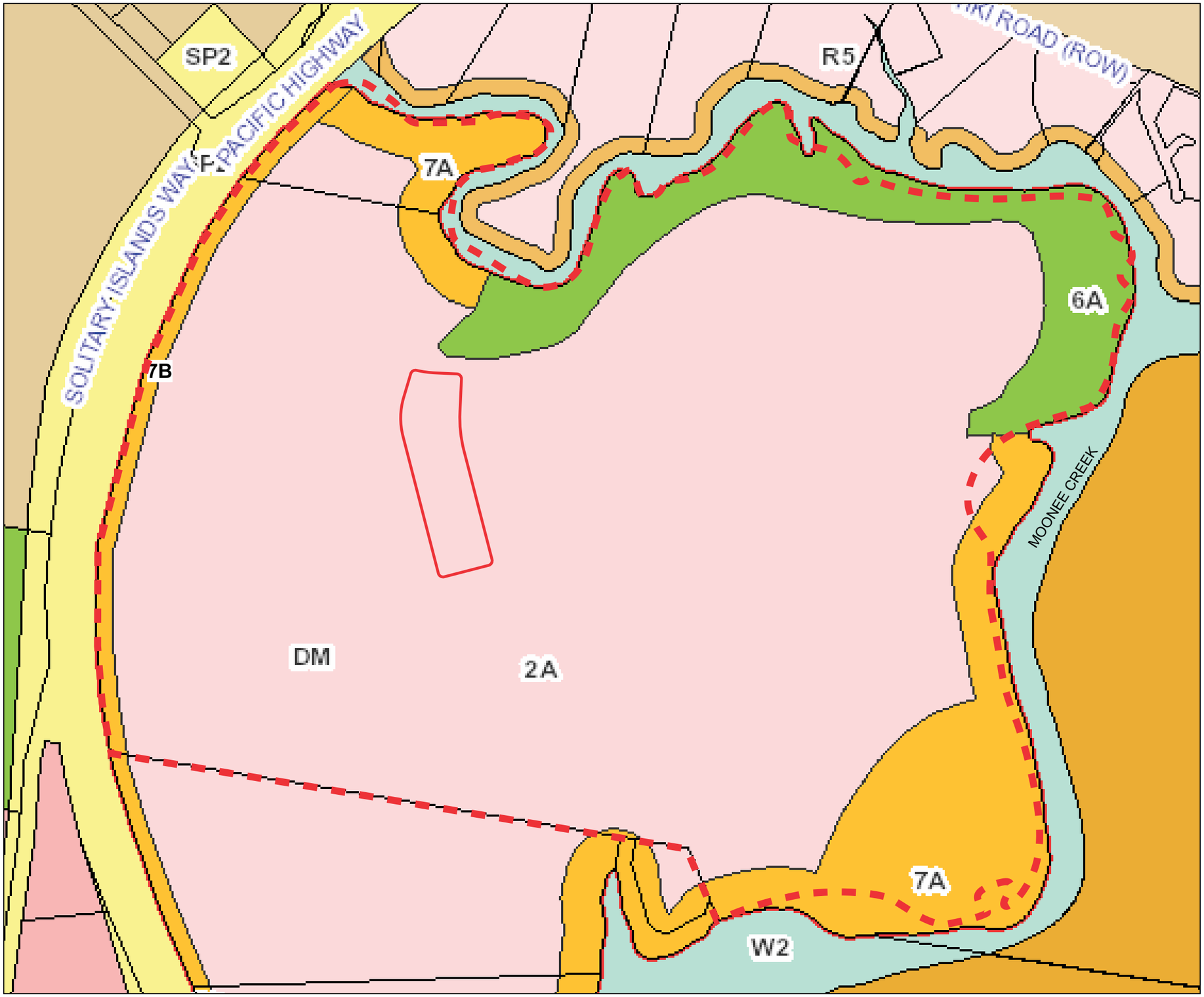
FIGURE 7

PREPARED: BW
DATE: 16 October 2017
FILE: N02066_CHC Veg Value.cdr

TITLE

COFFS HARBOUR CITY COUNCIL VEGETATION VALUE



LEGEND

- Subject Site
- The Glades Development Site
- Cadastre

Coffs Harbour City LEP 2013

- R2 - Low Density Residential
- R5 - Large Lot Residential
- RU2 - Rural Landscape
- RU3 - Forestry
- RE1 - Public Recreation
- E1 - National Parks & Nature Reserves
- SP2 - Infrastructure
- W2 - Recreational Waterways
- DM - Deferred Matter

Coffs Harbour City LEP 2000 Deferred Areas

- Residential 2A - Low Density Residential
- Open Space 6A - Public Recreation
- Environmental Protection 7A - Habitat & Catchment Zone
- Environmental Protection 7B - Scenic Buffer Zone

0 150m

1 : 5000

SOURCE: Coffs Harbour City Council Online Mapping Tool accessed 05/04/17

SCALE: 1 : 5000 @ A3

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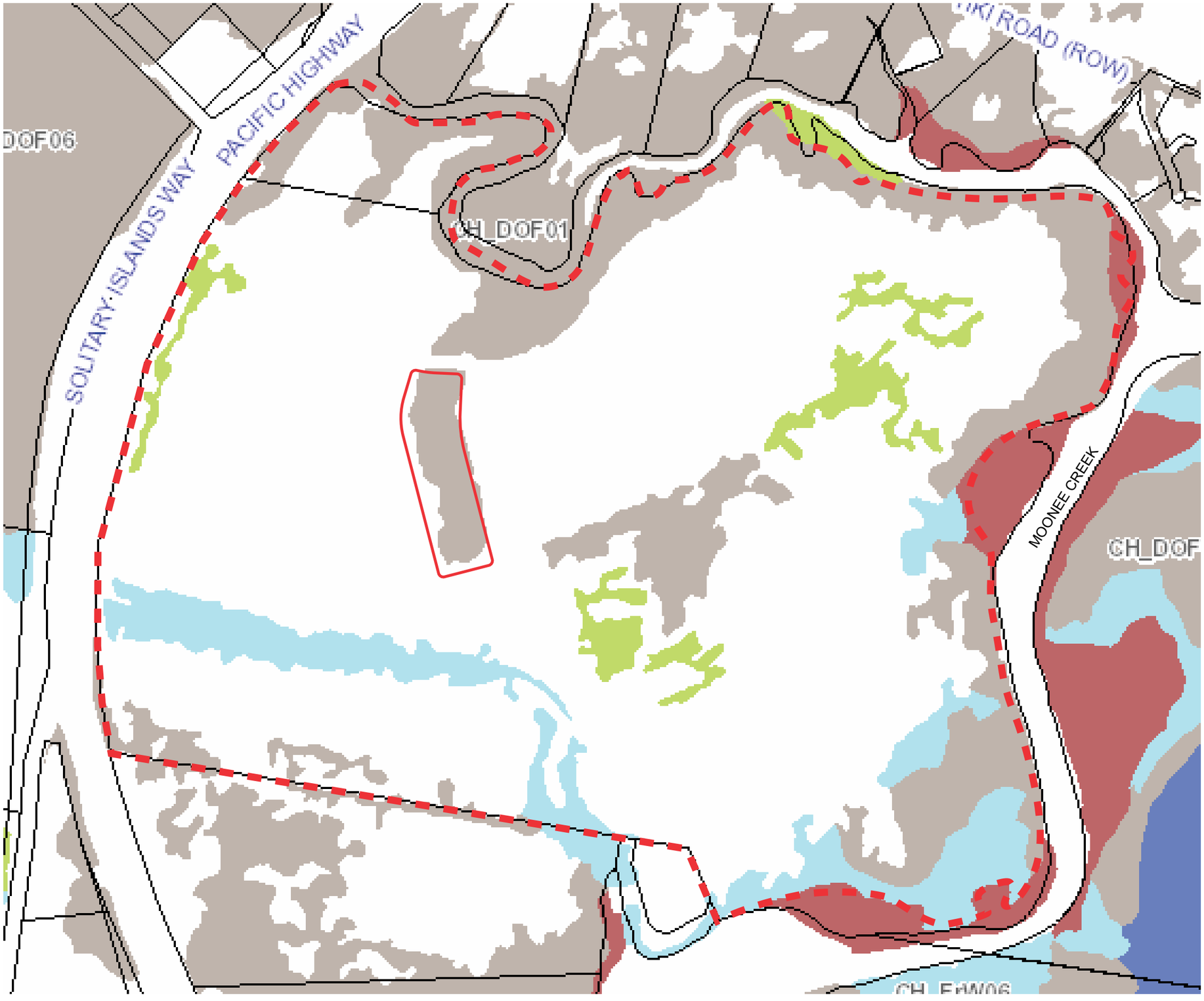
FIGURE 8

PREPARED: BW
DATE: 16 October 2017
FILE: N02066_Zoning.cdr

TITLE

ZONING PLAN



LEGEND

- Subject Site
- The Glades Development Site
- Cadastre

Coffs Harbour Fine Scale Vegetation Mapping

- Dry Sclerophyll Forests
- Forested Wetlands
- Freshwater Wetlands
- Remnant Native Vegetation
- Saline Wetlands

0 150m

1 : 5000

SOURCE: Coffs Harbour City Council Online Mapping Tool accessed 05/04/17

SCALE: 1 : 5000 @ A3

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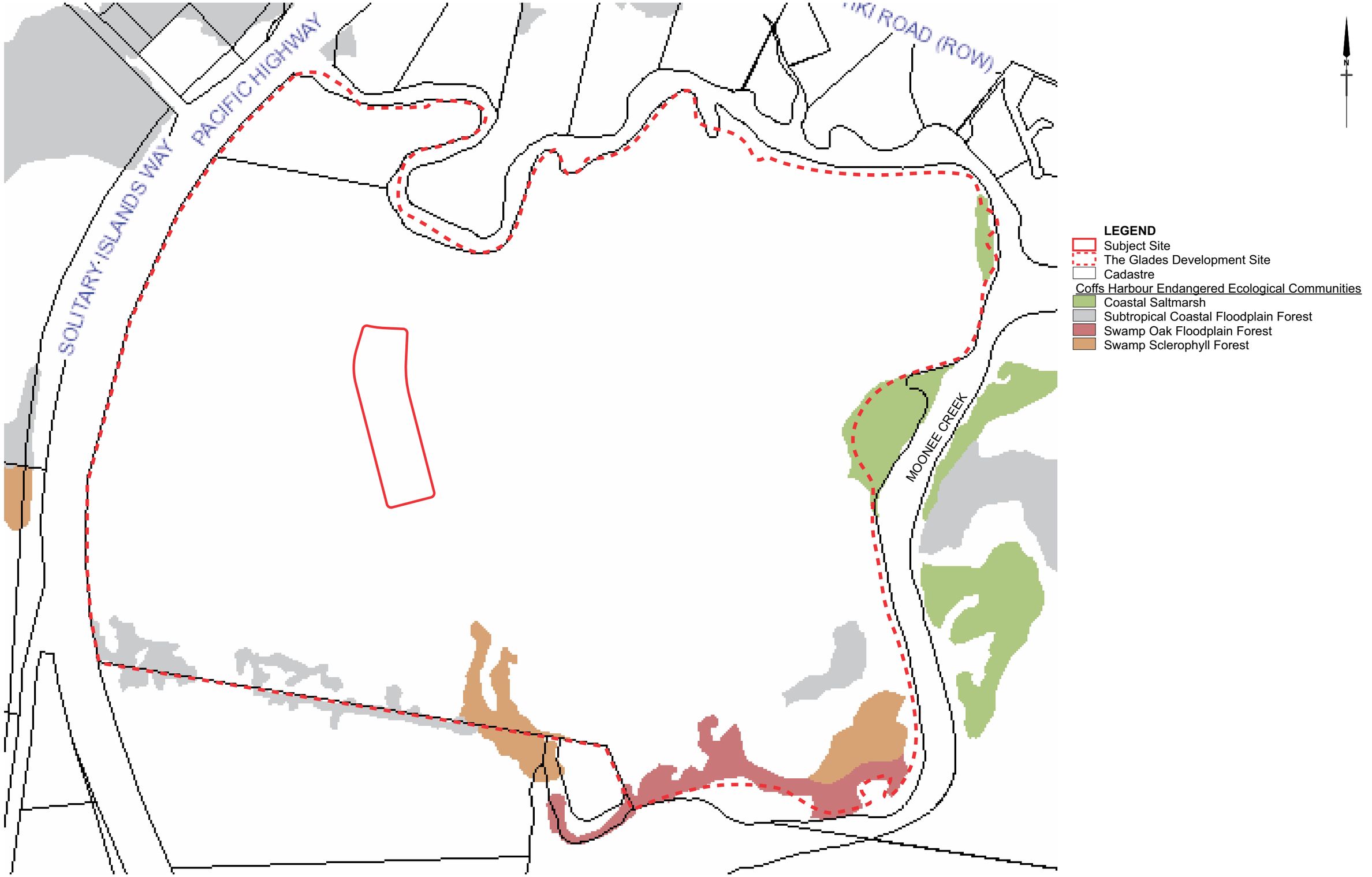
FIGURE 9

PREPARED: BW
DATE: 16 October 2017
FILE: N02066_CHC Veg.cdr

TITLE
COFFS HARBOUR CITY COUNCIL FINE SCALE VEGETATION MAPPING



SOURCE: Coffs Harbour City Council Online Mapping Tool accessed 05/04/17

SCALE: 1 : 5000 @ A3

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FIGURE 10

PREPARED: BW
DATE: 16 October 2017
FILE: N02066_CHC EEC.cdr

TITLE
COFFS HARBOUR CITY COUNCIL EEC'S

There are also no Over Cleared Vegetation types mapped on the Subject site (**FIGURE 11**).

SOURCE: Coffs Harbour City Council Online Mapping Tool accessed 05/04/17

SCALE: 1 : 5000 @ A3

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FIGURE 11

PREPARED: BW
DATE: 16 October 2017
FILE: N02066_CHC over cleared.cdr

TITLE
COFFS HARBOUR CITY COUNCIL OVER CLEARED VEGETATION TYPES

3 FAUNA ASSESSMENT

3.1 Introduction

This section includes a description of the methods used in determining which fauna species use, or are likely to use, the Subject site and a discussion of the results of the Fauna assessment. The fauna assessment involved a full fauna survey (i.e. specialised bird, bat and amphibian survey, spotlighting, hair sampling and trapping) and was completed across the entire The Glades development site.

3.2 Methods

3.2.1 Desktop Review

The following databases were reviewed as part of the desktop assessment to find records of State and Commonwealth Threatened species[3] within 10km of the Subject Site and within Moonee Nature Reserve which is adjacent to the site:

- the Commonwealth *EPBC Act* (*1999*) PMST (Dept. Environment 2013); and
- Atlas of NSW Wildlife (OEH 2016) database.

3.2.2 Literature Review

A comprehensive literature review was completed by JWA (2003b) as part of a Flora and Fauna Assessment for a nearby site in the locality. This review used a number of sources to identify records of Threatened species in the locality.

The Flora and Fauna Assessment of the Moonee Release Area (Clancy 1998) was also consulted.

3.2.3 Habitat Assessment

Site habitats were assessed to determine their value for native fauna species. This assessment was completed in conjunction with the flora survey. The assessment focused on identifying habitat features associated with Threatened species as well as other native fauna groups. Particular attention was paid to habitat features such as:

- The presence of mature trees with hollows, fissures and/or other suitable roosting/nesting places.
- The presence of Koala food trees.
- The presence of preferred Glossy black cockatoo feed trees (Forest oak and/or Black she-oak).
- The presence of Yellow-bellied glider feeding scars.

[3] As listed within schedules of the *TSC Act (1995)* and *EPBC Act (1999).*

- Condition, flow and water quality of drainage lines and bodies of water.
- Areas of dense vegetation.
- Presence of hollow logs/debris and areas of dense leaf litter.
- Presence of fruiting flora species.
- Presence of blossoming flora species, particularly winter-flowering species.
- Vegetation connectivity and proximity to neighbouring areas of intact vegetation.
- Presence of caves and man-made structures suitable as microchiropteran bat roost sites.

3.2.4 Corridor Analysis

3.2.4.1 Background

Maintaining habitat connectivity at the landscape scale is required to maintain the viability of species populations in the long term (Beier and Noss, 1998). In fragmented landscapes, corridors of native vegetation (or fauna corridors) that connect larger habitat areas can enhance landscape connectivity by:

- providing habitat for fauna and flora species; and
- facilitating the movement and dispersal of fauna and flora species between larger and/or more suitable habitat areas in the landscape.

Importantly, even where corridors physically connect two habitat areas, it is crucial that the habitat requirements and movement capacities of the species for which proposed corridors are intended is considered in the design (e.g. width, length, vegetation type and vegetation structure) of fauna corridors in order for the corridors to provide functional connectivity in the landscape (Tischendorf and Fahrig, 2000; Hess and Fischer, 2001).

The existing Project Approval included an open space area located between residential precincts 1 and 2 (**FIGURE 5**). This proposed open space area covers a total of 1.747 ha and contains native vegetation that was proposed to be retained. The Section 75W modification application to modify the Project Approval proposes to remove this open space area and clear this vegetation in order to create additional residential allotments.

In order to determine the habitat and connectivity values of this vegetation, JWA completed desktop and site-based assessments. The corridor assessment methodology utilised is outlined in the following sections.

3.2.4.2 Desktop Assessment

Prior to conducting the field survey, aerial photography over the subject site, adjacent waterway corridors and wider locality was reviewed. The basic premise of aerial photographic interpretation in this case was to identify areas of potential flora and fauna

habitat and corridor values within the locality and determine the level of connectivity between these areas and the subject vegetation.

3.2.4.3 Site Assessment

Subsequent to the above desktop review, one (1) ecologist from JWA completed an inspection of the Subject site on the 14th and 15th of February 2017 to assess biodiversity and corridor values. The inspection included ground-truthing previous vegetation mapping, searches for threatened flora and fauna species, and one (1) night of spotlighting.

A habitat assessment, including searches for evidence of Threatened fauna species previously recorded from the broader The Glades development site, and an assessment of the likely impacts on fauna movement opportunities resulting from the removal of vegetation were also completed.

To further assess whether vegetation would be an effective movement corridor for native fauna, values considered included corridor width, length, shape, habitat type and quality, structural complexity, edge effects, general movement patterns of target fauna groups, and any fauna diversion or exclusion requirements (e.g. culverts, rope bridges, fences).

3.2.5 Fauna Surveys

3.2.5.1 Background

A number of detailed fauna surveys have been completed by JWA over The Glades development site:

- A detailed fauna survey over five (5) days by two (2) ecologists between the 10th and the 14th of May 2004. The weather was generally fine and warm during the survey period, although nights were notably cool to cold.
- A targeted survey was completed over three (3) nights by two (2) ecologists between the 22nd and the 24th of September 2004 targeting the Grass owl. The weather during this period was mild and windy with some light rain in the evenings of the 23rd and 24th.
- A targeted survey for the Wallum froglet was completed by two (2) ecologists on the nights of the 6th and 7th September 2005.
- A night of spotlighting was completed by one (1) ecologist over the subject site on the 14th February 2017 as part of the corridor analysis;
- A detailed fauna survey was completed by two (2) ecologists over four (4) days between the 27th and the 30th of March 2017. The weather was generally fine and warm for the survey period, with rain falling on the 30th. Minimum and maximum temperatures throughout this survey were 19°C and 30°C respectively (BOM 2017). This survey was originally planned to occur over five (5) days, however due to severe weather experienced as a result of ex-tropical cyclone Debbie, including flash flooding and strong winds, the survey was terminated early. The closest

weather station at Coffs Harbour (approx. 13km south of the site) recorded 104.8 mm of rain and winds up to 69km/hr on the 31st March (BOM 2017).

- A brief fauna survey was completed by two (2) ecologists in conjunction with the recent BBAM assessment on the 14th and 15th November 2017 and included active searches and incidental observations.

3.2.5.2 Survey Techniques

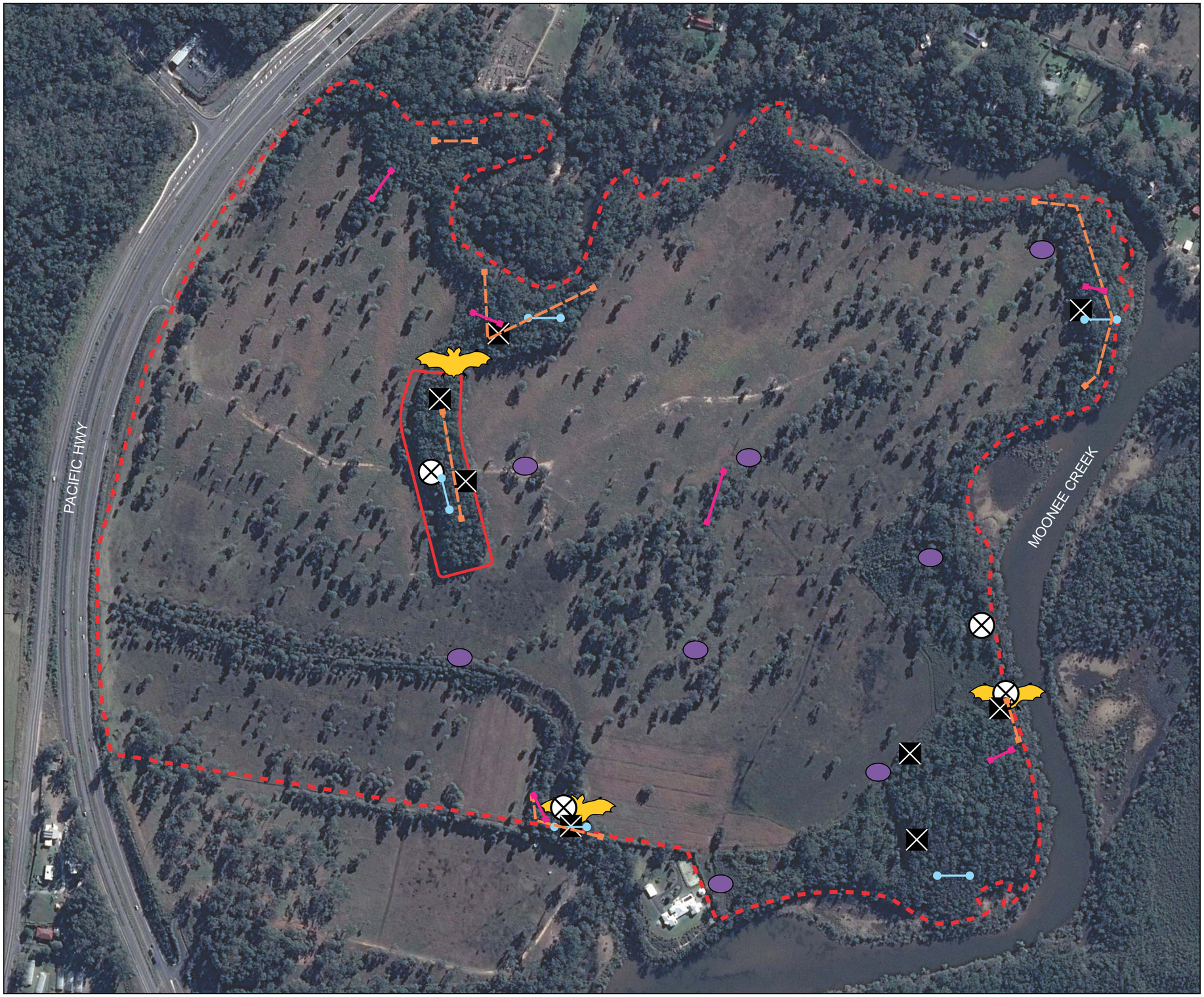
The 2004 and 2017 detailed fauna surveys were completed in accordance with the methodology set out in the Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre *et al*. 2012) and the DRAFT Threatened Species Survey and Assessment Guidelines (NSW Department of Environment and Climate Change 2009).

Fauna species were detected using a combination of trapping techniques, opportunistic sightings and active searches during daylight and at night. All traps were routinely checked as soon as practicably possible after first light to minimise the capture stress to any trapped animals and to prevent captured animals from overheating during warm daylight hours. Captured animals were handled for a minimum amount of time to reduce stress associated with handling. Care was taken to ensure that captured animals were released into areas where they could find immediate and safe shelter and predators could not intercept them.

The detailed fauna surveys were designed to target identified threatened species. Techniques utilised during the fauna surveys are described below. Unless otherwise indicated, the following survey techniques were utilised in both the 2004 and 2017 site assessments. **FIGURES 12** and **13** shows the location of trap and survey sites for the 2004 and 2017 surveys, respectively. A summary of the 2004 and 2017 survey effort for the site assessments are shown in **TABLE 5.** It should be noted that the 2017 survey was cut short due to inclement weather resulting in localised flash-flooding.

TABLE 5
SUMMARY OF TRAPPING EFFORT

Trap/survey type	Survey effort 2004	Survey effort 2017
Elliott trapping	293 trap nights	198 trap nights
Arboreal Elliott trapping	33 trap nights	16 trap nights
Total Elliott trapping	326 trap nights	214 trap nights
Cage traps	32 trap nights	36 trap nights
Pitfall traps	75 trap nights	108 trap nights
Harp traps	6 trap nights	NA
Hair tubes	420 trap nights	NA
Anabat/SongMeter (bat calls)	3 nights	2 nights
Spotlighting	14 hours	18 hours
Call playback	4 nights + 3 nights targeted survey for Grass owls	3 nights



LEGEND

Subject Site

The Glades Development Site

2004 Trapping Locations

Hair Tubes

Elliott Lines

Pitfall Lines

Call Playback Locations

Harp Traps

Cage Traps

Anabat Locations

N

0 150m

1 : 5000

SOURCE: JWA Site Investigations 2004; Google Earth June 2016 Aerial Photo

SCALE: 1 : 5000 @ A3

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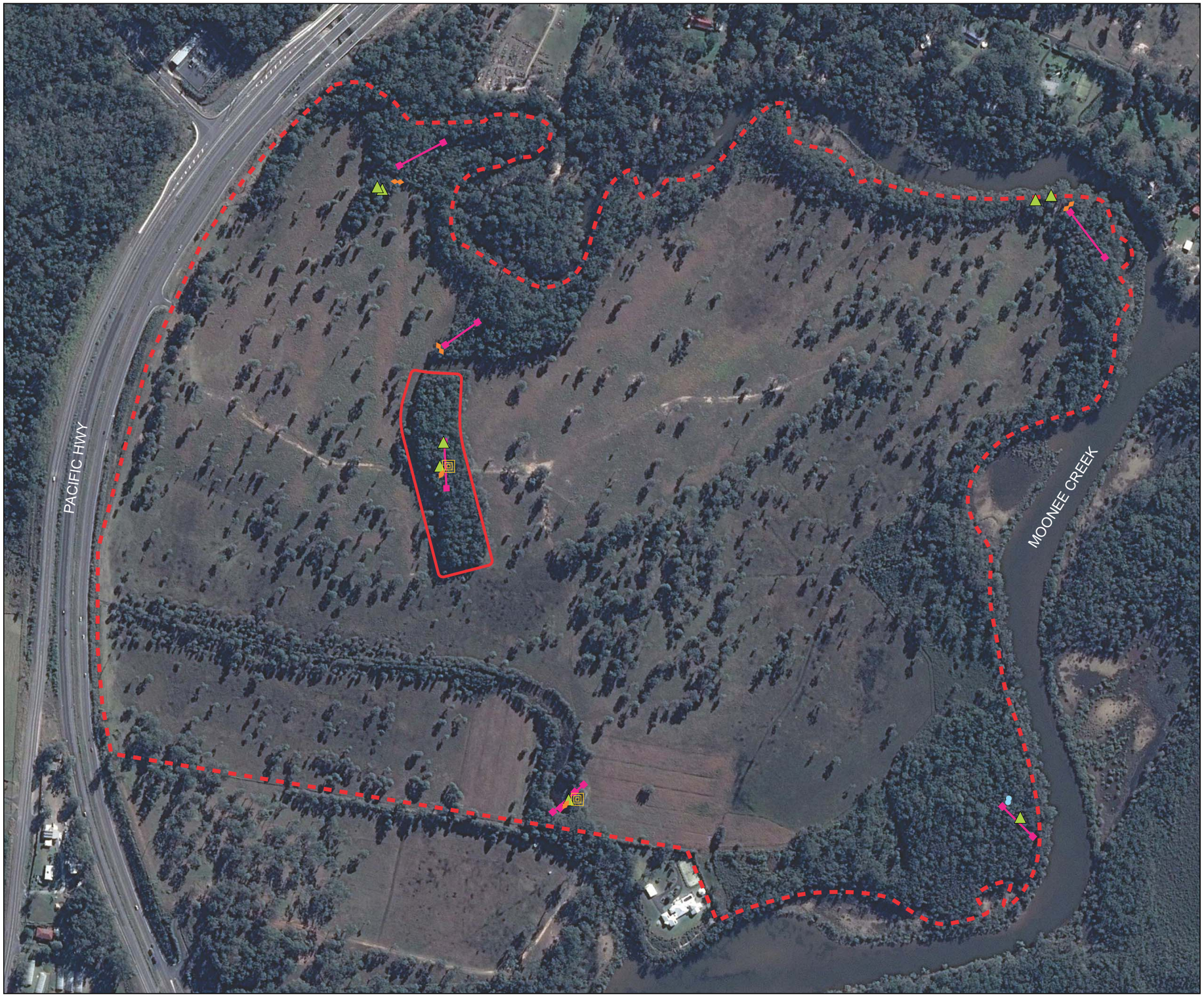
FIGURE 12

PREPARED: BW
DATE: 16 October 2017
FILE: N02066_Trapping 2004.cdr

TITLE

TRAPPING LOCATIONS 2004



N

LEGEND

Subject Site

The Glades Development Site

2017 Trapping Locations

Trapping Lines

Funnel Lines

Pitfall Lines

Song Meter

Camera Traps

0 150m

1 : 5000

SOURCE: JWA Site Investigations 2017; Google Earth June 2016 Aerial Photo

SCALE: 1 : 5000 @ A3

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FIGURE 13

PREPARED: BW
DATE: 16 October 2017
FILE: N02066_Trapping 2017.cdr

TITLE

TRAPPING LOCATIONS 2017

Trap/survey type	Survey effort 2004	Survey effort 2017
Bird survey	Diurnal dusk/dawn survey – 8 hrs, 5 days opportunistic records	4 days opportunistic records
Amphibian survey	2 hours targeted survey, call playback, 3 nights opportunistic records	2 nights of opportunistic records and call playback
Reptile survey	1 hour targeted survey, 5 days, 4 nights opportunistic records	4 days/nights opportunistic records
Camera traps	NA	24 trap nights

Active Searching
Logs, sheets of tin, cardboard, bark and leaves were overturned in search of reptiles and amphibians while incidentally traversing the Subject site. Diggings were searched for signs of droppings. The Subject site was actively searched for scats and bones. Active observation of bird activity was undertaken during all site visits.

Chewed Cone Survey
Target species – Glossy black cockatoo

A ground search was undertaken where the feed tree species *Allocasurina littoralis* and/or *A. torulosa* occur to look for the presence of chewed cones, a sign of feeding activity of the Glossy black cockatoo.

Tree Hollow Survey
A systematic survey was undertaken of scattered trees within grasslands on the Subject site, which are likely to be removed for the proposed development. Any trees containing hollows, spouts, fissures etc were marked by GPS and mapped.

Stag Watching
Target species – arboreal mammals and nocturnal bird species

Each of the trees identified with hollows within the development area were observed for emerging fauna from before dusk for a period of one hour for one (1) night only in 2004. Hollow bearing trees were also observed for one (1) night in 2017. Observers positioned themselves so that the silhouette of any fauna dispersing from the tree could be clearly seen, and also utilised a 50W spotlight powered by 12V batteries to make periodic checks of the hollow.

Type 'A' and 'B' Elliott Box Traps and Cage Traps
Target species – ground-dwelling and arboreal mammals.

This methodology provides an insight into the size and density of populations of ground fauna which may form a component of the diet of raptors such as the Eastern grass owl and the Masked owl. It also indicates the extent of invasion by exotic species such as the

Black rat and the House mouse which allows an assessment of the 'naturalness' of the area to be made.

Eighty-four (84) type 'A' Elliott traps and eight (8) cage traps were deployed over a period of four (4) nights in 2004. Trapping effort totalled three-hundred and sixty-eight (368) trap nights for the 2004 survey. Trap locations are shown in **FIGURE 12.** Each Elliott trap was baited with rolled oats, honey, peanut butter and vanilla essence, while cage traps were baited with either a combination of banana and apple or chicken necks.

Sixty (60) type 'A' Elliott traps, six (6) type 'B' Elliot traps, and twelve (12) cage traps were deployed over a period of three (3) nights in 2017. Traps were deployed along six (6) trapping lines, spread out across The Glades development site to ensure each vegetation type was adequately surveyed. Trapping effort totalled two-hundred and thirty-four (234) trap nights for the 2017 survey. Trap locations are shown in **FIGURE 13.** Each Elliott trap was baited with a mixture of rolled oats, honey, and peanut butter. While cage traps were baited with either a combination of banana and apple, a mixture of peanut butter, honey and oats, or sardines.

Arboreal Traps
Eight type 'B' arboreal Elliott traps were set for a period of 2 nights in 2017 for a total of sixteen (16) trap nights. Elliott traps were set on arboreal platforms attached to the side of potential habitat trees at approximately 3-4m above the ground. Arboreal Elliott trap locations were situated along the Elliot and cage trapping lines shown in **FIGURE 13**. Arboreal Elliott traps were baited with a mixture of peanut butter, honey and oats. Honey water was also sprayed on the trunk of trees above the arboreal traps.

Pitfall Traps/Funnel Traps
Target species – Common planigale, reptiles, amphibians.

In 2004, five (5) pitfall lines of five (5) buckets (10 litre) spaced five (5) metres apart (incorporating drift fencing) were set for a period of three (3) nights. A total of 75 bucket nights were achieved during this component of the Study. Pitfall trap locations are shown in **FIGURE 12.**

In 2017, pitfalls were set along a series of line transects throughout The Glades development site (the use of pitfall traps was dependant on ground conditions). Where ground conditions were not suitable for installing pitfall traps (i.e. hard, rocky ground) funnel traps were utilised instead. Six (6) pitfall/funnel trap transect lines, each with six (6) pitfall/funnel traps, were set for a period of three (3) nights for a total of one hundred and eight (108) trap nights. Pitfall/Funnel trap locations are shown in **FIGURE 13**.

Hair Tubes
Target species – ground-dwelling mammals.

In 2004, six (6) lines of five (5) hair tubes each were laid on the Subject site. Each Hair Tube was baited with rolled oats, honey, peanut butter and vanilla essence and then set for a period of fourteen (14) nights. Samples were identified by Barbara Triggs.

No hair tube traps were deployed during the 2017 surveys as this labour-intensive technique did not reveal any additional fauna species that were not otherwise recorded by alternative survey techniques (i.e. Elliott traps, cage traps, pitfall traps) during the 2004 surveys.

Call Playback Techniques
Target species - Powerful owl, Masked owl, Koala, Grass owl, Yellow-bellied glider, Squirrel glider and Wallum froglet.

In both 2004 and 2017, call playback was carried out over four (4) and three (3) nights, respectively, at various locations throughout The Glades site for a period of one (1) hour. Target species included: Powerful owl, Masked owl, Koala, Grass owl, Yellow-bellied glider, Squirrel glider and Wallum froglet. Calls were broadcast, and then followed by a five (5) minute listening period. Call playback locations are shown in **FIGURE 12** and **13.**

A targeted Grass owl call playback was undertaken at seven (7) selected sites for three consecutive nights on the 23rd, 24th, & 25th of September 2004. Grass owl calls were broadcast and a ten minute listening period followed. Spotlighting was undertaken for 10 minutes at each of the sites following call broadcast to determine whether owls had flown in to the broadcast site.

Specialist Avian Survey
Target species - All diurnal avian species

In 2004, a survey was carried out to sample diurnal bird species. A dawn and dusk census was completed by one (1) person walking through bushland along Skinners and Moonee Creeks for a total of two (2) hours over four (4) days. Incidental observations were recorded by both ecologists in 2004 while checking traps and mapping vegetation.

Incidental bird observation were recorded by two (2) ecologists in 2017 while checking traps and conducting other site assessments.

Harp Netting
Target species - All microchiropteran bats

In 2004, two (2) Harp traps were set in potential flyways over three (3) nights. Flyways were chosen on the basis of adequate cover on both sides of the trap, and screening was incorporated to enhance capture success. One of the harp traps was left in position for the three nights due to lack of other suitable positions. The other harp trap was moved each night in order to adequately survey The Glades site. A total of six (6) trap nights was achieved in this component of the study.

No harp traps were deployed during the 2017 surveys as this labour-intensive technique did not reveal any additional microchiropteran bat species that were not otherwise recorded by alternative survey techniques (i.e. Anabat) during the 2004 surveys.

Anabat Recording/Song Meter
Target species - All microchiropteran bats

In 2004 a Anabat II sonar detector (Titley Electronics, Ballina) was used to download the ultrasonic calls of Microchiropteran bats. Recording was undertaken for ten (10) hours per night over two (2) nights, and for four (4) hours on the third night. A total of twenty-four (24) hours of recording was undertaken. Recording times commenced from slightly before dusk. Recording was undertaken by positioning the Anabat II sonar detector facing across possible bat flyways (**FIGURE 12**). Anabat records were identified by Dr. Greg Richards.

In 2017, a SongMeter SM2Bat+ ultrasonic bat detector unit was used to record microbat calls from The Glades development site. The Songmeter was placed at two (2) locations over two (2) nights (one night per location) between the hours of dusk (1800h) and dawn (0600h). The data from these recordings were analysed by an expert in echolocation call identification. SongMeter locations are shown in **FIGURE 13**.

Spotlighting
Target species - Powerful owl, Masked owl, Eastern grass owl, Brush-tailed phascogale, Yellow-bellied glider, Squirrel glider, Koala, Grey-headed flying fox and all nocturnal bird species.

Spotlighting was undertaken by four (4) investigators for one and a half (1.5) hours each on the night of the 11th of May 2004 for a total of six (6) hours spotlighting. Additional spotlighting was carried out on the nights of the 12th and 13th of May 2004 by two (2) investigators for totals of four (4) hours and three (3) hours respectively. The weather for the spotlighting survey was fine and warm.

Spotlighting was undertaken by two (2) investigators for three hours each night between the 27th and 29th March 2017 for a total of eighteen (18) person hours spotlighting. The weather for the spotlighting surveys was warm and dry.

Sections of the site that could be accessed were driven in a four-wheel drive vehicle. The speed of the vehicle was kept under 5km/hour. A large spotlight was used to detect 'eye-shine' from nocturnal fauna. If fauna could not be identified from the vehicle, it was necessary to approach them on foot with a handheld spotlight and to identify them with binoculars.

Spotlighting was also conducted on foot in order to access heavily vegetated areas on the subject site. The observer walked at approximately 1km/h, allowing intensive listening as an adjunct to visual detection.

Koala Scat Searches
A search for Koala scats (approximately 2 minutes per tree) was undertaken under primary Koala feed trees known to be extensively utilised within Coffs harbour LGA, primarily Tallowwood (*Eucalyptus microcorys*) and Swamp mahogany (*E. robusta*).

Infrared Motion Detector Cameras
Eight (8) infrared motion detector cameras were positioned throughout the Subject site for a period of three (3) nights during the 2017 survey for a total of twenty-four (24) trap nights. Camera locations are shown in **FIGURE 13**. Bait included a mixture of peanut butter, honey and oats, and sardines, which was positioned to draw animals into the range of the camera.

3.3 Results and Discussion

3.3.1 Database Search

OEH database searches revealed forty-nine (49) threatened fauna species that may occur within 10km of the subject site. The Commonwealth PMST identified twenty-three (23) threatened fauna species that may occur within 10km of the subject site based on the availability of suitable habitat within the locality. Threatened fauna species detected in the database searches are listed in **TABLE 6**. The conservation status of each species listed in **TABLE 6** is shown in accordance with the Commonwealth *EPBC Act* (*1999*) and *TSC Act (1995)*. Species that will clearly not occur on the site i.e. whales, sharks, marine turtles and marine birds have been omitted.

Database searches using the Commonwealth PMST also revealed that twenty-five (25) migratory species may occur within 10km of the site based on the availability of suitable habitat. Migratory species identified in database searches are listed in **TABLE 7**.

TABLE 6
NPWS DATABASE RECORDS OF THREATENED FAUNA SPECIES
WITHIN 10 KM OF THE SUBJECT SITE

Scientific name	Common name	TSC Act*	EPBC Act#
Aepyprymnus refescens	Rufous bettong	V	-
Anthochaera phrygia	Regent honeyeater	E4A	CE
Argynnis hyperbius inconstans	Australian fritillary	(E)	CE
Artamus cyanopterus cyanopterus	Dusky woodswallow	V	-
Botaurus poiciloptilus	Australasian bittern	(E)	E
Calidris canutus	Red knot	-	E
Calidris ferruginea	Curlew sandpiper	(E)	CE
Callocephalon fimbriatum	Gang-gang cockatoo	V	-
Calyptorhynchus lathami	Glossy black-cockatoo	V	-
Chalinolobus dwyeri	Large-eared pied bat	(V)	V
Climacteris picumnus	Brown treecreeper	V	-
Coracina lineata	Barred cuckoo-shrike	V	-
Crinia tinnula	Wallum froglet	V	-
Daphoenositta chrysoptera	Varied sittella	V	-
Dasyomis brachypterus	Eastern bristlebird	(E)	E
Dasyurus maculatus	Spotted-tailed quoll	V	E
Ephippiorhynchus asiaticus	Black-necked stork	E1	-

Scientific name	Common name	TSC Act*	EPBC Act#
Erythrotriorchis radiatus	Red goshawk	(CE)	V
Esacus magnirostris	Beach stone-curlew	E4A	-
Glossopsitta pusilla	Little lorikeet	V	-
Grus rubicundus	Brolga	V	-
Haematopus fuliginosus	Sooty oystercatcher	V	-
Haematopus longirostris	Pied oystercatcher	E1	-
Haliaeetus leucogaster	White-bellied sea-eagle	V	-
Hieraaetus morphnoides	Little eagle	V	-
Hoplocephalus stephensii	Stephens' banded snake	V	-
Irediparra gallinacea	Comb-crested jacana	V	-
Ixobrychus flavicollis	Black bittern	V	-
Kerivoula papuensis	Golden-tipped bat	V	-
Litoria brevipalmata	Green-thighed frog	V	-
Litoria olonburensis	Wallum sedge frog	V	V
Lathamus discolor	Swift parrot	E1	CE
Lophoictinia isura	Square-tailed kite	V	-
Miniopterus australis	Little bentwing-bat	V	-
Miniopterus schreibersii oceanensis	Eastern bent-wing Bat	V	-
Mixophyes balbus	Stuttering frog	(E)	V
Mixophyes iteratus	Giant barred frog	E1	E
Mormopterus norfolkensis	Eastern freetail-bat	V	-
Myotis macropus	Large-footed myotis/ Southern myotis	V	-
Ninox strenua	Powerful owl	V	-
Numenius madagascariensis	Eastern curlew	-	CE
Pandion cristatus	Eatern osprey	V	-
Petauroides volans	Greater glider	-	V
Petaurus australis	Yellow-bellied glider	V	-
Petaurus norfolcensis	Squirrel glider	V	-
Petrogale penicillata	Brush-tailed rock-wallaby	(E)	V
Petroica boodang	Scarlet robin	V	-
Phascogale tapoatafa	Brush-tailed phascogale	V	-
Phascolarctos cinereus	Koala	V	V
Phyllodes imperiallis smithersi	Pink underwing month	(E)	E
Planigale maculata	Common planigale	V	-
Pomatostomus temporalis temporalis	Grey-crowned babbler (eastern subspecies)	V	-
Potorous tridactylus tridactylus	Long-nosed potoroo	(V)	V
Pseudomys novaehollandiae	New Holland mouse	(-)	V
Pteropus poliocephalus	Grey-headed flying-fox	V	V
Ptilinopus magnificus	Wompoo fruit-dove	V	-

Scientific name	Common name	TSC Act*	EPBC Act#
Ptilinopus regina	Rose-crowned fruit-dove	V	-
Rostratula australis	Australian painted snipe	(E)	E
Saccolaimus flaviventris	Yellow-bellied sheathtail-bat	V	-
Syconycteris australis	Common blossom-bat	V	-
Turnix melanogaster	Black-breasted button-quail	(CE)	V
Tyto longimembris	Eastern grass owl	V	-
Tyto novaehollandiae	Masked owl	V	-
Tyto tenebricosa	Sooty owl	V	-

* NSW Threatened Species Conservation Act 1995 (TSC Act)

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

E1 – Endangered (state), E2 – Endangered Population, E4 – Critically Endangered (state), E – Endangered (national), V – Vulnerable, CE – Critically Endangered (national)

TABLE 7
DATABASE RECORDS OF COMMONWEALTH LISTED MIGRATORY SPECIES WITHIN 10KM OF THE SITE

Scientific Name	Common Name	Status#
Actitis hypoleucos	Common sandpiper	M
Apus pacificus	Fork-tailed swift	M
Ardea alba	Great egret	M
Ardea ibis	Cattle egret	M
Calidris acuminata	Sharp-tailed sandpiper	M
Calidris canutus	Red knot	E
Calidris ferruginea	Curlew sandpiper	CE
Calidris melanotos	Pectoral sandpiper	M
Cuculus optatus	Oriental cuckoo	M
Cuculus saturates	Oriental cuckoo	M
Gallinago hardwickii	Latham's snipe	M
Gallinago megala	Swinhoe's snipe	M
Gallinago sternura	Pin-tailed snipe	M
Haliaeetus leucogaster	White-bellied sea-eagle	M
Hirundapus caudacutus	White-throated needletail	M
Lathamus discolour	Swift parrot	CE
Merops ornatus	Rainbow bee-eater	M
Monarch melanopsis	Black-faced monarch	M
Monarch trivirgatus	Spectacled monarch	M
Myiagra cyanoleuca	Satin flycatcher	M
Numenius madagascariensis	Eastern curlew	CE
Pandion haliaetus	Osprey	M
Rhipidura ruffrons	Rufous fantail	M
Rostratula benghalensis	Painted snipe	E
Tringa nebularia	Common greenshank	M

CCE - Critically Endangered, CE - Endangered, CV - Vulnerable & M – Migratory as listed within schedules of the Commonwealth *EPBCA (1999)*

A database search was also completed for records of Threatened fauna within Moonee Beach Nature Reserve which occurs adjacent the Subject site. Seventeen (17) Threatened species have been recorded from the Reserve and include:

- Glossy black-cockatoo (*Calyptorhynchus lathami*);
- Pied oystercatcher (*Haematopus longirostris*);
- Eastern Osprey (*Pandion haliaetus*);
- Black-necked stork (*Ephippiorhynchus asiaticus*);
- Brown treecreeper (*Climacteris picumnus*);
- Sooty oystercatcher (*Haematopus fuliginosus*);
- Comb-crested jacana (*Irediparra gallinacea*);
- Squirrel glider (*Petaurus norfolcensis*);
- Koala (*Phascolarctos cinereus*);
- Grey-headed flying fox (*Pteropus policephalus*);
- Common blossom bat (*Syconcteris australis*);
- Little bent-wing bat (*Miniopterus australis*);
- White-bellied sea-eagle (*Haliaeetus leucogaster*);
- Square-tailed kite (*Lophoictinia isura*);
- Little tern (*Sternula albifrons*);
- Little lorikeet (*Glossopsitta pusilla*); and
- Eastern bent-wing bat (*Miniopterus schreibersii oceanensis*).

3.3.2 Literature Review

A full fauna survey was completed for Lot 122 DP 1053566, Moonee Beach Road, Moonee by JWA in 2003. This site occurs approximately 1 km south-east of the site. Six (6) Threatened species were recorded:

- Pied oystercatcher (*Haematopus longirostris*);
- Osprey (*Pandion haliaetus*);
- Glossy black cockatoo (*Calyptorhynchus lathami*);
- Little bent-wing bat (*Miniopterus australis*);
- Large-footed myotis (*Myotis macropus*); and
- Grey-headed flying-fox (*Pteropus policephalus*).

The Clancy Flora and Fauna Assessment of the Moonee Release Area (1998) recorded eight (8) Threatened fauna species:

- Little bent-wing bat (*Miniopterus australis*);
- Common bent-wing bat (*Miniopterus schreibersii*);
- Large-footed myotis (*Myotis macropus*);
- Osprey (*Pandion haliaetus*);
- Pied oystercatcher (*Haematopus longirostris*);
- Sooty oystercatcher (*Haematopus fuliginosus*); and

- Glossy black cockatoo (*Calyptorhynchus lathami*).

Clancy (1998) recorded three (3) Threatened species from The Glades site:

- Yellow bellied glider (*Petaurus autralis*) – in the north-west corner of the site
- Common bent-wing bat (*Miniopterus schreibersii*) – in the eastern part of the Subject site
- Osprey (*Pandion haliaetus*) - from nest in the south-east of the Subject site.

Clancy (1998) also notes that Koalas have been recorded in the north-west of The Glades site along Skinners Creek.

3.3.3 Coffs Harbour LGA Fine-scale Vegetation Mapping

The Coffs Harbour Fine-scale Vegetation mapping has not identified any areas of High Value Arboreal Habitat on the Subject site (**FIGURE 14).**

3.3.4 Koala Habitat

The Coffs Harbour City Council has not mapped Koala habitat within the Subject site (**FIGURE 15**). However, secondary Koala habitat has been mapped north of the Subject site along the northern and eastern boundaries of The Glades site, as well as a few small patches mapped along the southern boundary of The Glades (**FIGURE 15**).

3.3.5 Habitat Assessment

3.3.5.1 Amphibians

Amphibians occurring in the region are poikilothermic, predominantly insectivorous and generally require free water for reproduction, with the exception of two highland genera (*Assa darlingtoni* and *Philoria* spp.). The habitat requirements of most species are unlikely to be determined by forest cover or floristics, but are more strongly influenced by factors such as climate, distance to water bodies, riparian vegetation, hydrological and morphological characteristics of water bodies and the availability of suitable micro-habitat for aestivation and shelter.

The majority of species that occur within the region lay eggs in or near temporary or permanent water bodies and rely on free water for larval development and metamorphosis. Of these species, only a few are dependent on forested habitats beyond the riparian zone or beyond areas of temporary inundation. These species include the Red-eyed tree frog (*Litoria chloris*), Leseuer's frog (*Litoria leseueri*), Fletchers frog (*Lechriodus fletcheri*) and the Barred frogs of the *Mixophyes* genus.

The Subject site is likely to provide good quality habitat for a range of frogs. The Subject site provides areas of moderately deep leaf litter for shelter. Surrounding vegetation within The Glades also offer a variety of good quality habitat for a range of frogs, including the dam in the south-east, the paperbark forest adjacent to the dam, and

SOURCE: Coffs Harbour City Council Online Mapping Tool accessed 05/04/17

SCALE: 1 : 5000 @ A3

JWA PTY LTD
Ecological Consultants

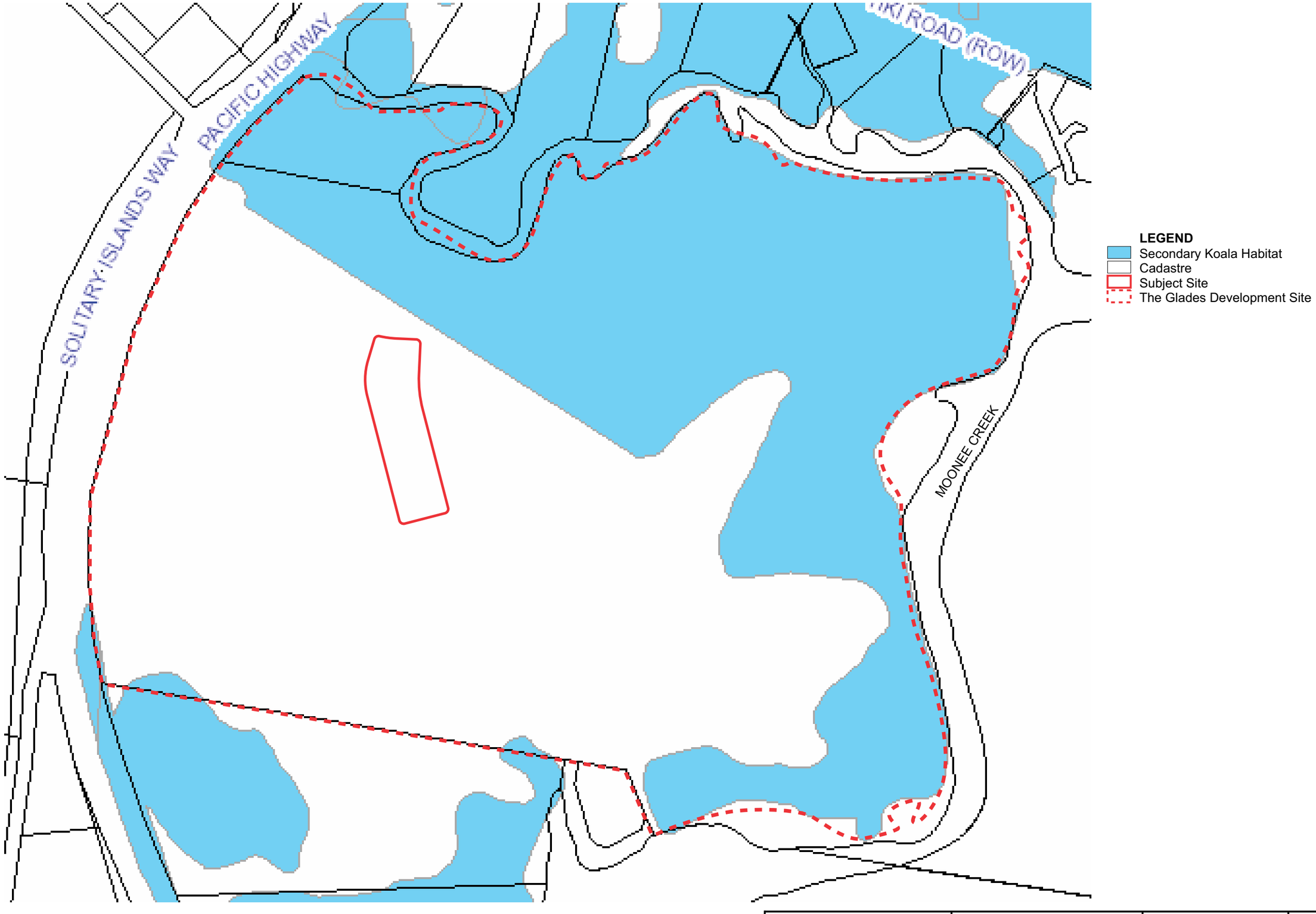
CLIENT
Rothwell Boys Pty Ltd

PROJECT
Flora & Fauna Assessment
Lots 1 & 2 DP725785
Pacific Highway, Moonee NSW
Coffs Harbour City Council LGA

FIGURE 14

PREPARED: BW
DATE: 16 October 2017
FILE: N02066_CHC Arboreal Hab.cdr

TITLE
COFFS HARBOUR CITY COUNCIL HIGH VALUE ARBOREAL HABITAT



SOURCE: Coffs Harbour City Council Online Mapping Tool accessed 05/04/17

SCALE: 1 : 5000 @ A3

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Pacific Highway, Moonee NSW
Coffs Harbour City Council LGA

FIGURE 15

PREPARED: BW
DATE: 16 October 2017
FILE: N02066_Koala.cdr

TITLE

COFFS HARBOUR CITY COUNCIL KOALA HABITAT

sedgeland communities. The drainage line in the north-western corner of The Glades site is another area of good quality habitat, with areas of dense Lomandra providing good shelter opportunities.

Grasslands provide suitable habitat for a range of Amphibian species, particularly along drainage depressions and soaks. Species commonly encountered in grassland communities include the Common eastern froglet, Eastern sign bearing froglet, Striped marsh frog, Spotted grass frog, Eastern dwarf tree frog, Rocket frog, Whistling tree frog and Cane toad. Sedgeland communities in low lying grassland areas may provide suitable habitat for these species.

Species typically encountered in or adjacent to Closed Forests include the Eastern dwarf tree frog, Red-eyed tree frog, Striped marsh frog, Cane toad and Dainty green tree frog. Relatively few species occur in conjunction with Closed Forest types when permanent water is absent. Species which typically occur in low elevation Rainforest and permanent streams such as the Giant barred frog (*Mixophyes iteratus*) are unlikely to occur at the Subject site.

3.3.5.2 Reptiles

As reptiles are poikilothermic, and predominantly insectivorous or carnivorous, their habitat requirements are less directly determined by vegetation species composition than other taxa which feed directly on plants. Reptile distributions are strongly influenced by structural characteristics of the vegetation, climate and other factors affecting thermoregulation such as shade and availability of shelter and basking sites (Smith *et al* 1994).

In a survey of the moist forest herpetofauna of North-eastern NSW, Smith *et al* (1989) found that few species discriminated between rainforest and wet sclerophyll forest, however, most species exhibited a response to differences in elevation and the availability of microhabitat components and other substrates.

The availability of microhabitats, of varying thermal properties is particularly important for most reptile species, as behavioural thermoregulation (regulation of body heat) is important in controlling critical body functions such as digestion, foraging activity and reproduction.

Reptile diversity and abundance is often (but not always) significantly higher in drier habitat types, particularly those with a wide variety of ground substrate microhabitats. This contrasts markedly with the distribution patterns of birds, and most mammals.

The single limiting factor in terms of species diversity in coastal vegetation is the lack of shelter sites (eg. logs, tree hollows and decorticating bark). Such habitat components characterise eucalypt forests and woodlands, where species diversity may be much higher, depending on disturbance factors.

The Subject site is considered to provide good quality habitat for reptiles due to the presence of: the combination of shelter and basking sites; fallen logs for shelter; forested areas with good canopy and leaf litter development; and reliable sources of prey.

3.3.5.3 Birds

The significance of near coastal environments of the N.S.W. Far North Coast and South-East Queensland as over-wintering habitat for migratory birds has been established by many observers and bird banders including Keast (1968), Robertson (1973), Gravatt (1974), Porter (1982) and Robertson and Woodall (1983). These patterns may be attributable to the relatively high winter temperatures and long growing season of this region compared with the rest of south-eastern Australia (Fitzpatrick and Nix 1973; Edwards 1979; Nix 1982; Specht *et al* 1981).

Many insectivorous birds from higher latitudes and elevation over-winter in the locality. These include species such as the Fantail cuckoo, Sacred kingfisher, Rainbow bee-eater, Noisy pitta, Tree martin, Black-faced cuckoo-shrike, Cicada bird, Golden whistler, Rufous whistler, Rose robin, Grey fantail, White-throated gerygone, Silvereye, Olive-backed oriole and Spangled drongo.

Birds such as honeyeaters and lorikeets are Blossom nomads (*ibid.*). These birds move locally in response to variation in the availability of nectar and or pollen, important components in their diet. Porter (1982) highlights the importance of Forest red gum, Broad-leaved paperbark and Coast banksia for Scaly-breasted and Rainbow lorikeets as these species flower during the lorikeet's winter breeding period. A sequence of important nectar bearing plants in the genera Eucalyptus, Banksia, Melaleuca and Callistemon provide a continuity of food for nectarivorous birds.

Studies of bird usage in rainforest remnants by Holmes (1987), Connelly and Specht (1988) and Lott & Duigan (1993) indicate that the diversity and abundance of birds is related to the size of the Rainforest patches and their degree of isolation from major areas of native forest. Lott & Duigan (1993) and Howe *et al* (1981) also note that sites with a higher diversity of vegetation and those which are closer to water generally support a greater diversity of birds. Locally nomadic and migratory rainforest species such as the Wompoo, Rose-crowned and Superb fruit-doves, Common koel and Black-faced cuckoo-shrike are known to use scattered areas of habitat as "stepping-stones" between more intact areas of forest (Date *et al* 1992; Lott & Duigan 1993).

The variety of habitats present on and adjacent to the Subject site is likely to result in a high diversity of resident and nomadic birds occurring on the Subject site over the year. Habitat which occur on or adjacent to the Subject site include open woodland, grassland, sclerophyll forest, wetland, and tidal communities such as mangrove and saltmarsh.

The Subject site provides foraging resources for nectarivorous birds due to the occurrence of Eucalypt, Melaleuca and Banksia species. The Subject site provides a relatively low diversity and abundance of fruiting species. The Subject site and adjacent areas of vegetation represent moderate quality habitat for frugivorous birds.

No trees with hollows necessary for hollow-nesting birds were recorded on the Subject site. However, a moderate number of trees with hollows were recorded in the surrounding The Glades development site. The Subject site may represent important forage habitat for hollow-dependent avifauna breeding in forests in the locality.

3.3.5.4 Mammals

Small terrestrial mammals generally occur in highest densities in association with a complex vegetation structure. A dense understorey layer, which provides shelter from predators and provides nesting opportunities, is particularly important.

In general, medium-large terrestrial mammals such as macropods select habitats which provide a dense cover for shelter and refuge and open areas for feeding. The larger species tend to occupy drier more open habitats: the smaller species, moister and more densely vegetated habitats.

All Arboreal mammals that occur in the region (with the exception of the Koala) utilise tree hollows for nesting and shelter (although the Common ringtail possum is not dependent on hollows). Smith & Lindenmeyer (1988) consider that shortage of nest hollows is likely to limit arboreal mammal populations where density of hollow bearing trees is less than 2 to 8 trees per hectare.

Arboreal folivores (*e.g.* Common ringtail possum, Greater glider) are widespread and abundant but exhibit local variation in response to such factors as tree species composition, foliage protein and fibre levels, leaf toughness, toxins, forest structure and the availability of shelter sites. Arboreal folivores are expected to be most abundant in areas of high productivity, high soil fertility and moderate climate, in conjunction with adequate shelter and suitable foraging substrate.

Arboreal nectarivore/insectivores feed on a wide variety of plant and insect exudates including the nectar of flowering eucalypts, and shrubs such as Banksia and Acacia sp. These species also feed extensively on insects, particularly under the shedding bark of eucalypts. The distribution of nectarivore/insectivores is considered to be related to the abundance of nectar and pollen producing plants, the abundance of bark shedding eucalypts which harbour insect prey, and the occurrence of sap and gum exudate producing trees (Sap feed trees) and shrubs (*e.g.* Acacia sp.). Arboreal nectarivores and insectivores are generally hollow dependent species.

No trees with hollows necessary for hollow-dependent mammals were recorded on the Subject site. However, a moderate number of trees with hollows were recorded in the surrounding The Glades site. However, as with the birds, the vegetation on and adjacent to the Subject site may represent important forage habitat for hollow-dependent mammals resident in forests in the locality. Trees known to be used by Koalas in the Coffs Harbour LGA occur on the Subject site and include Broad-leaved paperbark, Blackbutt and Pink bloodwood.

The structural complexity and habitat diversity of the Subject site is likely to support a moderate diversity and abundance of ground dwelling mammals. Expected species include: Black rat, Swamp rat, House mouse, *Antechinus* sp., *Melomys* sp., and the Northern brown bandicoot.

Insectivorous bats, like insectivorous birds, overlap considerably in diet and broad vegetation preferences (Hall 1981), but specialise in foraging in specific layers or substrates within the forest (Crome and Richards 1988). Vegetation on and adjacent to the Subject site is likely to provide forage habitat for a relatively high diversity and abundance of insectivorous bats, due to the combination of open, forested and denser areas of vegetation. The nectarivorous Common blossom bat may forage on Broad-leaved paperbark and Hairpin Banksia throughout the Subject site.

Several old-growth trees suitable for hollow-dependant bats occur along Skinners and Moonee Creeks. Areas of more mature forest along the northern edge of The Glades site represent suitable roost habitat for the Threatened Black flying-fox and Grey-headed flying fox. Suitable roost habitat for the Common blossom bat (*ie.* Littoral rainforest) does not occur on the Subject site.

3.3.5.5 Tree Hollows Within the Development Area

All of the trees within the development area of the Subject site were inspected for the presence of hollows, fissures or spouts. No trees with hollows were recorded within the Subject site impact area during the 2017 survey.

The majority of mature trees with well-developed hollows occur outside the development area, within the north-east and eastern portions of The Glades development site in vegetation communities flanking Skinners and Moonee Creeks.

3.3.6 Corridor Analysis

An assessment of the existing (pre-development) habitat values of the 1.747 ha of additional vegetation proposed to be removed from the subject site for native fauna groups and threatened fauna species previously recorded from the broader Glades development site was completed (**TABLE 8**). The assessment also includes a summary of the likely impacts of removing the vegetation within this area.

An assessment was also completed on the likely post-development corridor values of the vegetation for native fauna groups and threatened fauna species previously recorded from the broader development site (**TABLE 9**). The assessment also includes a summary of the likely impacts on fauna movement opportunities of removing the vegetation within this area. To assess whether this vegetation would be an effective movement corridor for native fauna, values considered included corridor width, length, shape, habitat type and quality, structural complexity, edge effects, general movement patterns of target fauna groups, and any fauna diversion or exclusion requirements (e.g. culverts, rope bridges, fences).

TABLE 8
ASSESSMENT OF EXISTING HABITAT VALUES OF ADDITIONAL VEGETATION TO BE REMOVED

Fauna group	Habitat provided by vegetation proposed for removal	Impacts
Amphibians	Amphibians occurring in the region are poikilothermic, predominantly insectivorous and generally require free water for reproduction. The habitat requirements of most species are unlikely to be determined by forest cover or floristics, but are more strongly influenced by factors such as climate, distance to water bodies, riparian vegetation, hydrological and morphological characteristics of water bodies and the availability of suitable micro-habitat for aestivation and shelter. The majority of species that occur within the region lay eggs in or near temporary or permanent water bodies and rely on free water for larval development and metamorphosis. Of these species, only a few are dependent on forested habitats beyond the riparian zone or beyond areas of temporary inundation. A small area (0.100ha) of Swamp sclerophyll forest occur within the northern portion of the vegetation proposed for removal and may provide suitable habitat for a range of native frog species. One (1) native frog species – Spotted grass frog (*Limnodynastes tasmaniensis*) - was recorded from this area during the recent surveys. One introduced frog species – Cane toad (*Bufo marinus*) – was also observed utilising this vegetation as habitat.	The loss of 0.100ha of potential habitat for commonly occurring native frog species is not considered significant when compared to available habitat to be retained/rehabilitated elsewhere on the broader development site.
Reptiles	As reptiles are poikilothermic, and predominantly insectivorous or carnivorous, their habitat requirements are less directly determined by vegetation species composition than other taxa which feed directly on plants. Reptile distributions are strongly influenced by structural characteristics of the vegetation, climate	The loss of 1.747ha of potential habitat for commonly occurring native reptile species is not considered significant when compared to available habitat to be retained/rehabilitated elsewhere on the broader development site.

Fauna group	Habitat provided by vegetation proposed for removal	Impacts
	and other factors affecting thermoregulation such as shade and availability of shelter and basking sites. The availability of microhabitats, of varying thermal properties is particularly important for most reptile species, as behavioural thermoregulation (regulation of body heat) is important in controlling critical body functions such as digestion, foraging activity and reproduction. Reptile diversity and abundance is often (but not always) significantly higher in drier habitat types, particularly those with a wide variety of ground substrate microhabitats. Suitable ground habitat (i.e. logs, fallen branches, leaf litter etc.) is present within the vegetation proposed for removal and may provide suitable habitat for a range of native reptile species. Two (2) native reptile species – Friendly sun skink (*Lampropholis amicula*) and Dark flecked sun skink (*L. guichenoti*) - were recorded from this area during the recent surveys.	
Birds	The significance of near coastal environments of the NSW Far North Coast and South-East Queensland as over-wintering habitat for migratory birds has been established by many observers and bird banders. These patterns may be attributable to the relatively high winter temperatures and long growing season of this region compared with the rest of south-eastern Australia. Many insectivorous birds from higher latitudes and elevation over-winter in the locality. Birds such as honeyeaters and lorikeets are blossom nomads. These birds move locally in response to variation in the availability of	The loss of 1.747ha of potential habitat for commonly occurring open country and disturbance-adapted native bird species is not considered significant when compared to available habitat to be retained/rehabilitated elsewhere on the broader development site.

Fauna group	Habitat provided by vegetation proposed for removal	Impacts
	nectar and or pollen, important components in their diet. A sequence of important nectar-bearing plants in the genera Eucalyptus, Banksia, Melaleuca and Callistemon provide a continuity of food for nectarivorous birds. Suitable habitat is present within the vegetation proposed for removal and may provide suitable habitat for a range of open country and disturbance-adapted native bird species. The vegetation is not considered suitable for forest interior or more reclusive species due to the linear nature of the patch and past disturbances. Thirteen (13) native bird species were recorded from this area during the recent surveys: - Magpie (*Gymnorhina tibicen*) - Eastern yellow robin (*Eopsaltria australis*) - Grey fantail (*Rhipidura fuliginosa*) - Grey shrike thrush (*Colluricincla harmonica*) - Laughing kookaburra (*Dacelo novaeguineae*) - Lewins honeyeater (*Meliphaga lewinii*) - Magpie-lark (*Grallina cyanoleuca*) - Noisy miner (*Manorina melanocephala*) - Pied butcherbird (*Cracticus nigrogularis*) - Rainbow lorikeet (*Trichoglossus haematodus*) - Red browed finch (*Neochmia temporalis*) - Torresian crow (*Corvus orru*); and - Variegated wren (*Malurus lamberti*)	
Mammals	Small terrestrial mammals generally occur in highest densities in association with a complex vegetation structure. A dense	The loss of 1.747ha of potential habitat for commonly occurring open country and disturbance-adapted native mammal species is not considered significant

Fauna group	Habitat provided by vegetation proposed for removal	Impacts
	understorey layer, which provides shelter from predators and provides nesting opportunities, is particularly important. In general medium-large terrestrial mammals such as macropods select habitats which provide dense cover for shelter and refuge and open areas for feeding. The larger species tend to occupy drier more open habitats: the smaller species, moister and more densely vegetated habitats. All Arboreal mammals that occur in the region (with the exception of the Koala) utilise tree hollows for nesting and shelter (although the Common ringtail possum is not dependent on hollows). Arboreal folivores (e.g. Common ringtail possum, Greater glider) are widespread and abundant but exhibit local variation in response to such factors as tree species composition, foliage protein and fibre levels, leaf toughness, toxins, forest structure and the availability of shelter sites. Arboreal folivores are expected to be most abundant in areas of high productivity, high soil fertility and moderate climate, in conjunction with adequate shelter and suitable foraging substrate. Arboreal nectarivore/insectivores feed on a wide variety of plant and insect exudates including the nectar of flowering eucalypts, and shrubs such as Banksia and Acacia sp. These species also feed extensively on insects, particularly under the shedding bark of eucalypts. The distribution of nectarivores/insectivores is considered to be related to the abundance of nectar and pollen producing plants, the abundance of bark shedding eucalypts which harbour insect prey, and the occurrence of sap and gum exudate-producing trees (Sap feed trees) and shrubs (e.g. Acacia sp.).	when compared to available habitat to be retained/rehabilitated elsewhere on the broader development site. There will be no loss of denning opportunities for hollow-dependant mammal species.

Fauna group	Habitat provided by vegetation proposed for removal	Impacts
	Arboreal nectarivores and insectivores are generally hollow-dependent species. Suitable habitat is present within the vegetation proposed for removal for a range of open country and disturbance-adapted ground-dwelling mammal species. Foraging opportunities are also available for a range of native arboreal mammals, however denning opportunities (i.e. old growth and/or hollow-bearing trees) are not present. Three (3) native mammal species were recorded from this area during the recent surveys: - Eastern grey kangaroo (*Macropus giganteus*); - Northern brown bandicoot (*Isodon macrourus*); and - Common brushtail possum (*Trichosurus vulpecula*).	
Threatened fauna species		
- Squirrel glider (*Petaurus norfolcensis*)	Breeding and denning sites for Squirrel glider are provided by tree hollows with a preference for small hollow entrances. The preferred feeding habitat contains winter flowering eucalypts or banksias including Swamp mahogany, Spotted gum, Coast banksia and Swamp paperbark. Foraging opportunities are present for the Squirrel glider within the vegetation proposed for removal, however denning opportunities (i.e. old growth and/or hollow-bearing trees) are absent. No Squirrel gliders were recorded in this area during recent surveys, nor have they been recorded utilising this vegetation during previous fauna surveys of the site.	The loss of 1.747ha of potential Squirrel glider foraging habitat is not considered significant when compared to available habitat to be retained/rehabilitated elsewhere on the broader development site. There will be no loss of denning opportunities for the Squirrel glider.

Fauna group	Habitat provided by vegetation proposed for removal	Impacts
- Glossy black cockatoo (*Calyptorhynchus lathami*)	Breeding sites for the Glossy black cockatoo consist of nests in large trees with large hollows (dead or alive) near streams and within 5-20km of a food source. It feeds on adult *Allocasuarina littoralis* and *A. torulosa* with individual trees believed to be selected on the basis of the nitrogen content of seeds. Stands of regenerating forage resources (i.e. *Allocasuarina* sp.) were observed in the southern half of the vegetation patch proposed for removal, however no mature *Allocasuarina* trees were observed, and no evidence of recent Glossy black cockatoo foraging activity (i.e. chewed cones) was recorded, nor have they been recorded utilising this vegetation during previous fauna surveys of the site. It is noted that foraging activity was recorded elsewhere on the broader development site during the recent surveys. No potential nesting sites (i.e. hollow-bearing trees) were observed.	The loss of approximately 0.87ha of potential Glossy black cockatoo foraging habitat is not considered significant when compared to available habitat to be retained/rehabilitated elsewhere on the broader development site. There will be no loss of nesting opportunities for the Glossy black cockatoo.
- Southern myotis (*Myotis adversus*)	Breeding and sheltering habitat for the Southern myotis consists of any forested riparian and adjacent vegetation around water bodies and coastal lakes and streams greater than first order streams. Breeding is in hollows, as well as under bridges and in caves. The Southern myotis forages in still water bodies with associated vegetation (tree line) and feeds on aquatic and other flying insects and small fish. The vegetation proposed for removal is not considered to represent suitable habitat for this species.	The proposed vegetation removal is not considered to impact on the Southern myotis or its habitat on the subject site.
- Little bent-wing bat (*Miniopterus australis*)	Breeding sites for Little bent-wing bats consist of limestone caves, where it usually occurs in association with the Common bent-wing bat. It congregates in high numbers in maternity roosts (in 1000's). It also shelters in a range of artificial structures including culverts,	The loss of 1.747ha of potential foraging habitat for the Little bent-wing bat is not considered significant when compared to available habitat to be

Fauna group	Habitat provided by vegetation proposed for removal	Impacts
	drains, mines etc. The Little bent-wing bat forages on flying insects in forested areas, predominantly swamp forest, moist eucalypt forest, rainforest and some dry forests. The vegetation proposed for removal does not contain suitable breeding or roosting habitat for this species. This species may occasionally forage within the vegetation.	retained/rehabilitated elsewhere on the broader development site. There will be no loss of breeding or roosting opportunities for this species.
- Osprey (*Pandion haliaetus*)	Ospreys forage for fish in fresh, brackish or saline waters of rivers, lakes, estuaries and inshore coastal waters. A breeding pair requires a suitable foraging area with nesting sites nearby. The nest is a large bulky structure of dead sticks, often located in a tall dead tree or on artificial structures such as power transmission poles or towers. It is used year after year for as long as it lasts. The vegetation proposed for removal does not represent suitable forage habitat for this species. No nest sites were observed in this patch of vegetation.	The proposed vegetation removal is not considered likely to impact on the Osprey or its habitat on the subject site.
- Black-necked stork (*Ephippiorhnchus asiaticus*)	The Black-necked stork inhabits swamps, mangroves, mudflats, dry floodplains, and irrigated land. An abundant supply of frogs and fish is required, together with suitable roost and nest trees, usually overhanging rivers and swamps. The vegetation proposed for removal is not considered to represent suitable habitat for this species.	The proposed vegetation removal is not considered likely to impact on the Black-necked stork or its habitat on the subject site.
- Wallum froglet (*Crinia tinnula*)	Wallum froglets are found only in acid paperbark swamps and sedge swamps of the coastal 'wallum' country. Wallum is a banksia-dominated lowland heath ecosystem characterised by acidic waterbodies. This species does not utilise open or free water in swamps but prefers the vegetated, muddy edges of pools, both temporary and permanent. Refuge habitat consists of a dense cover of ground vegetation, with interspersed tree canopy cover.	The proposed vegetation removal is not considered likely to impact on the Wallum froglet or its habitat on the subject site.

Fauna group	Habitat provided by vegetation proposed for removal	Impacts
	Breeding occurs in late winter in ephemeral sites such as larger puddles in heath or puddles in watercourses and creek-lines. The vegetation proposed for removal is not considered to represent suitable habitat for this species.	
- Koala (*Phascolarctos cinereus*)	Koalas utilise areas with a high diversity of known food trees (three or more) including Tallowwood, Grey gum, Forest oak, Sydney blue gum, Swamp mahogany and Red gums. The Koala shelters in larger trees with big lateral branches (not necessarily food trees). The Koala can disperse over any open habitat (including pasture and grassland) as long as scattered trees are present. Whilst a small number of Tallowwoods are scattered throughout the vegetation proposed for removal, no evidence of Koala activity (i.e. scats) was recorded during the recent surveys despite extensive searches, nor has the Koala been recorded from this area of the site during past surveys.	The loss of 1.747ha of potential habitat for the Koala is not considered significant when compared to available habitat to be retained/rehabilitated elsewhere on the broader development site.

TABLE 9

ASSESSMENT OF LIKELY POST-DEVELOPMENT CORRIDOR VALUES OF ADDITIONAL VEGETATION TO BE REMOVED

Fauna group	Corridor requirements	Impacts
Amphibians	A narrow sufficiently vegetated riparian/wetland corridor linking suitable habitat is generally sufficient for Amphibian movement, depending on species present. The core riparian area should be sufficient to provide protection from predators and to maintain moisture levels during extended periods of drought.	The vegetated corridor provided by the open space between residential precincts 1 and 2 is not considered suitable for amphibians due to the lack of riparian vegetation. The removal of this vegetation is not considered likely to impact on movement opportunities for amphibian species occurring on the site.

Fauna group	Corridor requirements	Impacts
Reptiles	A diversity of habitats is required to allow the movement of sun-loving and shade-loving species. A dense core habitat area should be provided as well as more open outer habitat areas.	The vegetated corridor provided by the open space between residential precincts 1 and 2 may provide suitable movement opportunities for a range of reptile species. However, these movement opportunities would be severely limited however by the road crossings at both the northern and southern ends of the corridor, lack of connecting vegetation to the south and potential edge effects associated with APZ construction and maintenance. The removal of this vegetation is not considered likely to impact on movement opportunities for reptile species occurring on the site when compared to other retained corridors along Moonee Creek and Skinners Creek.
Birds	A densely vegetated corridor is adequate to enable most birds to move between remnant habitat areas up to 1.2km apart. Corridors should include a densely vegetated core area and an outer densely vegetated buffer area to reduce impacts by introduced opportunistic species such as the Noisy minor. Fragmented ecosystems within an unnatural or hostile matrix may also create unnatural metapopulations i.e. where fragmented vegetation is more likely to be dominated by more aggressive edge species.	Suitable movement opportunities for a range of open country and disturbance-adapted native bird species is likely to be provided by the vegetated corridor provided by the open space between residential precincts 1 and 2. The vegetation is not considered suitable as a corridor for forest interior or more reclusive species due to the linear nature of the patch and past disturbances. The removal of this vegetation is not considered likely to impact on movement opportunities for reptile species occurring on the site when compared to other retained corridors along Moonee Creek and Skinners Creek.
Mammals	Small terrestrial mammals generally occur in highest densities in association with a complex vegetation structure, particularly in	The vegetated corridor proposed to be removed lacks densely vegetated or moist forest habitats required

Fauna group	Corridor requirements	Impacts
	areas with a dense understorey layer that provides shelter from predators and which offers nesting opportunities. Macropods require dense habitats for shelter but will readily graze in open areas and may be sensitive to edge effects such as an increase in light, noise and activity. Minimisation of these effects will enhance the value of the corridor. Minimisation of dog predation can enhance the value of corridors for macropods. Many species of arboreal marsupials appear to be sensitive to edge effects such as light, noise and activity. Microchiropteran bats use riparian corridors (amongst other features) for navigation, although an open flyway of any structure will encourage movement between habitat areas. These species readily disperse through disturbed landscapes. Megachirpteran bats also readily disperse through disturbed landscapes. Movements of this group are extensive and unrestricted by cleared or developed areas.	to facilitate the movement of forest interior species or species dependent on high levels of cover. More open forest types are present and may facilitate the movement of woodland or grassland species and Macropods. However, these movement opportunities would be severely limited however by the road crossings at both the northern and southern ends of the corridor, lack of connecting vegetation to the south and potential edge effects associated with APZ construction and maintenance. Potential edge effects are also likely to limit the suitability of this vegetated corridor for forest interior species and arboreal mammals. The removal of this vegetation is not considered likely to impact on movement opportunities for mammal species occurring on the site when compared to other retained corridors along Moonee Creek and Skinners Creek.
Threatened fauna species		
- Squirrel glider (*Petaurus norfolcensis*)	Many species of arboreal marsupials appear to be sensitive to edge effects such as light, noise and activity and this is considered to include the Squirrel glider.	Potential edge effects associated with APZ construction and maintenance are likely to limit the suitability of this vegetated corridor for the Squirrel glider. The removal of this vegetation is not considered likely to impact on movement opportunities for Squirrel gliders occurring on the site when compared to other retained corridors along Moonee Creek and Skinners Creek.

Fauna group	Corridor requirements	Impacts
- Glossy black cockatoo (*Calyptorhynchus lathami*)	This highly mobile species is not considered to be reliant on vegetated corridors for movement through the landscape.	The removal of this vegetation is not considered likely to impact on movement opportunities for the Glossy black-cockatoo.
- Southern myotis (*Myotis adversus*)	Microchiropteran bats use riparian corridors (amongst other features) for navigation, although an open flyway of any structure will encourage movement between habitat areas. These species readily disperse through disturbed landscapes	The removal of this vegetation is not considered likely to impact on movement opportunities for Southern myotis occurring on the site when compared to other retained corridors along Moonee Creek and Skinners Creek.
- Little bent-wing bat (*Miniopterus australis*)	Microchiropteran bats use riparian corridors (amongst other features) for navigation, although an open flyway of any structure will encourage movement between habitat areas. These species readily disperse through disturbed landscapes.	The removal of this vegetation is not considered likely to impact on movement opportunities for Little bent-wing bats occurring on the site when compared to other retained corridors along Moonee Creek and Skinners Creek.
- Osprey (*Pandion haliaetus*)	This highly mobile species is not considered to be reliant on vegetated corridors for movement through the landscape.	The removal of this vegetation is not considered likely to impact on movement opportunities for the Osprey.
- Black-necked stork (*Ephippiorhnchus asiaticus*)	This highly mobile species is not considered to be reliant on vegetated corridors for movement through the landscape.	The removal of this vegetation is not considered likely to impact on movement opportunities for the Black-necked stork.
- Wallum froglet (*Crinia tinnula*)	A narrow wetland corridor linking suitable habitat would be considered sufficient for the Wallum froglet. The core wetland/wallum habitat area should be sufficient to provide protection from predators and to maintain moisture levels during extended periods of drought.	The vegetated corridor provided by the open space between residential precincts 1 and 2 is not considered suitable for the Wallum froglet due to the lack of wetland/wallum vegetation. The removal of this vegetation is not considered likely to impact on movement opportunities for Wallum froglets occurring on the site.

Fauna group	Corridor requirements	Impacts
- Koala (*Phascolarctos cinereus*)	Koalas are known to use widely spaced trees to move between larger patches of forest. Koalas also move across landscapes by utilising 'stepping stones' of remnant vegetation. However, in residential areas where there are many hazards, such as the incidence of dog attack, car strike and stress amongst Koalas, 100m wide corridors in which tree canopies touch are preferential for long-term stability.	The vegetated corridor proposed to be removed may provide suitable movement opportunities for Koalas. However, these movement opportunities would be severely limited by the road crossings at both the northern and southern ends of the corridor, lack of connecting vegetation to the south and potential edge effects associated with APZ construction and maintenance. The removal of this vegetation is not considered likely to impact on movement opportunities for Koalas occurring on the site when compared to other retained corridors along Moonee Creek and Skinners Creek.

The assessment has determined that the likely post-development corridor values of the vegetation for native fauna species, including threatened fauna species previously recorded from the broader development site, are likely to be restricted to stepping stone habitat for highly mobile species only. The corridor values of the vegetation are considered to be significantly reduced due to (**FIGURE 16**):

- Road crossings at both the northern and southern ends of the corridor. The approved development plans do not allow for any fauna diversion or exclusion infrastructure at these road crossing (e.g. culverts, rope bridges, fences). Native fauna species would be at risk of injury or death at these road crossing points.
- Lack of connecting vegetation to the south. Whilst vegetation retention and rehabilitation works are proposed in open space areas to the south of the corridor, under the approved development layout these areas will be separated from the corridor by a road (discussed above), recreational areas (i.e. a playground, picnic facilities, boardwalks etc.), and stormwater treatment devices/basins. Fauna movement to the south would therefore be restricted to highly mobile species only.
- Edge effects. The approved development plans include the construction and maintenance of bushfire Asset Protection Zones (APZs) 20-40m wide within the eastern and western edges of the retained vegetation patch. This vegetation clearing/thinning and subsequent regular maintenance of APZs is considered likely to significantly reduce the habitat and corridor values of this vegetation patch for native fauna species, particularly forest interior species or species susceptible to edge effects.
- Lack of connectivity to significant habitat area. The subject site has limited connectivity to National Parks and Nature Reserves in the locality. The dual carriageway Pacific Highway to the west of the site represents a significant obstruction to fauna movement opportunities, as does existing residential development to the north and south of the site.

The development will retain (and embellish) significant fauna movement corridors occuring on the site along Moonee and Skinners Creeks. Riparian vegetation associated with these waterways provides connectivity between larger habitat areas. Waterway vegetation often provide higher quality corridor habitat because the vegetation around waterways is generally denser than surrounding areas and provides protection to, and facilitates the movement of, a range of fauna groups including more cryptic and slow-moving animals (Naiman and Décamps, 1997; Fitzgibbon *et al.*, 2007). Furthermore, waterways often have high invertebrate abundance and provide good sources of water and food for many animals.

3.3.7 Results of Fauna Surveys

3.3.7.1 Introduction

This section provides the results of all records and observations of fauna for the 2004 and 2017 surveys. Approximate locations of all Threatened species recorded on the Subject site and the surrounding The Glades development site are shown in **FIGURE 17**. A full list

In sensitive areas buffers to Skinners creek are increased from the minimum 50 metres

Recreation Node 1

20 metre highway buffer revegetated as thickly as APZ and service constraints will allow

Modification of existing vegetation will occur within highway buffer zone New roadside planting will accompany the construction of the entry road

Thinning of trees and understorey to reduce fire hazard

Site Boundary

Recreation Node 2

LEGEND

- Possible Fauna Movements to Habitat Corridors After Development
- Additional Impact Area Subject to Mod Application
- Subject Site
- The Glades Development Site

Proposed Offset Areas

- Proposed Rehabilitation / Offset Areas (13.71ha)
- Proposed Revegetation / Offset Areas (3.87ha)

Vegetation Management Plan

- Existing forest, swamp and mangrove communities protected and enhanced. Grazing removed and recreation contained to structured path ways. These areas will be fenced to allow rehabilitation to occur.
- Rehabilitation of indigenous forest communities. Natural buffer enhanced. Revegetation utilises existing seed source and fencing to aid re-establishment
- Rehabilitation of existing wetland, sedgeland, swamp sclerophyll and heath communities. Revegetation utilises existing seed source and fencing to aid re-establishment
- Revegetation of indigenous heath community. Slasing is to cease to allow natural recovery of plant species. The majority of this area will also be fenced to aid re-establishment
- Intensive landscape management within this zone. Recreation facilities are contained within areas of grassed open space with feature planting and interconnected via pathways. Area will be regularly mown and monitored to ensure quality of all landscape ad recreation features
- Proposed grouped indigenous tree planting (no understorey)
- Connecting laneway or medium strip, will be intensively managed and contain pathway, trees and grass
- * Any area shown white internal to the site will be mown and operate with dual primary purposes of storm water filtration and secondary as open space suitable for a variety of recreation uses
- Asset Protection Zone (APZ)

This zone has been identified for bushfire protection and complies with requirements recommended by the NSW Rural Fire Services. This zone also acts as an effective buffer between urban dwellings and natural vegetation. The APZ is part of the open space network and is characterised or may contain:

- recreation nodes
- perimeter roads
- block setbacks
- walking / cycle tracks
- playground / picnic facilities
- trees with no understorey
- will be slashed or mown regularly
- will operate as storm water filtering areas

0 150m

1 : 5000

SOURCE: JWA 2004 & 2017; ERM Annex H Plan 4 Veg Mgt (Jan 2018) (Ref: 20180206093044348.pdf)
SCALE: 1 : 5000 @ A3

JWA PTY LTD
Ecological Consultants

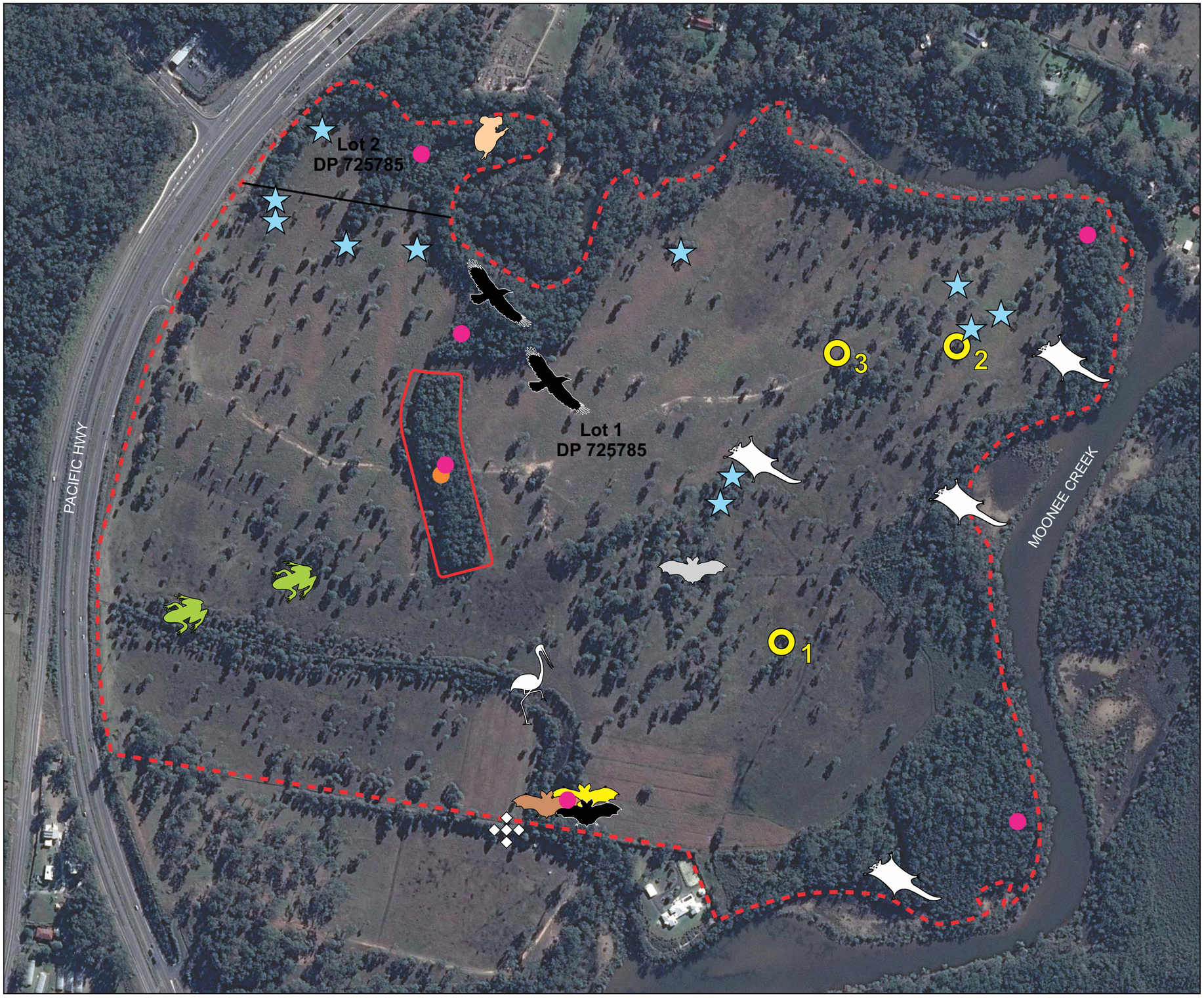
CLIENT
Winten Property Group Pty Ltd

PROJECT
Flora & Fauna Assessment
Lots 1 & 2 DP725785
Pacific Highway, Moonee NSW
Coffs Harbour City Council LGA

FIGURE 16

PREPARED: BW
DATE: 22 February 2018
FILE: N02066_Fauna Mvt.cdr

TITLE
PROPOSED OFFSET AREAS & POSSIBLE FAUNA MOVEMENTS AFTER DEVELOPMENT



LEGEND

- Subject Site
- The Glades Development Site

2004-2005 Surveys

- Squirrel glider
- Glossy black cockatoo
- Southern myotis
- Little bent-wing bat
- Common bent-wing bat
- Grey headed flying fox
- Osprey nest location (approximate)
- Black-necked stork
- Wallum froglet*
- Koala (scat)
- Koala feed tree within CHCC Secondary Koala Habitat (within development area only)
- Hollow bearing tree (within development area only)

2017 Surveys

- Common planigale
- Glossy black cockatoo (chewed cones)

* These records may have been a mis-identification of the Beeping froglet (*Crinia parinsignifera*).

Note: Koala feed trees and hollow bearing trees have been located by GPS survey which may contain an error of up to 4 metres.

0 150m

1 : 5000

SOURCE: JWA Site Investigations 2004 & 2017; Google Earth June 2016 Aerial Photo

SCALE: 1 : 5000 @ A3

JWA PTY LTD
Ecological Consultants

CLIENT
Rothwell Boys Pty Ltd

PROJECT
Flora & Fauna Assessment
Lots 1 & 2 DP725785
Pacific Highway, Moonee NSW
Coffs Harbour City Council LGA

FIGURE 17

PREPARED: BW
DATE: 16 October 2017
FILE: N02066_Fauna.cdr

TITLE

FAUNA RECORDS

of fauna species recorded and the year/s they were recorded in is provided in **APPENDIX 2.**

3.3.7.2 Reptiles

Five (5) reptile species were recorded during the 2004 fauna survey, and three (3) were recorded during the 2017 fauna survey, bringing the total to six (6) reptile species (**APPENDIX 2**). No Threatened reptiles were recorded.

3.3.7.3 Amphibians

Six (6) amphibian species were recorded during the 2004 site surveys, and are shown in **APPENDIX 2**. One Threatened species, the Wallum froglet was recorded in an incidental visit to The Glades site on the 3rd of June 2004 and was recorded from earlier surveys of The Glades site by JWA in 2003 (**FIGURE 17)**. However, this species was not recorded during the main survey period (May 2004). The main survey was completed in late Autumn during a relatively long dry spell. Amphibian activity could be expected to be low.

An additional survey was completed for Wallum froglets on The Glades development site in September 2005. Wallum froglets were not recorded during the targeted survey in 2005. However, six (6) other amphibian species were recorded, including two (2) additional species compared to the 2004 survey. A final targeted survey for the species was completed by frog expert Dr. Arthur White (Biosphere Consulting) in July 2006, however no Wallum froglets were recorded on Subject site during this survey either. White (2006) concluded that Wallum froglets utilise The Glades site periodically when conditions are favourable, and that no breeding habitat occurred on The Glades site, although potential breeding habitat did occur on neighbouring land to the south (Lot 7). As a result of field investigations, it is considered that the southern drain and adjacent land to the north and south comprise dispersal and forage habitat for the Wallum froglet on The Glades site and that no breeding habitat occurs on the Subject site.

Six (6) amphibian species were recorded during 2017 site surveys, bringing the total to ten (10) amphibian species (**APPENDIX 2**). The Threatened Wallum froglet was not recorded during the 2017 surveys despite suitable conditions being present. It is possible that the Wallum froglet continues to persist in small numbers on The Glades development site, but has suffered from competition with and been outcompeted by more aggressive open country species. Very large numbers of the Beeping froglets (*Crinia parinsignifera*) in particular have been recorded from the Subject site during the 2005 and 2017 surveys.

3.3.7.4 Birds

Fifty-nine (59) bird species were recorded throughout the The Glades development site in 2004, and thirty-seven (37) species in 2017, bringing the total to seventy-three (73) bird species. Birds recorded during the survey(s) are shown in **APPENDIX 2**.

Two (2) Threatened species have been recorded from The Glades development site - the Glossy black cockatoo (*Calyptorynchus lathami*) and Osprey (*Pandion haliaetus*). The

Black-necked stork (*Ephippiorhnchus asiaticus*) was also recorded in a preliminary survey by JWA in 2003. Locations of Threatened bird species records on or adjacent to the Subject site are shown in **FIGURE 17**.

3.3.7.5 Mammals

Twenty-nine (29) mammal species were recorded in 2004, including six (6) Threatened species:

- Squirrel glider (*Petaurus norfolcensis*)
- Little bent-wing bat (*Miniopterus australis*)
- Common bent-wing bat (*Miniopterus schreibersii*)
- Large-footed myotis (*Myotis macropus*)
- Koala (*Phascolarctos cinereus*)
- Grey-headed flying-fox (*Pteropus poliocephalus*)

Seven (7) introduced species including the Black rat, House mouse, Cow, Pig, Horse, Cat and Dog were also recorded in 2004.

Nine (9) mammal species were recorded in 2017, including two (2) Threatened species:

- Common planigale (*Planigale maculata*); and
- Grey-headed flying-fox (*Pteropus poliocephalus*).

One (1) introduced species, Cow, was also recorded on the Subject site in 2017.

A complete list of mammals recorded on or adjacent to (i.e. The Glades development site) the Subject site is shown in **APPENDIX 2**.

3.3.8 Threatened species considered possible occurrences on the Subject site

Based on the assessment of available habitat, Threatened fauna species known from the locality were assessed for the likelihood of their occurrence on the Subject site (**APPENDIX 3**). Nineteen (19) Threatened fauna species were known to occur or considered possible occurrences on the Subject site, including:

- Barred cuckoo-shrike (*Coracina lineata*);
- Brown treecreeper (*Climacteris picumnus*);
- Brush-tailed phascogale (*Phascogale tapoatafa*);
- Common blossom bat (*Syconycteris australis*);
- Common planigale (*Planigale maculata*) - RECORDED[#];
- Eastern freetail-bat (*Mormopterus norfolkensis*);
- Eastern grass owl (*Tyto longimembris*);
- Eastern osprey (*Pandion cristatus*) - RECORDED[#];
- Glossy black-cockatoo (*Calyptorhynchus lathami*) - RECORDED[#];
- Green-thighed frog (*Litoria brevipalmata*);

- Grey-headed flying-fox (*Pteropus poliocephalus*) - RECORDED[#];
- Koala[#] (*Phascolarctos cinereus*) - RECORDED[#];
- Little bentwing bat (*Miniopterus australis*) - RECORDED[#];
- Little lorikeet (*Glossopsitta pusilla*);
- Masked owl (*Tyto novaehollandiae*);
- Square-tailed kite (*Lophoictinia isura*);
- Squirrel glider (*Petaurus norfolcensis*) - RECORDED[#];
- Stephen's banded snake (*Hoplocephalus stephensii*); and
- Yellow-bellied glider (*Petaurus australis*).

[#]Recorded on The Glades development site.

Two (2) migratory fauna species were also considered to be possible occurrences on the subject site:

- Cattle egret (*Ardea ibis*); and
- Fork-tailed swift (*Apus pacificus*).

4 IMPACTS AND AMELIORATION

4.1 Impacts of the Proposed Development

4.1.1 Flora

The Subject site covers approximately 1.75 hectares, the majority of which is advanced regrowth closed forest. The proposed development intends to remove the vegetation within the Subject site and incorporate residential development (i.e. an additional 31 allotments).

A Flora and Fauna Assessment was completed for the Subject site in 2004 as part of The Glades development assessment (JWA 2007). This assessment identified the vegetation within the open space area as (**FIGURE 6**):

- Community 1f – Tall closed forest (*Eucalyptus planchoniana, Syncarpia glomulifera, Eucalyptusa pilularis*);
- Community 2b – Mid-high swamp sclerophyll forest (*Melaleuca sieberi +/- Melaleuca quinquenervia*); and
- Community 4a – Low closed grassland (*Andropogon virginicus, Themeda triandra*) with scattered trees.

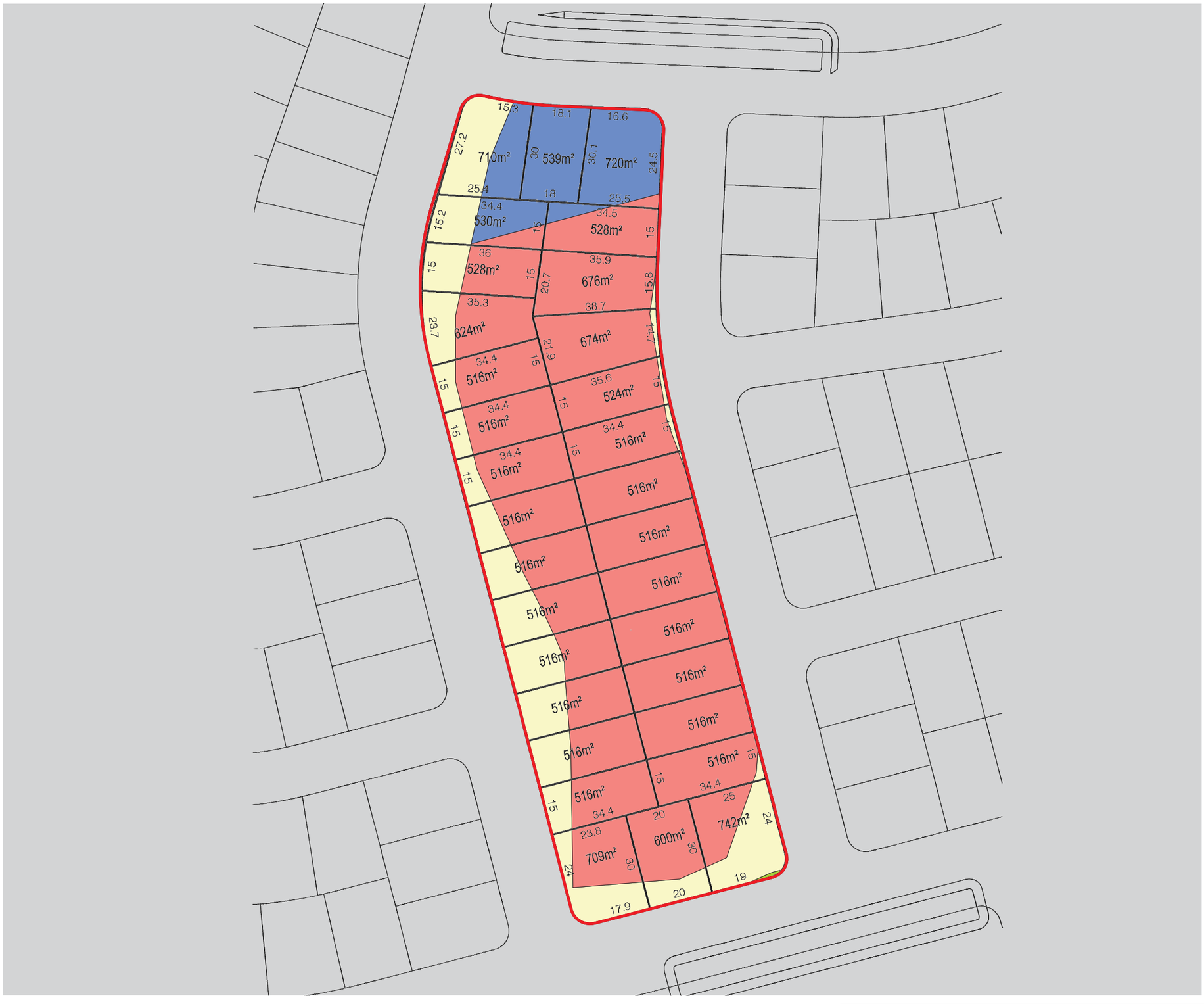
The boundaries and vegetation community descriptions were slightly modified in 2017 to reflect the current condition of these communities. **FIGURE 18** shows the impacts of the development layout to vegetation communities occurring on the Subject site. A summary of vegetation types to be lost and their respective areas are shown in **TABLE 10**. In total 1.75 ha of vegetation is proposed to be cleared. Of this vegetation to be lost, 1.37 ha is considered to be relatively intact native vegetation (i.e. communities 1f & 2b).

TABLE 10
VEGETATION TO BE LOST AS A RESULT OF THE PROPOSED DEVELOPMENT

Vegetation	Total Area	Area to be Removed	Area to be Retained
1f: Tall closed forest (*Eucalyptus planchoniana*, *Syncarpia glomulifera*, *Eucalyptus pilularis*)	1.19 ha	1.19 ha	0 ha
2b: Mid-high swamp sclerophyll forest (*Melaleuca sieberi +/- Melaleuca quinquenervia*)	0.18 ha	0.18 ha	0 ha
4a: Low closed grassland (**Andropogon virginicus* (Whiskey grass), *Themeda triandra* (Kangaroo grass)) with scattered trees.	0.37 ha	0.37 ha	0 ha
TOTAL	**1.75 ha**	**1.75 ha**	0 ha

Additional impacts on vegetation communities may include:

- Potential for degradation of retained areas of vegetation along Moonee Creek.



LEGEND

Subject Site

The Glades Approved Development Site

Dry Sclerophyll Forest/Woodland Communities

Community 1f - Tall closed forest (*Eucalyptus planchoniana*, *Syncarpia glomulifera*, *Eucalyptus pilularis*)

Swamp Sclerophyll Communities

Community 2b - Mid-high swamp sclerophyll forest (*Melaleuca sieberi*)

Grassland Communities

Community 4a - Low closed grassland (*Andropogon virginicus*, *Themeda triandra)* with scattered trees

Community 4b - Low closed grassland (*Themeda triandra*, *Juncus* sp.*)*

0 25m

1 : 1 250

SOURCE: RDM dwg no. 16083-1 & 16083-2 dated 12/10/17 (Ref: 20171013070442509.pdf); JWA Site Investigations 2004 & 2017

SCALE: 1 : 1250 @ A3

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FIGURE 18

PREPARED: BW
DATE: 24 October 2017
FILE: N02066_Impact Veg.cdr

TITLE

IMPACT ON VEGETATION COMMUNITIES

- Clearance of areas on the Subject site represents a loss of habitat available for dispersal for plants and will reduce visits by pollination and dispersal vectors.
- Disturbance to the Subject site creates opportunities for weeds to colonise. Weeds may be introduced to the Subject site in construction materials or by vehicles. Occupation of the Subject site creates opportunities for weeds to become established. Landscape species may escape to retained areas of vegetation.
- The removal of vegetation from the Subject site represents the loss of organic material from the site.
- Residents may create walking tracks through adjacent bushland areas retained within The Glades site to gain access to Moonee Creek. This may result in direct loss of vegetation, change in vegetation structure and increased opportunities for weeds and disturbance adapted animal species.
- Occupation of the Subject site may increase the risk of fire release into the surrounding bushland.

4.1.2 Fauna

The proposed development will result in some loss of foraging, sheltering and breeding habitat for native fauna occurring in the locality. This loss may have a range of impacts including:

- Loss of forage habitat for nectarivorous and insectivorous fauna species, including the loss of autumn/winter flowering plants.
- Minor decrease in the size of local fauna populations and increased susceptibility to threatening processes acting in the locality.
- Minor decrease in the size of the prey base for carnivorous species.
- Increased fragmentation of habitat in the locality.
- Some decrease in the genetic base for local fauna populations.
- Loss of sheltering and breeding habitat for native fauna.
- Reduction in opportunities for movement through the Subject site.
- Loss of trees containing hollows represents a loss of shelter habitat for hollow-dependent fauna. Loss of sub-mature eucalypts represents a decrease in the future recruitment of hollows.
- Loss of eucalypts, paperbarks, banksias and flowering shrubs decrease the food supply for nectarivores.
- Animals may be killed or injured during the clearance of vegetation.
- Domestic dogs and cats prey on native fauna and may have significant impacts on the populations of native species.
- Development of the Subject site may favour native and introduced disturbance adapted competitors. For example, Cane toads may out-compete other

amphibians and reptiles, aggressive open country bird species (e.g. Noisy miner, Crow, Pied currawong) may out-compete other birds, and non-native mammals (Black rat and House mouse) may out-compete other native small mammals).

- Increased light, noise and activity may cause reclusive species to move away from habitat edges.
- The proposed development will result in an increase in traffic on and to the Subject site. This increases the likelihood of animals being killed or injured by vehicles.
- Alterations to site hydrology and land use may alter the water quality or hydrological regime in Paperbark Communities or neighbouring areas of Moonee Creek.

The loss of 1.37 ha of intact native vegetation from the Subject site has the potential to impact on fauna movement. However, an assessment of biodiversity and corridor values of the area in question has determined that the likely impacts of the proposed vegetation clearing on native fauna species, including threatened fauna species previously recorded from the broader The Glades development site, and their habitats, is likely to be minimal. The habitat provided by this area of vegetation is not considered to be significant for any native fauna groups or threatened fauna species previously recorded from the broader development site. Furthermore, the post-development (The Glades development) corridor values of the Subject site are likely to be restricted to stepping stone habitat for highly mobile species only, as fauna movement opportunities would be significantly limited by adjacent roads, lack of connecting vegetation to the south, and edge effects.

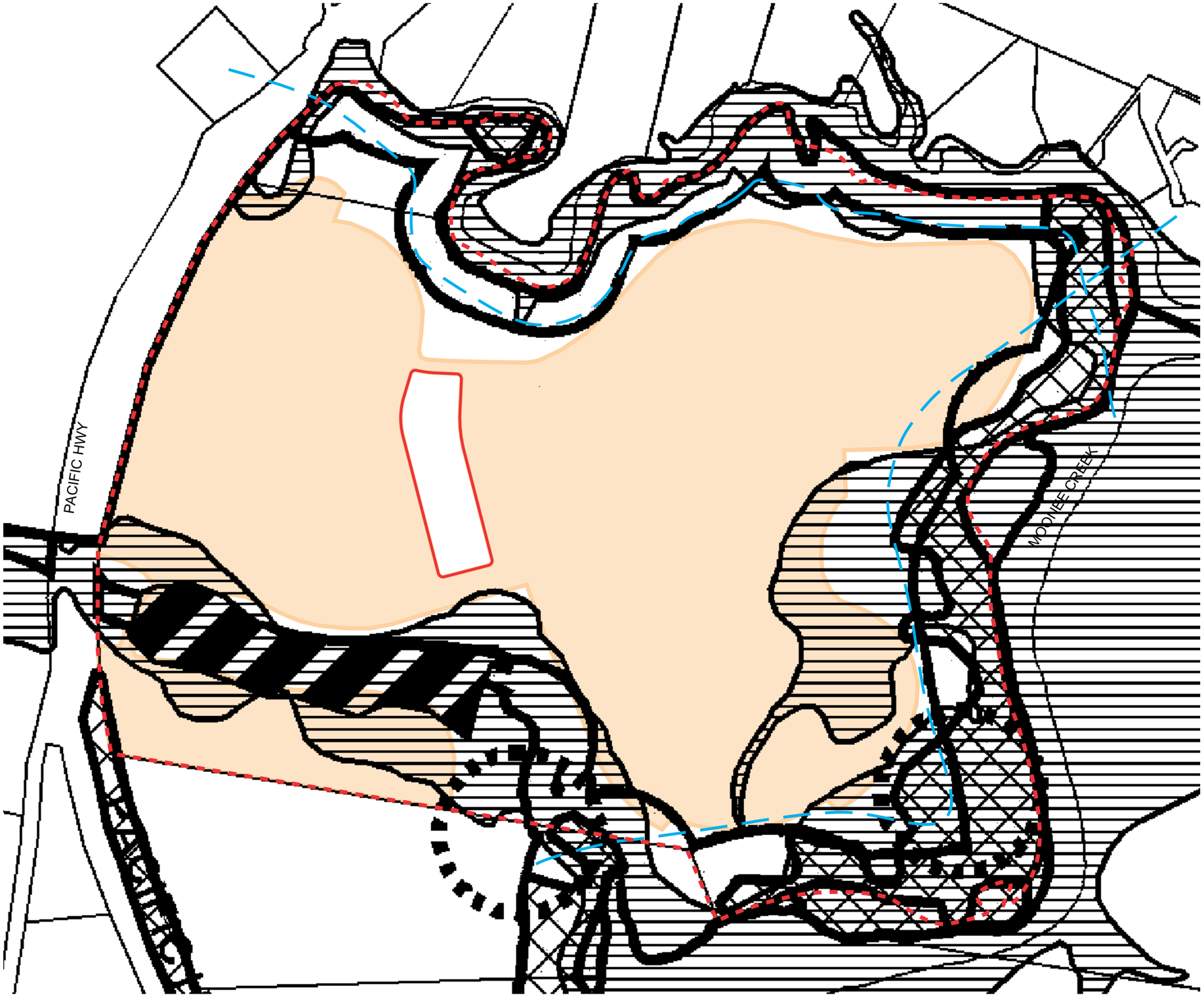
4.1.3 The Coffs Harbour City Council Moonee Development Control Plan

The Moonee Development Control Plan (DCP) was adopted by Coffs Harbour City Council on the 22 September 2004. The DCP applies to the Moonee Release Area, in which the Subject site occurs. Environmental mapping has been completed for the Moonee Release Area under the 2004 DCP.

FIGURE 19 shows the Moonee DCP environmental mapping in the context of the proposed development. No environmental mapping, such as buffers, flooding, SEPP 14 wetlands, protected vegetation, Osprey nests (which require a 100m buffer) or Wallum froglet habitat were mapped on the Subject site.

4.1.4 Impacts on Threatened species

The possible impacts of the Proposed development on Threatened fauna species recorded during the site survey (including Threatened species recorded within The Glades development site) are discussed as follows.



LEGEND

- Subject Site
- The Glades Development Site
- The Glades Impact Area
- Cadastre
- Creek Buffer

Moonee DCP

- Creek Buffers
- Flooding
- SEPP 14 Wetlands
- Wetlands Buffer
- Protected Vegetation
- Osprey Nest Buffer
- Wallum Froglet Habitat

0 150m

1 : 5000

SOURCE: Coffs Harbour City Council Moonee DCP Map 4; ERM Annex H - Plan 4 Veg Mgt (updated plan Jan 2018) (Ref: 20180206093044348.pdf)

SCALE: 1 : 5000 @ A3

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FIGURE 19

PREPARED: BW
DATE: 09 February 2018
FILE: N02066_DCP.cdr

TITLE
ENVIRONMENTAL MAPPING OF THE SUBJECT SITE BY CHCC DCP

4.1.4.1 Wallum froglet

The investigations undertaken by JWA and Arthur White have considered the mapped Wallum froglet investigation area (CHCC), and the results show that habitat for the species on the Subject site is restricted to the area adjacent to (and including) the southern drainage line (**FIGURE 20**) of The Glades development site, and consists of foraging habitat only. White (2006) notes that no breeding habitat occurs on The Glades site.

Development of the Subject site (refer to **FIGURE 20**) will not result in the loss of any Wallum froglet habitat (as mapped by White 2006).

4.1.4.2 Osprey

The Moonee DCP requires a 100m minimum buffer around active Osprey nests. Osprey nests have been located in the south-eastern corner and south of The Glades development site, as shown in **FIGURE 17** (Moonee DCP 2004). However, both nests were not observed during the 2017 site surveys, and are considered to have collapsed. No Osprey nests were recorded within the Subject site. There is some potential for occupation of the proposed development to impact on the nesting Ospreys through disturbance, although this is not considered to be significant.

4.1.4.3 Glossy black-cockatoo

The proposed development will result in the removal of some Black she-oak, a Glossy black cockatoo feed tree, from within grasslands with scattered trees on the Subject site. No suitable nest trees for this species occur within the development area, however loss of eucalypts from the development area will decrease the future recruitment of suitable nest hollows. Disturbance from the proposed development may reduce the likelihood of Glossy black-cockatoos feeding in proximate areas, although Glossy black-cockatoos are known to forage close to disturbance sources.

4.1.4.4 Black-necked stork

The proposed development within the Subject site will not result in disturbance to or the removal of habitat for this species.

4.1.4.5 Koala

The Coffs Harbour Koala Plan of Management (KPoM) (1999) details the operation actions to identify, protect and enhance koala habitat in the Coffs Harbour Area. The Coffs Harbour KPoM replaces the requirement under SEPP 44 for developments in Coffs Harbour LGA to address koala issues individually, and sets out a framework for conserving koalas in Coffs Harbour LGA. The KPoM has been addressed in **SECTION 4.2.4.** Primary or secondary Koala habitat has not been mapped on the Subject site by CHCC (**FIGURE 15**). It should be noted that a number of tree species present on the Subject site have also been identified in the Coffs Harbour KPoM as feed tree species. These are:

- Broad-leaved paperbark

LEGEND

- Subject Site
- The Glades Development Site
- The Glades Impact Area
- Creek Buffer

Wallum Froglet Habitat

- Core Wallum froglet habitat (JWA)
- Wallum froglet habitat area (Biosphere Environmental Consultants, Aug 2006)
- Drain
- Q100 Flood Line (Auspacific Engineers)

0 150m

1 : 5000

SOURCE: JWA Site Investigations; ERM Annex H - Plan 4 Veg Mgt (updated plan Jan 2018) (Ref: 20180206093044348.pdf)
SCALE: 1 : 5000 @ A3

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FIGURE 20

PREPARED: BW
DATE: 09 February 2018
FILE: N02066_Impacts WSF.cdr

TITLE
JWA'S MAPPING OF CORE WALLUM FROGLET HABITAT ON THE SITE

- Blackbutt
- Forest oak
- Tallowwood
- Swamp mahogany
- Forest red gum

Koala scats were found to the north of The Glades development site in vegetation fringing Skinners Creek where Tallowwood occur in an area of mapped as Secondary Koala Habitat. Clancy (1998) notes that Koalas have previously been recorded in this area. No koalas or evidence of their occurrence on the Subject site were observed in the 2004 or 2017 survey.

The proposed development is likely to limit opportunities for Koala movement over the Subject site, with movement restricted to retained vegetation along the northern and eastern margins of The Glades site. There is also the potential for Koalas to be injured or killed during clearing of vegetation on the Subject site, or from vehicle strike within the developed urban areas. Urban development of the Subject site also has the potential to increase risks to Koalas from straying dogs, and drowning in swimming pools.

Whilst the Subject site is not mapped as primary or secondary koala habitat, the clearing of this area will result in the loss of *Eucalyptus pilularis* trees, which is listed as a primary koala habitat tree species that should not be removed unless the development will not destroy, damage or compromise the values of the land as koala habitat (CHCKP 1999). As koalas have not been recorded in this area of the Subject site, the removal of *E. pilularis* from this portion of the Subject site is not considered likely to destroy, damage or compromise the values of the land as koala habitat.

4.1.4.6 Grey-headed flying-fox

The proposed development will result in the loss of foraging habitat for this species and reduce the foraging efficiency of any individuals foraging on the Subject site. There is no suitable roosting habitat for this species on the Subject site. The Grey-headed flying-fox is likely to continue to forage in retained areas of vegetation on The Glades development site, and will not be significantly affected by the proposed development.

4.1.4.7 Squirrel glider

Squirrel gliders were recorded on the eastern margins of The Glades development site in eucalypt woodland, and also within scattered eucalypts within grasslands in the centre of The Glades site. This species is likely to utilise most of the sclerophyll and paperbark communities along the eastern edge of the Subject site, including scattered eucalypts in grassland adjacent to these communities.

Loss of vegetation within the Subject site will result in a reduction of forage habitat for the Squirrel glider and diminish movement corridors. There is potential for increased

disturbance to Squirrel gliders feeding and denning in vegetated areas proximate to the development, and the further possibility of predation from cats. There is also the potential for direct mortality during construction.

4.1.4.8 Little bent-wing bat

The Little bent-wing bat forages on insects in forested habitats and roosts in caves, tunnels and similar structures. The proposed development will result in the loss of some foraging habitat for this species in the woodland environment of the Subject site, which will reduce the foraging efficiency of any individuals foraging on the Subject site.

4.1.4.9 Common bent-wing bat

As for Little bent-wing bat.

4.1.4.10 Large-footed myotis

The Large-footed myotis forages over creeks and other water bodies. It roosts in caves, tunnels, under bridges and in tree-hollows. The proposed development will not affect foraging or roosting habitat for this species, but may result in the loss of tree hollows that may provide future potential roost sites.

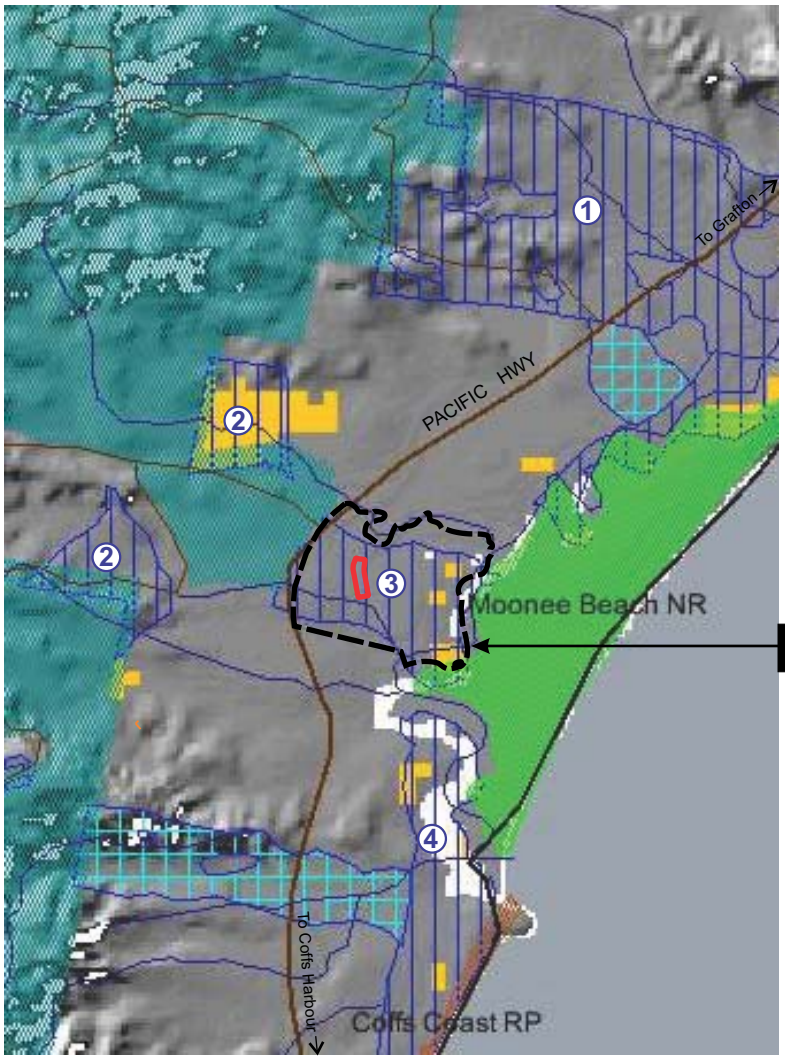
4.1.4.11 Common planigale

The Common planigale forages in dry sclerophyll, swamp sclerophyll, heathland and grassland at ecotone with rainforest. Breeding and sheltering sites for Common planigales consist of nests of eucalypt leaves in logs or under bark, cracks in soil, grass tussocks, and building debris. They require dense leaf litter or ground cover. Loss of vegetation within the Subject site will result in a reduction of forage and nesting habitat for the Common planigale. There is potential for increased disturbance to Common planigales feeding and nesting in vegetated areas proximate to the development, and the further possibility of predation from cats. There is also the potential for direct mortality during construction.

4.1.5 Corridor Impacts

The NPWS Key Habitats and Corridors database shows several regional habitat corridors within the locality of the Subject site. These are shown in **FIGURE 21**. The Subject site itself occurs within the Wedding Bells – Moonee Beach Regional Corridor which links Moonee Beach Nature Reserve and Skinners Creek. This corridor is comprised of the following fauna assemblages identified by NPWS:

- Moist escarpment foothills UNC
- Dry coastal foothills UNC
  UNC = Upper North Coast



LEGEND

Subject Site

The Glades Development Site

Key Habitats & Corridors

Key Habitat

Regional Corridor

Sub-regional Corridor

① Moonee Regional Corridor

② Hoys Regional Corridor

③ Wedding Bells - Moonee Beach Regional Corridor

④ Moonee Nature Reserve Regional Corridor

Tenure

Aboriginal Area

Historical Site

National Park

Nature Reserve

Regional Park

State Recreation Area

State Forest

0 1.5km

SOURCE: CANRI Website 12.11.04
Key Habitats & Corridors in North East NSW

SCALE: 1 : 50 000 @ A4

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FIGURE 21

PREPARED: BW
DATE: 24 October 2017
FILE: N02066_NPWS Corridors.cdr

TITLE

NPWS KEY HABITATS & CORRIDORS

To the south of the Subject site lies the Moonee Nature Reserve – Sapphire Regional Corridor which links Moonee Beach Nature reserve and Hills Beach, and consists of the following fauna assemblages:

- Moist escarpment foothills UNC
- Dry coastal foothills UNC
- Coastal complex UNC

The Hoys Corridor occurs to the west of the Subject site in two areas which link Skinners Creek with Skinners Road in the north and Cunninghams Creek in the south. Fauna assemblages consist of:

- Wet escarpment UNC
- Moist escarpment foothills UNC

The proposed development will contribute towards a reduction in the efficacy of the Subject site as a corridor due to habitat loss and fragmentation. However, the northern and eastern parts of the broader The Glades site will retain movement habitat to consolidate the link between the Moonee Beach Nature Reserve and habitats on the southern side of Skinners Creek. These areas are considerd to have greater corridor values than the Subject site as vegetation provides a generally wider corridor and does not encourage wildlife to enter roadways or residential areas where hazards exist.

The proposed S75 ammendment for the additional 31 allotments will result in the removal of 1.747 ha of land containing an isolated patch of native vegetation. Consideration was given to the likely post-development corridor values of this retained vegetation. The ongoing corridor values of the vegetation were considered to be significantly reduced due to (**FIGURE 16**):

- Approved road crossings at both the northern and southern ends of the corridor. The approved The Glades development plans do not allow for any fauna diversion or exclusion infrastructure at these road crossings (e.g. culverts, rope bridges, fences). Native fauna species would be at risk of injury or death at these road crossing points, and they may act as a disincentive for dispersal for some species due to lack of cover.
- Lack of connecting vegetation to the south. While vegetation retention and rehabilitation works are proposed in open space areas to the south of the corridor, under the approved development layout these areas will be separated from the corridor by a road (discussed above), recreational areas (i.e. a playground, picnic facilities, boardwalks etc.), and stormwater treatment devices/basins. Fauna movement to the south would therefore be restricted to highly mobile species only.
- Edge effects. The approved The Glades development plans include the construction and maintenance of bushfire Asset Protection Zones (APZs) 20-40m wide within the eastern and western edges of the retained vegetation patch (i.e. vegetation within the Subject site). This vegetation clearing/thinning and

subsequent regular maintenance of APZs is likely to significantly reduce the habitat and corridor values of this vegetation patch for native fauna species, particularly forest interior species or those susceptible to edge effects.

- Lack of connectivity to significant habitat area. The Subject site has limited connectivity to National Parks and Nature Reserves in the locality. The dual carriageway Pacific Highway to the west of the Subject site presents a significant obstruction to fauna movement, as does existing residential development to the north and south of the Subject site.

The assessment determined that following the approved development, corridor values would be likely restricted to stepping stone habitat for highly mobile species. The loss of this 'stepping stone' habitat as a result of the proposed S75 modification is considered unlikely to have any significant impacts on native fauna species (including Threatened species) utilising the Subject site, and more common disturbance adapted species are likely to continue to use street and landscape trees to move across the Subject site.

It is acknowledged that the removal of scattered trees throughout the site may result in a restriction in dispersal opportunities for the both the Squirrel and Feathertail glider, however these species will be able to disperse via vegetation to the east of the The Glades site.

FIGURE 16 shows the extent of dispersal opportunities for fauna on the broader The Glades development site following the approved development and the proposed development of the Subject site.

4.1.6 Impacts on Moonee Beach Nature Reserve

The proposed development has the potential to result in impacts on habitats within Moonee Beach Nature Reserve as a result of increased visitation to the reserve.

Nature Reserves, as opposed to National Parks, are managed for conservation purposes only and are not intended to provide for visitors. Impacts associated with increased visitation may include creation of informal pathways, trampling of vegetation, picking of wildflowers, increased disturbance of fauna, increased risk of fire, increased potential for dumping of rubbish and increased potential for invasion of exotic flora and fauna.

4.1.7 Other Possible Impacts

Other possible impacts from the proposed development include alterations to the hydrology, and impacts on water quality on the Subject site.

4.2 Amelioration

4.2.1 Introduction

This section discusses possible ameliorative measures and opportunities for enhancing the natural environment on the Subject site and associated The Glades development i.e. plant communities, fauna communities, and Threatened species.

It should be noted that the original Project Approval for The Glades development incorporates general rehabilitiation and revegetation works in accordance with an approved Vegetation Management Plan. However, these areas are now proposed to be rehabilitated/revegated to a much higher standard towards PCT benchmarks and will therefore generate credits to offset impacts of the proposed additional 31 allotments on the Subject site.

4.2.2 Amelioration for Plant Communities

It is possible that the proposed loss of 1.37 ha of realatively intact native vegetation will be required to be offset. Whilst it is understood that Coffs Harbour City Council has specified its own offset requirements within the Development Control Plan 2015, Part E Environmental Controls, determination of offsets based on NSW BioBanking Assessment Methodology (BBAM) is considered the most up-to-date and equitable approach for determining ecological offset requirments in NSW.

In this regard, surveys of the impact site and proposed offset sites have been completed utilising the BBAM. The BBAM provides a streamlined process to assess biodiversity values at a site (e.g. vegetation condition) and to determine the quantum of offsets required. The process would generally be as follows:

- The BBAM is established under section 127B of the Threatened Species Conservation Act 1995. It is used to assess the biodiversity values of a development site for the purpose of obtaining a biobanking statement, or a biobank (offset) site for the purpose of entering into a biobanking agreement.
- A range of scientifically based criteria have been collected by an accredited assessor from the impact area. This involved comprehensive assessment using plot and transect techniques within each vegetation type to be affected.
- These have been entered into the BioBanking Credit Calculator (BBCC) which is an online application that applies the BBAM to calculate the number and type of biodiversity credits required to offset the impacts of developments on biodiversity.
- This included ecosystem credits for native vegetation types along with species credits for individual threatened species habitat. The number of credits calculated depends on a number of factors such as site values (e.g. the structure and function of ecosystems) and landscape context (e.g. the values for connectivity and area of vegetation).
- The results have indicated that 74 ecosystem credits would be required to offset the loss of intact native vegetation from the subject site (**APPENDIX 4**). The required 74 ecosystem credits for this component of the development can be readily offset on the broader The Glades development site. Proposed comprehensive rehabilitation/revegetation works towards PCT benchmarks as offset for the additional 31 allotments are over and above the general rehabilitation and revegetation works required under the Project Approval.

- Credits required can either be purchased from an existing biobank site or generated by undertaking conservation management at a new biobank (offset) site.
- The proposed offset may be provided on site, or alternatively, off site as long as it generates credits for the impacted vegetation/species and occurs within the same Interim Biogeographic Regionalisation for Australia (IBRA) subregion (based on major catchment areas).
- The BBAM was therefore used to calculate the number and type of credits that can be created (e.g. through revegetation or rehabilitation of existing vegetation).
- The results have indicated that rehabilitation of existing vegetation to be retained on site would create 112 ecosystem credits (**APPENDIX 5**). Furthermore, the revegetation of 3.87 ha of currently cleared land over The Glades development site would potentially create an additional 38 credits.
- An Offset Strategy/Management Plan would need to be prepared including:
    - identification of offset location/s;
    - Justification for offset calculation methodology;
    - Details of rehabilitation/revegetation strategy;
    - Techniques for weed control/removal;
    - Ongoing maintenance requirments; and
    - Monitoring and reporting procedures.

Other amelioration measures include:

- Weeds should be controlled during construction.
- Vegetation removed during construction should be mulched for use on the Subject site. This will prevent the introduction of weeds from seeds in mulch brought in from elsewhere.
- Weeds should be controlled in landscaped areas and areas of retained vegetation.
- Known environmental weeds (e.g. Umbrella tree) should be avoided.
- Landscape plantings should include a majority of native species that will provide forage habitat for nectarivorous and frugivorous birds and bats.
- Landscaping trees should be situated where possible to reduce the amount of disturbance to retained areas of habitat.

4.2.3 Amelioration for Fauna

Vegetation clearance for the proposed development will result in some loss of habitat for fauna utilising the Subject site. However, suitable habitat will be retained within the adjacent The Glades development site, particularly along the northern and eastern boundaries. Amelioration for fauna and Threatened fauna not significantly affected by

the proposed development is included below, while amelioration for the Koala, Squirrel glider, Glossy black-cockatoo and Common planigale are discussed in **SECTION 4.2.4.**

The following amelioration measures apply:

- Landowners should control dogs on the Subject site. All animals should reside within fenced enclosures and be on a leash when outside of the enclosure. Cats should be banned from the Subject site under the companion Animals Act (1998) to reduce likely impacts on local fauna.
- Appropriate disposal of rubbish and food scraps reduces opportunities for non-native predators and disturbance adapted competitors.
- Landscape and landfill materials should be sourced from a supplier where Cane toads do not occur.
- A qualified fauna handler should be on site when clearing occurs.
- 40 km/hr speed limit to be imposed on internal access roads.
- Lighting and koala exclusion fencing is provided where appropriate on roadways adjacent to koala habitat.

4.2.4 Amelioration for Threatened species

4.2.4.1 Koala

The Subject site proposed for development contains potential koala habitat that will be lost, however this area is not mapped as primary or secondary koala habitat under the Coffs Harbour CKPOM. It should be noted however that *Eucalyptus pilularis* is present within the Subject site.

It is recommended that:

- Koala habitat trees (e.g. Broad-leaved paperbark, Blackbutt, Forest oak, Tallowwood, Swamp mahogany, Forest red gum) be included as part of proposed revegetation/offset plantings over The Glades development site (**FIGURE 6**) to compensate for any Koala habitat trees removed.
- Dogs should be strictly controlled within the proposed development, i.e.: must be contained within an appropriately fenced yard, and on a leash at all times when outside of a fenced enclosure.
- Swimming pools should be fenced to restrict access by Koalas.

It is unlikely that Koala feed trees will be retained within the development envelope and it is not considered desirable that Koalas be able to access or move through developed/residential areas of the Subject site. Suitable movement habitat occurs along the northern and eastern boundaries of The Glades development site.

4.2.4.2 Squirrel glider

Some loss and fragmentation of forage habitat for the Squirrel glider will occur due to the loss of habitat within the Subject site. It is recommended that:

- Cats should be banned under the Companion Animals Act (1998) to reduce likely impacts on Squirrel gliders.
- A qualified fauna handler should be on the Subject site when clearing occurs.

4.2.4.3 Glossy black cockatoo

While all the Black she-oak to be lost to the proposed development are immature and do not currently constitute a food resource for the Glossy black cockatoo, it is recommended that this Glossy black cockatoo food tree species be included as part of proposed revegetation/offset plantings over The Glades development site (**FIGURE 6**) to compensate for any trees removed.

4.2.4.4 Common planigale

There will be some loss and fragmentation of forage habitat for the Common planigale as a result of the proposed development. It is recommended that:

- Cats should be banned under the Companion Animals Act (1998) to reduce likely impacts on Common planigales.
- A qualified fauna handler should be on the Subject site when clearing occurs.

4.2.5 Amelioration for Wildlife Corridors

It is considered that movement opportunities for the majority of fauna species will persist on the broader The Glades site through the retention of vegetation in north, south and east of the site. However, the proposed development of the Subject site will result in the loss of some 'stepping stone' corridor features. As a result, the following amelioration measures are proposed:

- Rehabilitation of currently cleared or degraded areas of vegetation in the east, north and south of the greater The Glades site (**FIGURE 16**). This is expected to further enhance current movement opportunities in these areas both within The Glades site and onto adjacent properties.
- Exclusion fencing should be installed as appropriate to encourage fauna such as Koalas to utilise corridor habitat areas and avoid entering hazardous areas such as roadways.

5 Statutory Considerations

5.1 Introduction

This section includes assessments of the impacts of the Proposed development with regard to:

- Section 5A of the *Environment Protection & Assessment Act (1979)* (Assessment of Significance);
- *State Environmental Planning Policy No. 44* (SEPP 44) – Koala Habitat Protection; and
- The *Commonwealth Environment Protection and Biodiversity Conservation Act (1999)*.

5.2 Assessment of Significance (Seven Part Test)

5.2.1 Background

An Assessment of Significance (7-part test equivalence) has been undertaken for all listed species/EECs recorded on the Subject site, including threatened fauna predicted to occur over time **(SECTION 3.3)**. Potential impacts on threatened species, populations or ecological communities, or their habitats were assessed using the *Threatened Species Assessment Guidelines: The Assessment of Significance* (DECC 2007).

The Assessment of Significance should not be considered a "pass or fail" test as such, but a system allowing proponents to undertake a qualitative analysis of the likely impacts and ultimately whether further assessment needs to be undertaken via a Species Impact Statement. All factors must be considered and an overall conclusion must be drawn from all factors in combination. Where there is any doubt regarding the likely impacts, or where detailed information is not available, a Species Impact Statement should be prepared.

Mitigating, ameliorative or compensatory measures proposed as part of the action, development or activity should not be considered in determining the degree of the effect on threatened species, populations or ecological communities, unless the measure has been proven successful for that species in a similar situation. In many cases where complex mitigating, ameliorative or compensatory measures are required, such as translocation, bush restoration, purchase of land, further assessment through the Species Impact Statement process is likely to be required.

In determining the nature and magnitude of an impact, it is important to consider matters such as:

- Pre-construction, construction and occupation/maintenance phases;
- All on-site and offsite impacts, including location, installation, operation and maintenance of auxiliary infrastructure and fire management zones;
- All direct and indirect impacts;

- The frequency and duration of each known or likely impact/action;
- The total impact which can be attributed to that action over the entire geographic area affected, and over time;
- The sensitivity of the receiving environment; and
- The degree of confidence with which the impacts of the action are known and understood.

Recovery and threat abatement plans, priorities action statements and threatened species profiles may provide further guidance on whether an action/activity is likely to be significant.

Application of the precautionary principle requires that a lack of scientific certainty about the potential impacts of an action does not itself justify a decision that the action is not likely to have a significant impact. If information is not available to conclusively determine that there will not be a significant impact on a threatened species, population or ecological community, or its habitat, then it should be assumed that a significant impact is likely.

5.2.2 Flora

No Threatened flora species were recorded on the Subject site.

5.2.3 Endangered Ecological Communities (EECs)

No Endangered Ecological Communities (EECs) occur on the Subject site.

5.2.4 Fauna

5.2.4.1 Background

Eleven (11) threatened fauna species have been recorded on or within the vicinity of the Subject site (**FIGURE 17**). Based on an assessment of available habitat, a further thirteen (13) threatened fauna species are considered to possibly occur on the Subject site over time. An 'Assessment of Significance' has been completed for each of these twenty-four (24) species in **APPENDIX 6**.

5.2.4.2 Result of Assessment of Significance

On the basis of the assessments provided in **APPENDIX 6**, which included consideration of proposed amelioration measures that have been used successfully for threatened fauna species in similar situations, it is considered that a Species Impact Statement (SIS) is not required for threatened fauna species occurring on (or possibly occurring on) the Subject site.

5.3 Koala Habitat Assessment

A Comprehensive Koala Plan of Management (KPoM) was prepared by the NSW NPWS in close consultation with Coffs Harbour City Council (CHCC) under the statutory provisions of SEPP 44 – Koala Habitat Protection. The adoption of the KPoM replaces the requirement under SEPP 44 for developments in Coffs Harbour LGA to address Koala issues individually and sets out a framework for conserving Koalas in Coffs Harbour LGA (Lunney *et al* 1999). The adoption of the KPoM does not negate the responsibility of Council or a proponent considering undertaking a development requiring Council consent to fully consider whether such an activity is likely to result in a significant effect on a threatened species, population or ecological community or their habitat.

The Subject site is not mapped as primary or secondary koala habitat under the Coffs Harbour CKPOM. However, the clearing of this area will result in the loss of *Eucalyptus pilularis* trees, which is listed as a primary koala habitat tree species that should not be removed unless the development will not destroy, damage or compromise the values of the land as koala habitat (CHCKP 1999). Koala habitat trees identified in the Coffs Harbour CKPOM are protected under the local Tree Preservation Order. Any of these trees required to be removed for development must be replaced in the vicinity according to the "*Guidelines for Planting Koala Trees In Coffs Harbour LGA*" contained in the Coffs Harbour CKPOM.

Impacts on Koalas have been discussed in **SECTION 4** of this report. Amelioration measures have been recommended to satisfy the requirements of the Coffs Harbour KPoM.

5.4 Commonwealth Environment Protection and Biodiversity Conservation Act (1999)

5.4.1 Introduction

The *Environment Protection & Biodiversity Conservation (EPBC) Act (1999)* was passed by Commonwealth Parliament in June 1999 and came into force on 16 July 2000. A person must not, without an approval under the Act, take an action that has or will have, or is likely to have, a significant impact on a matter of National Environmental Significance (NES). These matters are listed as:

a) the world heritage values of a declared World Heritage property,
b) the ecological character of a declared Ramsar wetland,
c) a threatened species or endangered community listed under the Act,
d) a migratory species listed under the Act, or
e) the environment in a Commonwealth marine area or on Commonwealth land.

The Act also prohibits the taking, without an approval under the Act, of:

a) a nuclear action, or
b) an action in a Commonwealth marine area or on Commonwealth land, that has or will have, or is likely to have, a significant impact on the environment.

An action includes a project, development, undertaking or an activity or series of activities. An action does not require approval if it is a lawful continuation of a use of land, sea or seabed that was occurring before the commencement of the Act. An enlargement, expansion or intensification of a use is not a continuation of a use.

The *EPBC Act (1999)* does not require Commonwealth approval for the rezoning of land. It does, however, suggest that when rezoning land, planning authorities should consider whether to allow actions that could significantly affect NES matters or the environment of Commonwealth land.

Matters of NES in NSW are:

a) Declared World Heritage Areas;
b) Declared Ramsar Wetlands;
c) Listed Threatened Species;
d) Listed Ecological Communities in NSW;
e) Listed migratory species (JAMBA and CAMBA).

5.4.2 Subject Site Assessment

A Commonwealth Assessment will be required for proposed activities on the Subject site if they affect a matter of NES. Matters of NES in NSW were identified in the previous section. There are no declared World Heritage Areas or Ramsar Wetlands in the Locality, adjacent to, or on Subject site.

5.4.3 Listed Threatened Species

A number of species listed as threatened in the *Commonwealth Environmental Protection and Biodiversity Conservation Act (1999)* are known from the wider locality, these are listed in **TABLES 3 and 6**.

No Commonwealth Threatened flora species were recorded on the Subject site.

Three (3) Commonwealth Threatened fauna species, the Swift parrot, Koala and the Grey-headed Flying-fox, are considered possible or known occurrences at the Subject site.

If the proposed development is deemed to have a significant impact on any of these species, Commonwealth approval will be required.

An action has, will have, or is likely to have a significant impact on a critically endangered or endangered species if it does, will, or is likely to:

- lead to a long-term decrease in the size of a population, or
- reduce the area of occupancy of the species, or
- fragment an existing population into two or more populations, or

- adversely affect habitat critical to the survival of a species, or
- disrupt the breeding cycle of a population, or
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*, or
- interfere with the recovery of the species.

The Critically Endangered Swift parrot is considered a possible but unlikely occurrence on the Subject site. It is considered that the proposed development is unlikely to have a significant impact on this species, due to the retention of foraging habitat along Moonee and Skinners Creeks as part of The Glades development.

An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to:

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

An important population is one that is necessary for a species' long-term survival and recovery. This may include populations that are:

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

It is considered that Proposed development will not result in any such impacts on the Vulnerable Grey-headed flying-fox or Koala, due to the retention of foraging habitat along Moonee and Skinners Creeks as part of The Glades development. This species forages widely and is likely to utilise a large area of forage habitat within the locality.

It is considered that the Subject site does not support an important population of any species listed as vulnerable in the *EPBC Act (1999)* and a significant impact on these species will not be incurred.

5.4.4 Listed Ecological Communities in NSW

None of the ecological communities currently listed in the *EPBC Act (1999)* occur on the Subject.

5.4.5 Listed Migratory Species

Listed migratory species in NSW are considered predominantly in the Japan-Australia Migratory Bird Agreement (JAMBA) and China-Australia Migratory Bird Agreement (CAMBA).

Two (2) Commonwealth listed migratory species, the White-bellied sea eagle and Osprey have been recorded on the adjoining The Glades development site. Another two (2) listed migratory species, the Cattle egret and Fork-tailed swift, are considered possible to be possible occurrences on the Subject site.

An action has, will have, or is likely to have a significant impact on a migratory species if it does, will, or is likely to:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of *important habitat* of the migratory species, or
- result in invasive species that is harmful to the migratory species becoming established* in an area of *important habitat* of the migratory species, or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an *ecologically significant proportion* of the population of the species.

(* Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a migratory species by direct competition, modification of habitat, or predation.)

An area of important habitat is:

- habitat utilised by a migratory species occasionally or periodically within a region that supports an *ecologically significant proportion* of the population of the species, or
- habitat utilised by a migratory species which is at the limit of the species range, or
- habitat within an area where the species is declining.

It is considered that although a number of listed migratory species are known or likely to occur occasionally on the Subject site, no area of important habitat occurs on the Subject site for listed migratory species.

5.4.6 Requirement for Commonwealth Assessment

On the basis of the above assessment, it is concluded that Commonwealth Assessment is not required for the proposed development of the Subject site.

6 Summary and Conclusions

JWA have been engaged by Rothwell to complete a Flora and Fauna Assessment for part of The Glades development site (Lots 1 & 2 DP 725785) at Moonee. The subject site is a 1.75 ha of land within the central portion of The Glades development.

It is understood that Rothwell Boys propose to lodge an application (75W modification application) seeking to modify Project Approval 06-0143 issued by the Minister for Planning on 5th March 2009, to include additional residential subdivision over a 1.75 ha of land within the central portion of The Glades development (i.e. the subject site). The current report is an amended and updated version of the Flora and Fauna Assessment prepared by JWA in 2007 and includes additional field surveys and an impact assessment for the proposed additional allotment layout.

The proposed development is for the Subject site to be subdivided into thirty-one (31) residential allotments. The proposed development will result in the loss of vegetation for the construction of houses, access roads, driveways and associated infrastructure. There are potential associated impacts on flora, fauna (including Threatened species), and the Moonee Nature Reserve adjacent to the Subject site.

In total 1.75 hectares of vegetation is proposed to be cleared, the majority of which is advanced regrowth closed forest. Of this vegetation to be lost, 1.37 ha is considered to be relatively intact native vegetation (i.e. communities 1f & 2b). The proposed development will result in minor loss of foraging, sheltering and breeding habitat for native fauna occurring in the locality. Impacts of the proposed development on most Threatened species recorded on the Subject site is not considered to be significant.

The Subject site is not mapped as primary or secondary koala habitat under the Coffs Harbour CKPOM. However, the clearing of this area will result in the loss of *Eucalyptus pilularis* trees, which is listed as a primary koala habitat tree species. Any of these trees required to be removed for development must be replaced in the vicinity according to the "*Guidelines for Planting Koala Trees In Coffs Harbour LGA*" contained in the Coffs Harbour CKPOM.

It is possible that the proposed loss of intact native vegetation within the Subject site (comprising an area of 1.37 ha) will be required to be offset. In this regard, surveys of the impact site and proposed offset sites have been completed utilising the BioBanking Assessment Methodology (BBAM). The results have indicated that 74 ecosystem credits would be required to offset the loss of this vegetation. The BBAM was also used to calculate the number and type of credits that can be created (e.g. through revegetation or rehabilitation of existing vegetation) on the broader The Glades development site. The results have indicated that rehabilitation of existing vegetation to be retained on site would create 112 ecosystem credits, whilst the revegetation of 3.87 ha of currently cleared land over The Glades development site would potentially create an additional 38 credits.

It is noted that the original Project Approval for The Glades development incorporates general rehabilitiation and revegetation works in accordance with an approved Vegetation Management Plan. However, these areas are now proposed to be rehabilitated/revegated to a much higher standard towards PCT benchmarks and will therefore generate credits to offset impacts of the proposed additional 31 allotments on the Subject site. Therefore, the required 74 ecosystem credits for this component of the development can be readily offset on the broader The Glades development site.

A Section 5A assessment (Assessment of Significance) was undertaken for twenty-four (24) Threatened fauna species known or considered a possible occurrence at the Subject site over time. The assessment concluded that the impacts of the proposed development would be unlikely to result in the local extinction of any of these species. A Species Impact Statement is not required.

An assessment under the *Commonwealth Environment Protection and Biodiversity Conservation Act (1999)* concluded that the proposed development will not have a significant impact on any matters of National Environmental Significance. Commonwealth assessment of the proposal is therefore not required.

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Appendix 1 - Plant Species List

Grouping and Family		Botanical Name	Common Name
Ferns and Fern Allies	Adiantaceae	*Adiantum hispidulum*	Rough maidenhair
Ferns and Fern Allies	Adiantaceae	*Adiantum aethiopicum*	Common maidenhair
Ferns and Fern Allies	Blechnaceae	*Blechnum indicum*	Swamp water fern
Ferns and Fern Allies	Dennstaedtiaceae	*Hypolepis muelleri*	Harsh ground fern
Ferns and Fern Allies	Dennstaedtiaceae	*Pteridium esculentum*	Bracken fern
Ferns and Fern Allies	Lindsaeaceae	*Lindsaea dimorpha*	
Ferns and Fern Allies	Polypodiaceae	*Platycerium bifurcatum*	Elkhorn fern
Ferns and Fern Allies	Sealaginellaceae	*Selaginella uliginosa*	Swamp selaginella
Gymnosperms	Pinaceae	*Pinus Elliottii**	Slash pine
Monocotyledons	Anthericaceae	*Sowerbaea juncea*	Vanilla plant
Monocotyledons	Blandfordiaceae	*Blandfordia grandiflora* [#]	Christmas bells
Monocotyledons	Cyperaceae	*Baumea articulata*	
Monocotyledons	Cyperaceae	*Baumea rubiginosa*	Bog rush
Monocotyledons	Cyperaceae	*Caustis blakei*	
Monocotyledons	Cyperaceae	*Caustis recurvata*	Curly wigs
Monocotyledons	Cyperaceae	*Cyperus difformis*	Rice sedge
Monocotyledons	Cyperaceae	*Eleocharis equisetina*	Sag
Monocotyledons	Cyperaceae	*Gahnia clarkei*	Tall saw sedge
Monocotyledons	Cyperaceae	*Gahnia sieberiana*	Red-fruited saw sedge
Monocotyledons	Cyperaceae	*Ptilothrix deusta*	Feather sedge
Monocotyledons	Iridaceae	*Patersonia sericea*	Silky purple flag
Monocotyledons	Juncaceae	*Juncus kraussii*	Salt rush
Monocotyledons	Juncaceae	*Juncus planifolius*	
Monocotyledons	Juncaceae	*Juncus remotiflorus*	
Monocotyledons	Juncaceae	*Juncus* sp.	
Monocotyledons	Juncaceae	*Juncus usitatus*	
Monocotyledons	Lomandraceae	*Lomandra hystrix*	Matrush
Monocotyledons	Lomandraceae	*Lomandra longifolia*	Spiny-headed matrush
Monocotyledons	Luzuriagaceae	*Eustrephus latifolius*	Wombat berry
Monocotyledons	Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling lily
Monocotyledons	Orchidaceae	*Cryptostylis subulata*	

Grouping and Family		Botanical Name	Common Name
Monocotyledons	Orchidaceae	*Cryptostylis erecta*	
Monocotyledons	Orchidaceae	*Thelmyitra* sp.	
Monocotyledons	Phormiaceae	*Dianella caerulea*	Blue flax lily
Monocotyledons	Poaceae	*Avena* sp.*	Wild oats
Monocotyledons	Poaceae	*Echinopogon* sp.	
Monocotyledons	Poaceae	*Entolasia* sp.	Panic
Monocotyledons	Poaceae	*Imperata cylindrica*	Blady grass
Monocotyledons	Poaceae	*Ischaemum australe*	
Monocotyledons	Poaceae	*Oplismenus hirtellus* ssp. *Imbecillis*	Basket grass
Monocotyledons	Poaceae	*Paspalum dilatatum**	Paspalum
Monocotyledons	Poaceae	*Phragmites australis*	Common reed
Monocotyledons	Poaceae	*Sporobolus indicus* var. *indicus**	Parramatta grass
Monocotyledons	Poaceae	*Sporobolus virginicus*	Salt couch
Monocotyledons	Poaceae	*Themeda triandra*	Kangaroo grass
Monocotyledons	Restionaceae	*Empodisma minus*	
Monocotyledons	Restionaceae	*Lepyrodia interrupta*	Heath rush
Monocotyledons	Restionaceae	*Lepyrodia scariosa*	
Monocotyledons	Smilacaceae	*Smilax glyciphylla*	Sweet sarsparilla
Monocotyledons	Xanthorrhoeaceae	*Xanthorrhoea fulva*	Swamp grass tree
Dicotyledons	Apiaceae	*Centella asiatica*	Pennywort
Dicotyledons	Apocynaceae	*Parsonsia straminea*	Common silkpod
Dicotyledons	Araliaceae	*Polyscias sambucifolia*	Elderberry panax
Dicotyledons	Asclepiadaceae	*Gomphocarpus physocarpus**	Balloon cotton bush
Dicotyledons	Asteraceae	*Ageratina adenophora**	Crofton weed
Dicotyledons	Asteraceae	*Ageratum houstonianum**	Blue billygoat weed
Dicotyledons	Asteraceae	*Baccharis halimifolia**	Groundsel
Dicotyledons	Avicenniaceae	*Avicennia marina* var *australasica*	Grey mangrove
Dicotyledons	Baueraceae	*Bauera capitata*	Dog rose
Dicotyledons	Caesalpinioideae	*Senna pendula* var *glabrata**	Winter senna
Dicotyledons	Casuarinaceae	*Allocasuarina littoralis*	Black she-oak
Dicotyledons	Casuarinaceae	*Allocasuarina torulosa*	Forest oak
Dicotyledons	Casuarinaceae	*Casuarina glauca*	Swamp oak
Dicotyledons	Chenopodiaceae	*Sarcocornia quinqueflora*	Samphire
Dicotyledons	Clusiaceae	*Hypericum gramineum*	Small St Johns wort
Dicotyledons	Dilleniaceae	*Hibbertia linearis*	
Dicotyledons	Dilleniaceae	*Hibbertia obtusifolia*	

Grouping and Family		Botanical Name	Common Name
Dicotyledons	Dilleniaceae	*Hibbertia scandens*	Climbing guinea flower
Dicotyledons	Dilleniaceae	*Hibbertia riparia*	
Dicotyledons	Dilleniaceae	*Hibbertia vestita*	
Dicotyledons	Droseraceae	*Drosera spathulata*	Spoon-leaved sundew
Dicotyledons	Elaeocarpaceae	*Elaeocarpus reticulatus*	Blueberry ash
Dicotyledons	Epacridaceae	*Epacris calvertiana*	
Dicotyledons	Epacridaceae	*Epacris microphylla*	
Dicotyledons	Epacridaceae	*Leucopogon microphyllus*	
Dicotyledons	Epacridaceae	*Leucopogon parviflorus*	Coastal bearded heath
Dicotyledons	Epacridaceae	*Melichrus procumbens*	Jam tarts
Dicotyledons	Epacridaceae	*Monotoca scoparia*	Prickly monotoca
Dicotyledons	Epacridaceae	*Sprengelia sprengelioides*	
Dicotyledons	Epacridaceae	*Styphelia viridis*	Green styphelia
Dicotyledons	Epacridaceae	*Trochocarpa laurina*	Tree heath
Dicotyledons	Ericaceae	*Epacris obtusifolia*	Blunt-leaf heath
Dicotyledons	Euphorbiaceae	*Breynia oblongifolia*	Coffee bush
Dicotyledons	Euphorbiaceae	*Bridelia exaltata*	Brush ironbark
Dicotyledons	Euphorbiaceae	*Glochidion ferdinandi* var. *ferdinandi*	Cheese tree
Dicotyledons	Euphorbiaceae	*Glochidion ferdinandi var. pubens*	Hairy cheese tree
Dicotyledons	Euphorbiaceae	*Ricinocarpos pinifolius*	Wedding bush
Dicotyledons	Fabaceae	*Aotus lanigera*	
Dicotyledons	Fabaceae	*Bossiaea ensata*	
Dicotyledons	Fabaceae	*Dillwynia floribunda*	
Dicotyledons	Fabaceae	*Dillwynia glaberrima*	
Dicotyledons	Fabaceae	*Hovea purpurea*	
Dicotyledons	Fabaceae	*Jacksonia scorparia*	Dogwood
Dicotyledons	Fabaceae	*Pultenaea daphnoides*	
Dicotyledons	Fabaceae	*Pultenaea retusa*	
Dicotyledons	Fabaceae	*Pultenaea* species J	
Dicotyledons	Gompholobium	*Gompholobium pinnatum*	Pinnate wedge pea
Dicotyledons	Goodeniaceae	*Dampiera stricta*	Blue dampiera
Dicotyledons	Haloragaceaea	*Gonocarpus teucrioides*	Raspwort
Dicotyledons	Lauraceae	*Cassytha glabella*	Devil's twine
Dicotyledons	Lauraceae	*Cinnamomum camphora**	Camphor laurel
Dicotyledons	Lauraceae	*Cryptocarya microneura*	Murrogan
Dicotyledons	Lauraceae	*Endiandra sieberi*	Hard corkwood

Grouping and Family		Botanical Name	Common Name
Dicotyledons	Menispermaceae	*Stephania aculeata*	Prickly snake vine
Dicotyledons	Mimosaceae	*Acacia disparrima*	Hickory wattle
Dicotyledons	Mimosaceae	*Acacia brownii*	Heath wattle
Dicotyledons	Mimosaceae	*Acacia fimbriata*	Fringed wattle
Dicotyledons	Mimosaceae	*Acacia floribunda*	Gossamer wattle
Dicotyledons	Mimosaceae	*Acacia longissima*	Narrow leaf acacia
Dicotyledons	Mimosaceae	*Acacia myrtifolia*	Red-stemmed wattle
Dicotyledons	Mimosaceae	*Acacia sophorae*	Coastal wattle
Dicotyledons	Mimosaceae	*Acacia suaveolens*	Sweet wattle
Dicotyledons	Mimosaceae	*Acacia ulicifolia*	Prickly moses
Dicotyledons	Moraceae	*Ficus coronata*	Creek sandpaper fig
Dicotyledons	Myrsinaceae	*Aegiceras corniculatum*	River mangrove
Dicotyledons	Myrtaceae	*Angophora costata*	Rusty gum
Dicotyledons	Myrtaceae	*Ochrosperma lineare*	Straggly baeckea
Dicotyledons	Myrtaceae	*Callistemon pachyphyllus*	Crimson bottlebrush
Dicotyledons	Myrtaceae	*Callistemon salignus*	Willow bottlebrush
Dicotyledons	Myrtaceae	*Corymbia intermedia*	Pink bloodwood
Dicotyledons	Myrtaceae	*Eucalyptus eugenoides*	Narrow-leaved stringybark
Dicotyledons	Myrtaceae	*Eucalyptus globoidea #*	White stringybark
Dicotyledons	Myrtaceae	*Eucalyptus microcorys*	Tallowwood
Dicotyledons	Myrtaceae	*Eucalyptus pilularis*	Blackbutt
Dicotyledons	Myrtaceae	*Eucalyptus planchoniana*	Bastard tallowwood
Dicotyledons	Myrtaceae	*Eucalyptus resinifera*	Red mahogany
Dicotyledons	Myrtaceae	*Eucalyptus robusta*	Swamp mahogany
Dicotyledons	Myrtaceae	*Eucalyptus siderophloia*	Northern grey ironbark
Dicotyledons	Myrtaceae	*Eucalyptus tereticornis*	Forest red gum
Dicotyledons	Myrtaceae	*Eucalyptus tindaliae*	Queensland white stringybark
Dicotyledons	Myrtaceae	*Kunzea capitata*	
Dicotyledons	Myrtaceae	*Leptospermum juniperinum*	Tea-tree
Dicotyledons	Myrtaceae	*Leptospermum polygalifolium*	Tea-tree
Dicotyledons	Myrtaceae	*Leptospermum whitei*	White's teatree
Dicotyledons	Myrtaceae	*Lophostemon suaveolens*	Swamp turpentine

Grouping and Family		Botanical Name	Common Name
Dicotyledons	Myrtaceae	*Lophostemon confertus*	Brushbox
Dicotyledons	Myrtaceae	*Melaleuca linariifolia*	Flax-leaved paperbark
Dicotyledons	Myrtaceae	*Melaleuca nodosa*	Prickly-leaved paperbark
Dicotyledons	Myrtaceae	*Melaleuca quinquenervia*	Broad-leaved paperbark
Dicotyledons	Myrtaceae	*Melaleuca sieberi*	Sieber's paperbark
Dicotyledons	Myrtaceae	*Melaleuca thymifolia*	
Dicotyledons	Myrtaceae	*Syncarpia glomulifera*	Turpentine
Dicotyledons	Myrtaceae	*Tristaniopsis laurina*	Water gum
Dicotyledons	Nymphaeceae	*Nymphaea* sp.	Waterlily
Dicotyledons	Oleaceae	*Notelaea ovata*	Mock olive
Dicotyledons	Onagraceae	*Ludwigia peploides*	Water primrose
Dicotyledons	Passifloraceaea	*Passiflora edulis* *	Passionfruit
Dicotyledons	Pittosporaceae	*Billardiera scandens*	Apple berry
Dicotyledons	Plantaginaceae	*Plantago spp.**	Plantains
Dicotyledons	Polygonaceae	*Persicaria strigosa*	Smartweed
Dicotyledons	Proteaceae	*Banksia integrifolia*	Coast banksia
Dicotyledons	Proteaceae	*Banksia oblongifolia*	Swamp banksia
Dicotyledons	Proteaceae	*Banksia spinulosa*	Hairpin banksia
Dicotyledons	Proteaceae	*Lomatia silaifolia*	Crinkle bush
Dicotyledons	Proteaceae	*Persoonia conjuncta*	Geebung
Dicotyledons	Proteaceae	*Persoonia stradbrokensis*	Geebung
Dicotyledons	Proteaceae	*Persoonia virgata*	Geebung
Dicotyledons	Ranunculaceae	*Clematis aristata*	Mountain clematis
Dicotyledons	Rhamnaceae	*Alphitonia excelsa*	Red ash
Dicotyledons	Rutaceae	*Boronia safrolifera*	Pink boronia
Dicotyledons	Sapindaceae	*Dodonaea triquetra*	Hop bush
Dicotyledons	Sapindaceae	*Guioa semiglauca*	Guioa
Dicotyledons	Solanaceae	*Solanum nigrum**	Black-berry nightshade
Dicotyledons	Thymelaeaceae	*Pimelea glauca*	
Dicotyledons	Thymelaeaceae	*Pimelea linifolia*	Slender riceflower
Dicotyledons	Verbenaceae	*Lantana camara**	Lantana
Dicotyledons	Violaceae	*Viola hederacea* subsp. *Hederaceae*	Native violet
Dicotyledons	Vitaceae	*Cissus hypoglauca*	Five-leaf water vine

* Introduced Species

Significant (Sheringham & Westaway 1995)

Appendix 2 – Fauna Species List

Common name	Scientific name	Method of identification	Survey year
REPTILES			
Dark flecked sun skink	*Lampropholis guichenoti*	Capture	2004
Friendly sun skink	*Lampropholis amicula*	Capture	2004, 2017
Eastern bearded dragon	*Pogona barbata*	Observed	2004, 2017
Pink tongue lizard	*Cyclodomorphus gerrardii*	Observed	2017
Swamp snake	*Hemiaspis signata*	Capture	2004
Southern calyptotis	*Calyptotis ruficauda*	Capture	2004
AMPHIBIANS			
Beeping froglet	*Crinia parinsignifera*	Capture, call	2005, 2017
Common eastern froglet	*Crinia signifera*	Call, capture	2004, 2005, 2017
Dusky toadlet	*Uperoleia fusca*	Call	2005
Eastern dwarf tree frog	*Litoria fallax*	Call	2004, 2005, 2017
Red-backed broodfrog	*Pseudophryne coriacea*	Capture, call	2017
Striped marsh frog	*Limnodynastes peronii*	Call	2004, 2005, 2017
Spotted grass frog	*Limnodynastes tasmaniensis*	Capture, call	2004, 2005
Broad-palmed rocket frog	*Litoria latopalmata*	Capture	2004
Wallum froglet	*Crinia tinnula*	Call	2005
Emerald-spotted tree frog	*Litoria peronii*	Call	2017
BIRDS			
Bar-shouldered dove	*Geopelia humeralis*	Observed	2017
Black duck	*Anas superciliosa*	Observed	2004
Black-faced cuckoo-shrike	*Coracina novaehollandiae*	Observed	2017
Black-necked stork#	***Ephippiorhnchus asiaticus***	Observed	2003
Blue-faced honeyeater	*Entomyzon cyanotis*	Observed	2017
Brahminy kite	*Haliastur indus*	Observed	2004
Brown goshawk	*Accipiter fasciatus*	Observed	2004
Brown thornbill	*Acanthiza pusilla*	Observed	2004, 2017
Eastern rosella	*Platycercus eximius*	Observed	2004, 2017
Eastern spinebill	*Acanthorhynchus tenuirostris*	Observed	2017
Eastern yellow robin	*Eopsaltria australis*	Observed	2004
Fan-tailed cuckoo	*Cacomantis flabelliformis*	Observed	2004
Forest kingfisher	*Todiramphus macleayii*	Observed	2017
Galah	*Eolophus roseicapilla*	Observed	2017

Common name	Scientific name	Method of identification	Survey year
Glossy black cockatoo	***Calyptorhynchus lathami***	Observed	2004, 2017 (chewed cones)
Golden whistler	*Pachycephala pectoralis*	Observed	2004, 2017
Grey butcherbird	*Cracticus torquatus*	Observed	2017
Grey fantail	*Rhipidura fuliginosa*	Observed	2004
Grey shrike thrush	*Colluricincla harmonica*	Observed	2004
Kookaburra	*Dacelo novaeguineae*	Observed	2004, 2017
Lewins honeyeater	*Meliphaga lewinii*	Observed	2004, 2017
Little lorikeet	*Glossopsitta pusilla*	Observed	2004
Magpie	*Gymnorhina tibicen*	Observed	2004, 2017
Magpie-lark	*Grallina cyanoleuca*	Observed	2004, 2017
Masked lapwing	*Vanellus miles*	Observed	2004, 2017
Mistletoe bird	*Dicaeum hirundinaceum*	Observed	2004
Nankeen night heron	*Nycticorax caledonicus*	Observed	2004
Noisy friarbird	*Philemon corniculatus*	Observed	2004, 2017
Noisy minor	*Manorina melanocephala*	Observed	2004, 2017
Osprey	***Pandion haliaetus***	Observed	2004
Pelican	*Pelecanus conspicillatus*	Observed	2004
Pheasant coucal	*Centropus phasianinus*	Observed	2017
Pied butcherbird	*Cracticus nigrogularis*	Observed	2004, 2017
Pied cormorant	*Phalacrocorax varius*	Observed	2004
Pied currawong	*Strepera graculina*	Observed	2004, 2017
Purple swamp hen	*Porphyrio porphyrio*	Observed	2004, 2017
Rainbow bee-eater	*Merops ornatus*	Observed	2004
Rainbow lorikeet	*Trichoglossus haematodus*	Observed	2004, 2017
Red browed finch	*Neochmia temporalis*	Observed	2004
Red wattlebird	*Anthochaera carunculate*	Observed	2017
Sacred kingfisher	*Todiramphus sanctus*	Observed	2004, 2017
Satin bowerbird	*Ptilonorhynchus violaceus*	Observed	2004
Scaly breasted lorikeet	*Trichoglossus chlorolepidotus*	Observed	2004
Scarlet honeyeater	*Myzomela sanguinolenta*	Observed	2004, 2017
Scarlet robin	*Petroica multicolor*	Observed	2004
Silvereye	*Zosterops lateralis*	Observed	2017
Spotted pardalote	*Pardalotus punctatus*	Observed	2004
Sprangled drongo	*Dicrurus bracteatus*	Observed	2004, 2017
Striated pardalote	*Pardalotus striatus*	Observed	2004
Superb wren	*Malurus cyaneus*	Observed	2004
Tawny frogmouth	*Podargus strigoides*	Observed	2004, 2017
Tawny grassbird	*Megalurus timoriensis*	Observed	2017
Torresian crow	*Corvus orru*	Observed	2004, 2017
Varied sitella	*Daphoenositta chrysoptera*	Observed	2004
Variegated wren	*Malurus lamberti*	Observed	2004

Common name	Scientific name	Method of identification	Survey year
Wedge tailed eagle	*Aquila audax*	Observed	2004
Weebill	*Smicronis brevirostris*	Observed	2017
Welcome swallow	*Hirundo neoxena*	Observed	2004
Whistling kite	*Haliastur sphenurus*	Observed	2004, 2017
White-browed scrubwren	*Sericornis frontalis*	Observed	2017
White cheeked honeyeater	*Phylidonyris nigra*	Observed	2004
White faced heron	*Egretta novaehollandiae*	Observed	2004, 2017
White ibis	*Threskiornis molucca*	Observed	2004
White-bellied cuckoo shrike	*Coracina papuensis*	Observed	2004
White-bellied sea eagle	*Haliaeetus leucogaster*	Observed	2004
White-breasted woodswallow	*Artamus leucorynchus*	Observed	2004
White-naped honeyeater	*Melithreptus lunatus*	Observed	2004
White-necked heron	*Ardea pacifica*	Observed	2004
White-throated treecreeper	*Cormobates leucophaeus*	Observed	2004
Willie wagtail	*Rhipidura leucophrys*	Observed	2017
Yellow faced honeyeater	*Lichenostomus chrysops*	Observed	2004
Yellow-faced honeyeater	*Lichenostomus chrysops*	Observed	2004
Yellow-tailed black cockatoo	*Calyptorhynchus funereus*	Observed	2004, 2017
MAMMALS			
DASYURIDAE			
Antechinus flavipes	Yellow-footed antechinus	Elliottt	2004
Planigale maculata	Common planigale	Elliott, camera traps	2017
PARAMELIDAE			
Isodon macrourus	Northern brown bandicoot	Cage	2004
PETAURIDAE			
Petaurus norfolcensis	Squirrel glider	Spotlighting	2004
Petaurus breviceps	Sugar glider	Spotlighting	2017
PHALANGERIDAE			
Trichosurus vulpecula	Common brushtail possum	Spotlighting, capture, camera	2004, 2017
MACROPODIDAE			
Macropus giganteus	Eastern grey kangaroo	Observed	2004, 2017
Macropus rufogriseus	Red-necked wallaby	Camera trap	2017
Wallabia bicolor	Swamp wallaby	Observed	2004

Common name	Scientific name	Method of identification	Survey year
PHASCOLARCTIDAE			
Phascolarctos cinereus	Koala	Scat	2004
PTERIPODIDAE			
Pteropus poliocephalus	Grey-headed flying fox	Call, sighting	2004, 2017
MURIDAE			
Mus musculus	House mouse*	Elliottt	2004
Rattus fuscipes	Bush rat	Elliottt	2004, 2017
Rattus lutreolus	Swamp rat	Elliottt	2004
Rattus rattus	Black rat*	Elliottt	2004
BOVIDAE			
Bos taurus	European cattle*	Observed	2004, 2017
CANIDAE			
Canis familiaris	Dog*	Scat, tracks	2004
ACROBATIDAE			
Acrobates pygmaeus	Feathertail glider	Observed	2004, 2017
SUIDAE			
Sus scrofa	Pig*	Observed	2004
EQUIDAE			
Equus caballus	Horse*	Scat, tracks	2004
FELIDAE			
Felis catus	Cat*	Scat, tracks	2004
VESPERTILIONIDAE			
Chalinolobus gouldii	Gould's wattled bat	Anabat	2004
Chalinolobus morio	Chocolate wattled bat	Anabat	2004
Miniopterus australis	Little bent-wing bat	Harp trap, Anabat	2004
Miniopterus schreibersii	Common bent-wing bat	Anabat	2004
Nyctophilus gouldi	Gould's long-eared bat	Harp trap, Anabat	2004
Vespadelus darlingtoni	Large forest bat	Anabat	2004
Vespadelus regulus	Southern forest bat	Anabat	2004
Vespadelus vulturnus	Little forest bat	Harp trap	2004
Myotis macropus	Large-footed myotis	Harp trap	2004
Scotorepens sp.	Broadnosed bat sp.	Anabat	2004
MOLOSSIDAE			
Mormopterus sp.	Freetail bat sp.	Anabat	2004
Threatened species are shown in **bold** # Recorded in 2003 JWA survey *Introduced species			

Appendix 3 – Habitat suitability assessment

LIKELIHOOD OF OCCURRENCE OF THREATENED FAUNA SPECIES ON SUBJECT SITE

Species	Likelihood of occurrence on the Subject site	Notes
Australasian bittern (*Botaurus poiciloptilus*)	Unlikely	The Australasian bittern is widespread but uncommon in south-west and south-east Australia, generally preferring freshwater habitats with tall, dense vegetation with bulrushes and spikerushes.
Australian fritillary (*Argynnis hyperbius inconstans*)	Unlikely	They are restricted to open, swampy, coastal areas where the larval food plant, *Viola betonicifolia*, grows as a small, insignificant ground herb in association with *Lomandra longifolia* (long leaved matrush) and grasses, especially the grass *Imperata cylindrica* (blady grass). Habitat does not occur on the site.
Australian painted snipe *(Rostratula australis)*	Unlikely	The Painted Snipe occurs in the better watered areas of eastern Australia and the NT. They are generally rare and prefer shallow freshwater swamps or saltmarsh areas.
Barred cuckoo-shrike *(Coracina lineata)*	**Possible**	The Barred cuckoo-shrike is generally uncommon and is rare in NSW, living in rainforest, eucalypt forests and woodland, swamp woodlands and timber, along watercourses, wandering nomadically in search of fruit.
Beach stone-curlew	Unlikely	Beach Stone-curlews are found exclusively along the coast, on a wide range of beaches, islands, reefs and in estuaries, and may often be seen at the edges of or near mangroves. They forage in the intertidal zone of beaches and estuaries, on islands, flats, banks and spits of sand, mud, gravel or rock, and among mangroves. Beach Stone-curlews breed above the littoral zone, at the backs of beaches, or on sandbanks and islands, among low vegetation of grass, scattered shrubs or low trees; also among open mangroves (Dept. Environment 2012). Suitable habitat does not occur on the Subject site.

Species	Likelihood of occurrence on the Subject site	Notes
Black bittern (*Ixobrychus flavicollis*)	Unlikely	This species occurs in coastal and sub-coastal areas of south-west, north and eastern Australia. It is usually found in the dense vegetation fringing streams, swamps, tidal creeks and mudflats, particularly amongst Swamp she-oaks and Mangroves.
Black-breasted button-quail (*Turnix melanogaster*)	Unlikely	In north-east NSW, there are few reliable records, all north of the Bruxner Highway and east of the Great Divide. This species prefers drier rainforests and viney scrubs, often in association with Hoop Pine and a deep, moist leaf litter layer.
Black-faced monarch (*Monarch melanopsis*)	Unlikely	This species occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical (mesophyll) rainforest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket/shrubland, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest. During winter or migration, this species also occurs in marginal habitats such as 20-30 years old regrowth rainforest, nearby open eucalypt forest (mainly wet sclerophyll forests), especially in gullies with a dense, shrubby understorey as well as dry sclerophyll forests and woodlands, often with a patchy understorey. (Dept. Environment 2012).
Black-necked stork (*Ephippiorhynchus asiaticus*)	Unlikely. Recorded in The Glades development site in 2003	This species is widespread in northern Australia but sparse on the east coast from Qld to southern NSW. It inhabits swamps, mangroves, mudflats, dry floodplains and irrigated land and occasionally forages in open grassy woodland. Suitable habitat does not occur within the Subject site, however it has been observed foraging near the dam in The Glades development site.
Brolga (*Grus rubicunda)*	Unlikely	This species occurs in shallow wetlands and open grassland habitats. Suitable habitat occurs on the Subject site and may be utilised by this species, particularly after heavy rain.

Species	Likelihood of occurrence on the Subject site	Notes
Brown treecreeper (*Climacteris picumnus*)	**Possible**	This species occupies eucalypt woodlands, particularly those without a dense understorey. It nests in tree hollows in permanent territories and has been recorded in Moonee Beach Nature Reserve.
Brush-tailed phascogale (*Phascogale tapoatafa*)	**Possible**	This species inhabits dry sclerophyll open forest as well as heathlands, swamps, rainforest and wet sclerophyll forest. Suitable habitat occurs on the Subject site.
Brush-tailed rock-wallaby (*Petrogale penicillata*)	Unlikely	This species lives on rocky escarpments, granite outcrops and cliffs, which have caves and ledges for shelter and face north for warmth. Suitable habitat for this species is not considered to occur within the study area.
Cattle egret (*Ardea ibis*)	**Possible**	This species inhabits tropical and temperate grasslands, wooded lands and terrestrial wetlands. It uses predominately shallow, open and fresh wetlands including meadows and swamps with low emergent vegetation and abundant aquatic flora. This species often forages away from water on low lying grasslands, improved pastures and croplands. It is commonly found in cattle fields and other farm areas that contain livestock. This species roosts in trees, or amongst ground vegetation in or near lakes and swamps (Dept. Environment 2012).
Comb-crested jacana (*Irediparra gallinacea*)	Unlikely	This species lives on floating vegetation in freshwater lakes and ponds.
Common blossom bat	**Possible**	They often roost in littoral rainforest and feed on flowers in adjacent heathland and paperbark swamps. Common Blossom Bats in NSW, the Southern part of their range, feed mostly on nectar. There are a number of blossom producing trees on the Subject site.
Common greenshank (*Tringa nebularia*)	Unlikely	This species is known to occupy habitat associated with estuaries.

Species	Likelihood of occurrence on the Subject site	Notes
Common planigale *(Planigale maculata)*	**Recorded on site in March 2017**	This species occurs in coastal north-east NSW, occupying a wide range of habitats. The Common planigale is found in Rainforest, Sclerophyll forest, Grasslands, Marshlands, rocky areas, some suburban areas and usually close to water. Suitable habitat occurs within the study area.
Common sandpiper (*Actitis hypoleucos*)	Unlikely	This species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. This species has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. This species generally forages in shallow water and on bare soft mud at the edges of wetlands; often where obstacles project from substrate, e.g. rocks or mangrove roots. Birds sometimes venture into grassy areas adjoining wetlands. Roost sites are typically on rocks or in roots or branches of vegetation, especially mangroves (Dept. Environment 2012).
Curlew sandpiper (*Calidris ferruginea*)	Unlikely	Suitable habitat for this species includes tidal reefs and pools, weed-covered rocks, pebbly, shelly and sandy shores with stranded seaweed, and mudflats (Dept. Environment 2012).
Dusky woodswallow	Unlikely	The Dusky Woodswallow is found in open forests and woodlands, and may be seen along roadsides and on golf courses. Occurs in small flocks, hawking insects through clearings and above the canopy. Suitable habitat for this species is considered to occur on the Subject site.
Eastern bent-wing bat *(Miniopterus schreibersii oceanensis)*	Unlikely	This species occurs throughout Eastern Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures.

Species	Likelihood of occurrence on the Subject site	Notes
Eastern bristlebird (*Dasyomis brachypterus*)	Unlikely	This species inhabits moist, mountain ranges within about 100km of the coast. In Queensland most sightings have been within localised pockets of relatively open eucalypt forest in close proximity to denser vegetation along creek lines and rainforest. Soils are relatively fertile, derived from basalts of the Main Range Volcanics and Mt Warning Shield. The ground stratum of the eucalypt forests favoured by the eastern bristlebird is a mosaic of dense clumped grasses interspersed with patches of shrubs, ferns, tangled vines and fallen logs. The more common grasses include wild sorghum (*Sarga leiocladum*), kangaroo grass (*Themeda triandra*) and tussock grass (*Poa labillardieri*). The presence of mature wild sorghum tussocks is thought to be a good indicator of high quality bristlebird habitat (DEHP 2013).
Eastern curlew (*Numenius madagascariensis*)	Unlikely	This wading species is usually associated with estuaries, bays and lagoons where intertidal mud and sandflats occur. Occasionally also found on beaches, reefs and rocky islets.
Eastern freetail-bat (*Mormopterus norfolkensis*)	**Possible**	This species is sparsely distributed in coastal eastern Australia, from approximately Sydney to Fraser Island. This is a poorly known species for which specific habitat requirements are not known. Inferences from wing morphology and echo-location call design suggest that it forages in more open environments. This species has been recorded from forest types ranging from rainforest to dry sclerophyll forest and woodland, but most records are from dry sclerophyll forest and woodland. Suitable habitat for this species is considered to occur on the Subject site.
Eastern grass owl (*Tyto longimembris*)	**Possible**	Eastern Grass Owls are found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains. They rest by day in a 'form' - a trampled platform in a large tussock or other heavy vegetative growth. Suitable habitat for this species is considered to occur on the Subject site.

Species	Likelihood of occurrence on the Subject site	Notes
Eastern osprey *(Pandion cristatus)*	**Possible. Recorded in The Glades development side in May 2004**	This raptor is thinly distributed in coastal Australia. It nests in singularly overtopping, generally dead trees. The Eastern osprey hunts in coastal rivers, estuaries and streams and may gather nesting material from nearby forests. Suitable nesting habitat occurs within the study area. Two Osprey nests occur on The Glades development site, with the species observed over the site and Moonee Creek.
Fork-tailed swift (*Apus pacificus*)	**Possible**	The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher. In Australia, they mostly occur over inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over settled areas, including towns, urban areas and cities. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes. They sometimes occur above rainforests, wet sclerophyll forest or open forest or plantations of pines (DoE 2016).
Gang-gang cockatoo (*Callocephalon fimbriatum*)	Unlikely	The Gang-gang cockatoo is generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests from southern Victoria through south and central-eastern New South Wales. Suitable habitat for this species does not occur on the Subject site. Suitable habitat does not occur on the Subject site.
Giant barred frog *(Mixophyes iteratus)*	Unlikely	Giant barred frogs forage and live amongst deep, damp leaf litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1000m. They breed around shallow, flowing rocky streams from late spring to summer. Suitable habitat does not occur within the study area.

Species	Likelihood of occurrence on the Subject site	Notes
Glossy black cockatoo *(Calyptorhynchus lathami)*	**Possible. Recorded on site in May 2004 and chewed cones observed in March 2017**	The Glossy black-cockatoo is found in coastal forests and open inland woodland of eastern Australia. The Glossy Black's distribution is limited to habitat containing sufficient seed reserves of their three favoured species: *Allocasuarina littoralis*, *A. torulosa* and *A. verticillata* (Forshaw, 1981) in addition to suitable large hollow bearing trees for nesting. Suitable habitat exists within the study area.
Golden-tipped bat	Unlikely	This species occurs in rainforest habitats. Suitable habitat does not occur on the Subject site.
Great egret (*Ardea alba*)	Unlikely	The Great Egret has been reported in a wide range of wetland habitats (for example inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial). These include swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs. The species usually frequents shallow waters (DoE 2016).
Greater glider	Unlikely	The greater glider is an arboreal nocturnal marsupial, largely restricted to eucalypt forests and woodlands. It is primarily folivorous, with a diet mostly comprising eucalypt leaves, and occasionally flowers. It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows. Suitable habitat for this species is not considered to occur on the Subject site.

Species	Likelihood of occurrence on the Subject site	Notes
Green-thighed frog	**Possible**	This species occurs in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface waters gather after rain. It prefers wetter forests in the south of its range, but extends into drier forest in northern NSW and southern Queensland. Breeding occurs following heavy rainfall from spring to autumn, with larger temporary pools and flooded areas preferred. Foraging also occurs in leaf litter within 300m of breeding habitat (NSW OEH 2014).
Grey-crowned babbler *(Pomatostomus temporalis)*	Unlikely	The Grey-crowned babbler is patchily distributed throughout northern and eastern Australia but is considered rare in NSW. This species inhabits Open woodlands and along streams where vegetation is cleared. Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Woodlands on fertile soils in coastal regions.
Grey-headed flying fox *(Pteropus poliocephalus)*	**Possible.** Recorded on site in 2004 and 2017	This species occurs from central eastern Qld south to Victora. In NSW the Grey-headed flying fox mainly occurs in coastal areas and along river valleys. They typically roost in conspicuous camps in Lowland rainforest and Swamp forest, often in isolated remnants or on islands in rivers. They forage on fruit, nectar and pollen in Rainforests and Eucalypt forests.
Koala *(Phascolarctos cinereus)*	**Possible. Recorded on the adjacent The Glades development site in May 2004**	The Koala occurs in Eucalypt woodlands and forests throughout eastern Australia. They inhabit areas where there are appropriate food trees. No signs of Koala activity were recorded during surveys. Small numbers of preferred food trees occur on the site.

Species	Likelihood of occurrence on the Subject site	Notes
Large-eared pied bat *(Chalinolobus dwyeri)*	Unlikely	This species roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Hirundo ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. It is usually recorded in well-timbered areas containing gullies. Suitable habitat does not occur within the study area.
Large-footed myotis *(Myotis macropus)*	Unlikely. Recorded on The Glades development site in May 2004	This species is distributed throughout eastern Australia. It forages over bodies of water ranging from rainforest streams to large lakes and reservoirs. It roosts during the day in caves, mines, tunnels, tree hollows and under bridges. Suitable habitat is not present within study area. However, this species has been recorded foraging over dams within the study area.
Latham's snipe (*Gallinago hardwickii*)	Unlikely	This species prefers freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies). No suitable habitat is present on this site.
Little bent-wing bat *(Miniopterus australis)*	**Possible.** Recorded on The Glades development site in May 2004	This species occurs in coastal north-east NSW and eastern Qld. Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Roosts in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. This species was recorded from the study area during the survey and is likely to forage widely over the site.
Little eagle (*Hieraaetus morphnoides*)	Unlikely	The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. Occupies open eucalypt forest, woodland or open woodland.

Species	Likelihood of occurrence on the Subject site	Notes
Little lorikeet (*Glossopsitta pusilla*)	**Possible**	Distribution extends from north of Cairns, around the east coast of Australia, to Adelaide. It mostly occurs in dry, open eucalypt forests and woodlands. Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Suitable potential habitat for this species is found on the Subject site (i.e. flowering Eucalypts, Melaleucas and tree hollows).
Long-nosed potoroo *(Potorous tridactylus)*	Unlikely	This species inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature.
Masked owl (*Tyto novaehollandiae*)	**Possible**	In NSW, this species is recorded sporadically in the north-east along the coast and tablelands. It inhabits dry eucalypt forest and woodlands. It has a large home range of 500 – 1000 hectares covering forested and partly open country. Suitable habitat does not exist within the study area.
New Holland mouse (*Pseudomys novaehollandiae*)	Unlikely	Across the species' range, the New Holland Mouse is known to inhabit the following types of habitat (DoE 2016): • open heathland; • open woodland with a heathland understorey; and • vegetated sand dunes. Due to the largely granivorous diet of the species, sites where the New Holland Mouse is found are often high in floristic diversity, especially leguminous perennials (DoE 2016).

Species	Likelihood of occurrence on the Subject site	Notes
Oriental cuckoo (*Cuculus optatus*)	Unlikely	*Cuculus optatus* (also known as *C. saturatus optatus*) uses a range of vegetated habitats such as monsoon rainforest, wet sclerophyll forest, open woodlands and appears quite often along edges of forests, or ecotones between forest types (DoE 2016).
Painted snipe (*Rostratula benghalensis*)	Unlikely	This species 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; often with scattered clumps of lignum *Muehlenbeckia* or canegrass or sometimes tea-tree (*Melaleuca*). The species sometimes utilises areas that are lined with trees, or that have some scattered fallen or washed-up timber. Breeding habitat requirements may be quite specific: shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby. Nest records are all, or nearly all, from or near small islands in freshwater wetlands , provided that these islands are a combination of very shallow water, exposed mud, dense low cover and sometimes some tall dense cover (Dept. Environment 2012).
Pectoral sandpiper (*Calidris melanotos*)	Unlikely	Small, migratory wader that prefers shallow fresh to saline wetlands. This species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.
Pied oystercatcher	Unlikely	This species is a coastal shorebird. It forages and nests on ocean beaches and estuarine sandflats. The Pied oystercatcher has been recorded in Moonee Nature Reserve and during studies in the locality.

Species	Likelihood of occurrence on the Subject site	Notes
Pin-tailed snipe (*Gallinago sternura*)	Unlikely	Most often in or at the edges of shallow freshwater swamps, ponds and lakes with emergent, sparse to dense cover of grass/sedge or other vegetation. The species is also found in drier, more open wetlands such as claypans in more arid parts of species' range. It is also commonly seen at sewage ponds; not normally in saline or inter-tidal wetlands (Higgins & Davies 1996).
Pink underwing moth (*Phyllodes imperiallis smithersi*)	Unlikely	The Pink Underwing Moth is found below the altitude of 600 m in undisturbed, subtropical rainforest. It occurs in association with the vine *Carronia multisepalea*, a collapsed shrub that provides the food and habitat the moth requires in order to breed (DoE 2016).
Powerful owl (*Ninox strenua*)	Unlikely	The Powerful owl is found throughout south-eastern Australia but is uncommon. They have large home ranges (more than 1000 hectares) and occur in a variety of habitats, from woodland and open forest to tall moist forests and rainforests.
Rainbow bee-eater (*Merops ornatus*)	Unlikley	The Rainbow Bee-eater occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including mallee, and in open forests that are usually dominated by eucalypts, and farmland and areas of human habitation. It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water. It also occurs in inland and coastal sand dune systems, and in mangroves in northern Australia, and has been recorded in various other habitat types including heathland, sedgeland, vine forest and vine thicket, and on beaches (DoE 2016).
Red goshawk *(Erythrotriorchis radiatus)*	Unlikely	Most records of this species are from the Clarence River catchment, with a few from the lower Richmond and Tweed Rivers. In NSW this species is mainly found along or near watercourses, in swamp forest and woodlands and on the coastal plain. This is a very rare species and is unlikely to be found within the study area.

Species	Likelihood of occurrence on the Subject site	Notes
Red knot (*Callidris canutus*)	Unlikely	Suitable habitat for this species includes tidal reefs and pools, weed-covered rocks, pebbly, shelly and sandy shores with stranded seaweed, and mudflats (Dept. Environment 2012).
Regent honeyeater (*Anthochaera phrygia*)	Unlikely	This species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. They prefer woodlands that have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. Every few years non-breeding flocks are seen foraging in flowering coastal Swamp mahogany and Spotted gum forests, particularly on the central coast and occasionally on the upper north coast. This species is very rarely recorded in the locality. However, the Coffs Harbour area is known as a preferred coastal foraging area for this species.
Rose-crowned fruit-dove *(Ptilinopus regina)*	Unlikely	The Rose-crowned fruit-dove occurs along the coast and the ranges of Qld and Eastern NSW. It occurs mainly in subtropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful.
Rufous bettong (*Aepyprymnus refescens*)	Unlikely	Rufous Bettongs inhabit a variety of forests from tall, moist eucalypt forest to open woodland, with a tussock grass understorey. A dense cover of tall native grasses is the preferred shelter. Suitable habitat for this species is not considered to occur on the Subject site.

Species	Likelihood of occurrence on the Subject site	Notes
Rufous fantail (*Rhipidura ruffrons*)	Unlikely	The Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (*Eucalyptus microcorys*), Mountain Grey Gum (*E.cypellocarpa*), Narrow-leaved Peppermint (*E. radiata*), Mountain Ash (*E. regnans*), Alpine Ash (*E. delegatensis*), Blackbutt (*E. pilularis*) or Red Mahogany (*E. resinifera*); usually with a dense shrubby understorey often including ferns. They also occur in subtropical and temperate rainforests, where they have been recorded in temperate Lilly Pilly (*Acmena smithi*) rainforest, with Grey Myrtle (*Backhousia myrtifolia*), Sassafras (*Doryphora sassafras*) and Sweet Pittosporum (*Pittosporum undulatum*) subdominants. They occasionally occur in secondary regrowth, following logging or disturbance in forests or rainforests. When on passage, they are sometimes recorded in drier sclerophyll forests and woodlands, including Spotted Gum (*Eucalyptus maculata*), Yellow Box (*E. melliodora*), ironbarks or stringybarks, often with a shrubby or heath understorey (DoE 2016).
Satin flycatcher (*Myiagra cyanoleuca*)	Unlikely	Satin Flycatchers mainly inhabit eucalypt forests, often near wetlands or watercourses. They generally occur in moister, taller forests than the Leaden Flycatcher, *Myiagra rebecula*, often occurring in gullies. They also occur in eucalypt woodlands with open understorey and grass ground cover, and are generally absent from rainforest. In south-eastern Australia, they occur at elevations of up to 1400 m above sea level, and in the ACT, they occur mainly between 800 m above sea level and the treeline (DoE 2016).

Species	Likelihood of occurrence on the Subject site	Notes
Scarlet robin (*Petroica boodang*)	Unlikely	The scarlet robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species occurs in both mature and regrowth vegetation and occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. An important component of the habitat is abundant logs and fallen timber (NSW OEH 2015). The Scarlet Robin breeds on ridges, hills and foothills of the western slopes, the Great Dividing Range and eastern coastal regions; this species is occasionally found up to 1000 metres in altitude.
Sharp-tailed sandpiper (*Calidris acuminata*)	Unlikely	These birds forage on grasslands and mudflats. This species prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves (Dept. Environment 2017).
Sooty owl (*Tyto tenebricosa*)	Unlikely	Occurs in rainforests, including dry rainforest, subtropical and warm temperate rainforest, and moist eucalypt forests. They roost by day in the hollow of a tall forest tree or in heavy vegetation, and hunt by night for small ground mammals or tree-dwelling mammals such as Common ringtail possums or Sugar gliders. They nest in very large tree-hollows. Suitable habitat does not occur on the Subject site.
Sooty oystercatcher (*Haematopus fuliginosus*)	Unlikely	This species is a coastal shorebird. It prefers rocky shore habitats.

Species	Likelihood of occurrence on the Subject site	Notes
Spectacled monarch (*Monarch trivirgatus*)	Unlikely	The Spectacled Monarch prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves. Also inhabits Rainforests, eucalypt woodlands, coastal scrubs, damp gullies in rainforest, eucalypt forest, when migrating, more open woodlands (Birdlife Australia 2016; Pizzey and Knight 2002).
Spotted-tailed quoll *(Dasyurus maculatus)*	Unlikely	The Spotted-tailed quoll occurs along the escarpments, tablelands and coast of the eastern seaboard. It inhabits a range of habitats including dry and moist sclerophyll forests, woodlands, coastal heathlands and rainforests. The Quolls require large intact habitat patches and are generally only recorded from forested areas of the Great Dividing Range.
Square-tailed kite (*Lophoictinia isura*)	**Possible**	This species is thinly distributed through open forests, woodland and sandplains, both coastal and sub-coastal. The Subject site may provide suitable foraging habitat for this species
Squirrel glider (*Petaurus norfolcensis*)	**Possible.** Recorded on The Glades development site in May 2004	The Squirrel glider occupies wet and dry sclerophyll forests with open dry sclerophyll forests regarded as optimum habitat. This species was recorded in eucalypt woodland to the east of the Subject site.
Stephen's banded snake (*Hoplocephalus stephensii*)	**Possible**	Rainforest and eucalypt forests and rocky areas up to 950m. Nocturnal, and shelters between loose bark and tree-trunks, amongst vines, or in hollow trunks, limbs, rock crevices or under slabs of rock during the day. At night it hunts frogs, lizards, birds and small mammals (NPWS 2002). Habitat on the Subject site may suit this species.
Stuttering frog (*Mixophyes balbus*)	Unlikely	Inhabits temperate and sub-tropical rainforest and wet sclerophyll forest.
Swift parrot (*Lathamus discolor*)	Possible, but unlikely	Mainland populations of this species favour winter-flowering eucalypt forest and woodland, usually where abundant supplies of Eucalypt nectar exist. This species is rarely recorded in the locality. The last record within 5kms of the Subject site is from 1983.

Species	Likelihood of occurrence on the Subject site	Notes
Swinhoe's snipe (*Gallinago megala*)	Unlikely	This species inhabits shallow freshwater wetlands of various kinds including paddy fields, swamps and sewage farms, with bare mud or shallow water for feeding, with nearby vegetation cover. This species is also known to occur in grasslands, drier cultivated areas and market gardens (Higgins and Davies 1996). Most species records are from the Northern Territory.
Varied sittella	Unlikely	The Varied sittella are a sendentry species that inhabits eucalypt forests and woodlands, especially rough barked species and mature smooth-barked gums with dead branches, in most of mainland Australia. This species may forage periodically over the Subject site.
Wallum froglet *(Crinia tinnula)*	Unlikely. Recorded on The Glades development site in 2003 and in June 2004	The Wallum froglet is found in coastal areas from South-East Qld to the central coast of NSW. It is found only in acid Paperbark swamps and sedge swamps of the coastal 'wallum' country. The Wallum froglet is found in Paperbark swamps growing in areas with acid sandy (Wallum) soils, warm temperate grassland or near the edge of ponds.
Wallum sedge frog *(Litoria olongburensis)*	Unlikely	This species occurs in coastal areas from Frazer Island in south-east Qld to Yuraygir National Park in northern NSW. It inhabits paperbark swamps and sedge swamps of the coastal 'wallum' country. This species may occur within swampy areas of the study area.
White-bellied sea-eagle	Unlikely	This species has a large distribution range throughout SE QLD and is found in association with coasts, large rivers and estuaries and prefers to nest in large trees adjacent watercourses (Dept. Environment 2012).

Species	Likelihood of occurrence on the Subject site	Notes
White-throated needletail (*Hirundapus caudacutus*)	Unlikely	The White-throated Needletail is almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. Although they occur over most types of habitat, they are probably recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland. They also commonly occur over heathland, but less often over treeless areas, such as grassland or swamps (DoE 2016).
Wompoo fruit dove	Unlikely	This species is primarily associated with large undisturbed patches of tropical or subtropical evergreen rainforest. Occasionally this species will occur in patches of monsoon forest, closed gallery forest, wet sclerophyll forest, tall open forest, open woodlands or vine thickets near rainforests (Marchant and Higgins 1993). Suitable habitat does not occur on the Subject site.
Yellow-bellied glider	**Possible. Recorded on The Glades development site by Clancy (1998)**	Preferred habitats are tall open mature sclerophyll forests with a range of eucalypt species in areas of high rainfall. Eucalypt forest on the Subject site is relatively small in area, however may be utilised by Yellow-bellied gliders within the locality.
Yellow-bellied sheathtail-bat	**Possible**	The Yellow-bellied Sheathtail-bat is a wide-ranging species found across northern and eastern Australia. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. Suitable habitat occurs on the Subject site for this species.

Appendix 4 – BBAM Assessment (Impacts)

BioBanking Credit Calculator

Ecosystem credits

Proposal ID :	202/2017/4659D
Proposal name :	Glades Moonee Beach
Assessor name :	Matthew Jenkins
Assessor accreditation number :	202
Tool version :	v4.0
Report created :	17/11/2017 13:56

Assessment circle name	Landscape score	Vegetation zone name	Vegetation type name	Condition	Red flag status	Management zone name	Management zone area	Current site value	Future site value	Loss in site value	Credit required for bio diversity	Credit required for TS	TS with highest credit requirement	Average species loss	Species TG Value	Final credit requirement for management zone
1	22.00	NR124_Moderate/Good	Blackbutt - Turpentine open forest of the foothills of the NSW North Coast Bioregion	Moderate/Good	No	1	1.19	60.00	0.00	60.00	0	60	Masked Owl	88.89	3.00	60
1	22.00	NR217_Moderate/Good	Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	Moderate/Good	Yes	2	0.18	100.00	0.00	100.00	0	14	Barking Owl	100.00	3.00	14

BioBanking Credit Calculator

Species credits

Proposal ID :

Proposal name :

Assessor name :

Assessor accreditation number :

Tool version : v4.0

Report created : 17/11/2017 13:56

Scientific name	Common name	Species TG value	Identified population?	Can Id. popn. be offset?	Area / number of loss	Negligible loss	Red flag status	Number of credits
			No					

BioBanking credit report

This report identifies the number and type of credits required at a DEVELOPMENT SITE.

Date of report: 17/11/2017 Time: 2:11:40PM Calculator version: v4.0

Development details

Proposal ID:	202/2017/4659D
Proposal name:	Glades Moonee Beach
Proposal address:	Pacific Highway Moonee NSW
Proponent name:	Rothwell Boys Pty Ltd
Proponent address:	Lower North Shore Sydney
Proponent phone:	0467099119
Assessor name:	Matthew Jenkins
Assessor address:	PO Box 1465 Ballina NSW 2478
Assessor phone:	02 6686 3858
Assessor accreditation:	202

Improving or maintaining biodiversity

An application for a red flag determination is required for the following red flag areas

Red flag	Reason
Blackbutt - Turpentine open forest of the foothills of the NSW North Coast Bioregion	Vegetation type being > 70% cleared; or it contains an endangered ecological community;
Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	Vegetation type being > 70% cleared; or it contains an endangered ecological community;

The application for a red flag determination should address the criteria set out in the BioBanking Assessment Methodology. Please note that a biobanking statement cannot be issued unless the determination is approved.

Additional information required for approval:

- ☐ Change to percent cleared for a vegetation type/s
- ☐ Use of local benchmark
- ☐ Change negligible loss
- ☐ Expert report...
- ☐ Request for additional gain in site value
- ☐ Predicted threatened species not on site
- ☐ Change threatened species response to gain (Tg value)

Ecosystem credits summary

Plant Community type	Area (ha)	Credits required	Red flag
Blackbutt - Turpentine open forest of the foothills of the NSW North Coast Bioregion	1.19	60.00	No
Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	0.18	14.00	Yes
Total	1.37	74	

Credit profiles

1. Blackbutt - Turpentine open forest of the foothills of the NSW North Coast Bioregion, (NR124)

Number of ecosystem credits created 60

IBRA sub-region Coffs Coast & Escarpment

Offset options - vegetation types	Offset options - CMA sub-regions
Blackbutt - Turpentine open forest of the foothills of the NSW North Coast Bioregion, (NR124) Blackbutt - Tallowwood dry grassy open forest of the central parts NSW North Coast Bioregion, (NR119) Blackbutt grassy open forest of the lower Clarence Valley of the NSW North Coast Bioregion, (NR125) Brush Box tall moist forest of the northern ranges of the NSW North Coast Bioregion, (NR144) Red Mahogany open forest of the coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion, (NR222) Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast, (NR263) Tallowwood dry grassy forest of the far northern ranges of the NSW North Coast Bioregion, (NR267)	Coffs Coast & Escarpment and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

2. Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion, (NR217)

Number of ecosystem credits created 14

IBRA sub-region Coffs Coast & Escarpment

Offset options - vegetation types	Offset options - CMA sub-regions
Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion, (NR217) Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion, (NR254)	Coffs Coast & Escarpment and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

Species credits summary

Appendix 5 – BBAM Assessment (Offsets)

BioBanking Credit Calculator

Ecosystem credits

Proposal ID :	202/2017/4662B
Proposal name :	Glades Moonee Beach - Offset areas
Assessor name :	Matthew Jenkins
Assessor accreditation number :	202
Tool version :	v4.0
Report created :	17/11/2017 14:02

Assessment circle name	Landscape score	TS subzone number	Vegetation zone name	Vegetation type name	Condition	Management zone name	Management zone area	Current site value	Future site value	Gain in site value	Total credit created for management zone
1	12.00	NR124_Moderate/Good_1	NR124_Moderate/Good	Blackbutt - Turpentine open forest of the foothills of the NSW North Coast Bioregion	Moderate/Good	1	7.89	80.67	100.00	19.33	79
1	12.00	NR217_Moderate/Good_1	NR217_Moderate/Good	Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	Moderate/Good	2	2.75	87.33	100.00	12.67	23
1	12.00	NR220_Moderate/Good_1	NR220_Moderate/Good	Pink Bloodwood open forest of the coastal lowlands of the NSW North Coast Bioregion	Moderate/Good	3	3.85	91.67	100.00	8.33	29

BioBanking Credit Calculator

Species credits

Proposal ID :

Proposal name :

Assessor name :

Assessor accreditation number :

Tool version : v4.0

Report created : 17/11/2017 14:02

Scientific name	Common name	Species TG value	Biobank on identified population?	Number found?	Units	Number of credits
			No			

BioBanking credit report

This report identifies the number and type of credits required at a BIOBANK SITE

Date of report: 17/11/2017 Time: 2:10:03PM Calculator version: v4.0

Biobank details

Proposal ID:	202/2017/4662B
Proposal name:	Glades Moonee Beach - Offset areas
Proposal address:	Pacific Highway Moonee Beach
Proponent name:	Rothwell Boys Pty Ltd
Proponent address:	Lower North Shore Sydney
Proponent phone:	0467099119
Assessor name:	Matthew Jenkins
Assessor address:	PO Box 1465 Ballina NSW 2478
Assessor phone:	02 6686 3858
Assessor accreditation:	202

Additional information required for approval:

- ☐ Use of local benchmark
- ☐ Expert report...
- ☐ Request for additional gain in site value

Ecosystem credits summary

Plant Community type	Area (ha)	Credits created
Blackbutt - Turpentine open forest of the foothills of the NSW North Coast Bioregion	7.89	79.00
Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	2.75	23.00
Pink Bloodwood open forest of the coastal lowlands of the NSW North Coast Bioregion	3.85	29.00
Total	14.49	131

Credit profiles

1. Blackbutt - Turpentine open forest of the foothills of the NSW North Coast Bioregion, (NR124)

Number of ecosystem credits created	79
IBRA sub-region	Coffs Coast & Escarpment

2. Pink Bloodwood open forest of the coastal lowlands of the NSW North Coast Bioregion, (NR220)

Number of ecosystem credits created	29
IBRA sub-region	Coffs Coast & Escarpment

3. Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion, (NR217)

Number of ecosystem credits created	23
IBRA sub-region	Coffs Coast & Escarpment

Species credits summary

Additional management actions

Additional management actions are required for:

Vegetation type or threatened species	Management action details
Blackbutt - Turpentine open forest of the foothills of the NSW North Coast Bioregion	Exclude commercial apiaries
Blackbutt - Turpentine open forest of the foothills of the NSW North Coast Bioregion	Exclude miscellaneous feral species
Blackbutt - Turpentine open forest of the foothills of the NSW North Coast Bioregion	Feral and/or over-abundant native herbivore control
Blackbutt - Turpentine open forest of the foothills of the NSW North Coast Bioregion	Fox control
Blackbutt - Turpentine open forest of the foothills of the NSW North Coast Bioregion	Slashing
Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	Control of feral pigs
Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	Exclude commercial apiaries
Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	Exclude miscellaneous feral species
Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	Feral and/or over-abundant native herbivore control
Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	Fox control
Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	Maintain or re-introduce natural flow regimes
Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	Slashing
Pink Bloodwood open forest of the coastal lowlands of the NSW North Coast Bioregion	Control of feral pigs
Pink Bloodwood open forest of the coastal lowlands of the NSW North Coast Bioregion	Exclude commercial apiaries
Pink Bloodwood open forest of the coastal lowlands of the NSW North Coast Bioregion	Exclude miscellaneous feral species
Pink Bloodwood open forest of the coastal lowlands of the NSW North Coast Bioregion	Feral and/or over-abundant native herbivore control
Pink Bloodwood open forest of the coastal lowlands of the NSW North Coast Bioregion	Fox control
Pink Bloodwood open forest of the coastal lowlands of the NSW North Coast Bioregion	Slashing

Appendix 6 - Assessment of Significance (7 Part Test)

Fauna

(a) In the case of a Threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Tables showing the distribution, habitat and life cycle requirements of each species considered a possible occurrence at the Subject site are included as **APPENDIX 7.**

Barred cuckoo-shrike

Extent of the local population
The NPWS database contained two (2) records of this species within 10 kilometres of the Subject site.

The NPWS online database contained eleven (11) sightings of this species in the Coffs Harbour LGA.

Stages of the life-cycle affected by the proposed development
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis was based on local expert knowledge and identified breeding and sheltering sites for the Barred cuckoo-shrike as consisting of low elevation subtropical and littoral rainforest and coastal wet sclerophyll forest close to fruiting figs with the preferred habitat being a mature canopy. The Barred cuckoo-shrike forages in mature canopy and feeds on fruit and large insects including cicadas and phasmids with other small fruited figs as their preferred food.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Barred cuckoo-shrike, with the following results:

1st order disturbances	Urban development Weed invasion Loss of habitat trees (fig trees) in agricultural land Intensive horticulture

The proposed development will not result in significant loss of nesting or forage habitat for this species. Retention of all main areas on vegetation along Moonee and Skinners Creeks as part of the broader The Glades development provide suitable forage habitat for this species with connectivity to similar habitat to the west, north and south.

Likelihood of local extinction
It is considered unlikely that the proposed development will result in the local extinction of this species.

Black-necked stork

Extent of the local population
The NPWS database contained eleven (11) records of this species within 10 kilometres of the Subject site.

The NPWS online database contained one (1) sighting of this species in the Moonee Beach Nature Reserve, and one-hundred and forty-two (142) sightings in the Coffs Harbour LGA.

This species was recorded on The Glades development site, adjoining the Subject site, foraging near the dam in the preliminary study (JWA 2003).

Stages of the life-cycle affected by the proposed development
The Black-necked stork inhabits swamps, mangroves, mudflats, dry floodplains, and irrigated land. It occasionally forages in open grassy woodland (Environment Australia 1999). An abundant supply of frogs and fish is required, together with suitable roost and nest trees, usually overhanging rivers and swamps (SFNSW 1995). It strides through the water probing for prey with its bill and may chase fish. The nest is a large flat pile of sticks, grass and rushes in a tree, usually near water (NPWS 2002).

As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. This analysis was based on local expert knowledge and ranked the significance of various forms of disturbance for the Black-necked stork, with the following results:

1st order disturbances	Drainage of wetlands Dams
2nd order disturbances	Power lines Intensive horticulture (tea trees)
3rd order disturbances	Pesticide contamination of wetlands Urban development Loss of nest trees
4th order disturbances	Shooting

The proposed development will not result in significant loss of nesting or forage habitat for this species. There may be some increase in the level of disturbance to foraging birds as a result of increased visitation to the dam and associated wetland area within The Glades development site. Forage habitat around the dam and drainage line within The Glades site will not be affected by the proposed development.

Likelihood of local extinction
It is considered unlikely that the proposed development will result in the local extinction of this species.

Brown treecreeper

Extent of the local population
The NPWS database contained two (2) records of this species within 10 kilometres of the Subject site.

The NPWS online database contained one (1) sighting of this species in the Moonee Beach Nature Reserve, and six (6) sightings in the Coffs Harbour LGA.

Stages of the lifecycle affected by the proposed development
The Brown Treecreeper is a medium-sized insectivorous bird that occupies eucalypt woodlands, particularly open woodland lacking a dense understorey. It is sedentary and nests in tree hollows within permanent territories, breeding in pairs or communally in small groups. Birds forage on tree trunks and on the ground amongst leaf litter and on fallen logs for ants, beetles and larvae (NPWS 2002).

The NPWS Threatened Species Unit discusses the following threats for the Brown treecreeper:

- Clearance and the fragmentation of woodland habitat including removal of dead timber;
- Habitat degradation, including loss of hollow bearing trees, threatens Brown Treecreeper populations;
- Grazing by stock in woodland areas leads to a decrease in the diversity of ground-dwelling invertebrates decreasing the availability of food for the birds; and
- Brown Treecreepers are likely to be threatened by such factors as increased competition with aggressive honeyeater species and increased levels of nest predation that are a consequence of fragmentation of habitat.

The proposed development will result in the loss of suitable habitat for this species. However, major areas of vegetation (mostly dry sclerophyll forest) occurring along the northern and eastern boundaries of the broader The Glades development site are to be retained. The retained vegetation within The Glades site will provide suitable habitat for the Brown treecreeper. However, the loss of vegetation within the Subject site may require offsets.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

Brush-tailed phascogale

Extent of the local population
The NPWS database contained two (2) records of this species within 10 kilometres of the Subject site.

The NPWS online database contained no sightings of this species in the Moonee Beach Nature Reserve, and sixteen (16) sightings in the Coffs Harbour LGA.
Stages of the life-cycle affected by the proposed development

As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis identified breeding and sheltering sites for the Brush-tailed phascogale as consisting of nests in tree hollows. The Brush-tailed phascogale forages in a broad range of habitats, more common in dry sclerophyll forest and woodlands associated with flatter landscapes where foxes are scarce or absent.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Brush-tailed phascogale, with the following results:

1st order disturbances	Predation by cats Predation – fox Baiting for dingoes Clearing – loss of habitat
2nd order disturbances	Intensive horticulture - Clearing for tea tree horticulture

The proposed development will result in the loss of a small area of suitable habitat for this species, with the majority of suitable habitat to be retained within The Glades development site. However, the loss of vegetation within the Subject site may require offsets.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

Common blossom bat

Extent of the local population
The NPWS database contained twelve (12) records of this species within 10 kilometres of the Subject site.

The NPWS online database contained three (3) sightings of this species in the Moonee Beach Nature Reserve, and twenty (20) sightings in the Coffs Harbour LGA.

Stages of the life-cycle affected by the proposed development
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis identified breeding and sheltering sites for Common blossom bat as consisting of subtropical and littoral rainforest. This species breeds twice, in the coastal complex and riverine rainforest in spring and in the coastal complex in autumn. It needs a diverse array of nectivorous plant communities nearby. The Common blossom bat forages in a diverse range of nectar producing plant communities year-round; occasionally eating some rainforest fruits.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Common blossom bat, with the following results:

1st order disturbances	Clearing – habitat loss Management burns, including illegal
2nd order disturbances	Clearing resulting in fragmentation, increasing predation and decreasing food availability Wildfire Apiary Weed invasion Drainage of swamps Sand mining
3rd order disturbances	Logging of coastal sclerophyll forests with Banksia understorey Aerial spraying of bitou bush
4th order disturbances	Sand dune disturbance from recreational 4WDs
5th order disturbances	Barbed wire fences Introduced predators

This species forages on nectar-producing plants in Paperbark and Eucalypt habitats and is likely to forage on the Subject site at times. The proposed development will contribute toward the loss and fragmentation of habitat for this species and will result in a minor reduction in the availability of forage resources, primarily eucalypts and paperbarks. However, the majority of suitable habitat for this species is to be retained within The Glades development site. However, the loss of vegetation within the Subject site may require offsets.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species

Common planigale

Extent of the local population
The NPWS database contained three (3) records of this species within 10 kilometres of the Subject site.

The NPWS online database contained six (6) sightings of this species in the Coffs Harbour LGA.

Stages of the life-cycle affected by the proposed development
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis was based on local expert knowledge and identified breeding and sheltering sites for Common planigales as consisting of nests of eucalypt leaves in logs or under bark, cracks in soil, grass tussocks, and building debris. The Common planigale forages in dry sclerophyll, swamp sclerophyll, heathland and grassland at ecotone with rainforest. Requires dense leaf litter or ground cover.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Common planigale, with the following results:

1st order disturbances	Predation (cats) – potential interaction between predators and other processes Clearing – loss of habitat
2nd order disturbances	Altered fire regimes Baiting for dingoes
3rd order disturbances	Exotic competitors
4th order disturbances	Predation – cane toad

The proposed development will result in the loss of some foraging and shelter resources for this species. There is potential for increased disturbance to Common planigales feeding and nesting in vegetated areas proximate to the development, and the further possibility of predation from cats. The majority of suitable habitat for this species is to be retained within The Glades development site. However, the loss of vegetation within the Subject site may require offsets.

Likelihood of local extinction
It is considered unlikely that the proposed development will result in the local extinction of this species.

Eastern free-tail bat (*Mormopterus norfolkensis*)

Extent of the local population
The OEH database contained three (3) records of this species within 10 kilometres of the subject site and twelve (12) records of this species in the Coffs Harbour LGA.

The local population of this species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area. This species is highly mobile. The local population is therefore likely to extend to areas outside of the study area.

Stages of the life-cycle affected by the proposed development
The Eastern Free-tail Bat is a poorly known species for which specific habitat requirements are not known. The species has been recorded from forest types ranging from Rainforest to Dry Sclerophyll Forest and Woodland, but most records are from Dry Sclerophyll Forest and Woodland (NPWS 2002).

Breeding sites for the Eastern free-tail bat as consist of large mature tree hollows in dry forest woodland and possibly in moist forest (Environment Australia 1999). Inferences from wing morphology and echolocation call design suggest that it forages for flying insects in more open forest as well as adjacent cleared areas (Allison 1983).
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the north-east

region. The analysis was based on local expert knowledge and ranked the significance of various forms of disturbance for the Eastern free-tail bat, with the following results:

1st order disturbances	Logging – loss of hollows Clearing – loss of habitat
3rd order disturbances	Clearing - fragmentation Pesticides Grazing
4th order disturbances	Logging – loss of Understorey
5th order disturbances	Wildfire

The proposed development will not reduce the forage resource within the study area for this species. It is anticipated that this species will continue to forage over the study area and adjacent areas.

Likelihood of local extinction
It is considered unlikely that the proposed development would lead to the extinction of any local population of this species.

Eastern grass owl (*Tyto longimembris*)

Extent of the local population
The OEH database contained one (1) record of this species within 10 kilometres of the subject site and eight (8) records in the Coffs Harbour LGA.

The local population of this species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area. This is a highly mobile and dispersive species (Morcombe 2004). The local population is therefore likely to extend to areas well outside of the study area.

Stages of the life-cycle affected by the proposed development
The OEH Threatened Species Unit records the following information on the habitat and ecology of the Eastern grass owl.

Eastern grass owls are found in areas of tall grass, including grass tussocks in swampy areas, grassy plains, swampy heath, and cane grass, or sedges on flood plains. They rest by day in a 'form' – a trampled down platform in a large tussock or other heavy growth. When disturbed they burst out of cover, flying rather slowly, before dropping straight down again into cover. They also nest in trodden down grass.

The OEH Threatened Species Unit discusses the following threats for the Eastern grass owl:

- Loss of suitable habitat from grazing, agriculture and development;
- Disturbance and habitat degradation by stock;
- Use of pesticides in agriculture to control rodent populations thereby reducing food sources for owls, and potentially poisoning owls; and

- Frequent burning, which reduces ground cover.

The proposed development is not likely to reduce the forage and nesting resources within the study area for this species. It is anticipated that this species will continue to forage over the study area and adjacent areas.

Likelihood of local extinction
It is considered unlikely that the proposed development would lead to the extinction of any local population of this species.

Glossy black cockatoo

Extent of the local population
The NPWS database contained thirty-nine (39) records of this species within 10 kilometres of the Subject site.

The NPWS online database contained no sightings of this species in the Moonee Beach Nature Reserve, and four hundred and fifty-seven (457) sightings in the Coffs Harbour LGA.

This species was recorded flying over the Subject site on several occasions and signs of forage activity were observed.

Stages of the life-cycle affected by the proposed development
Breeding sites for the Glossy black cockatoo consist of nests in large trees with large hollows (dead or alive) near streams and within 5-20 km of a food source. The Glossy black cockatoo will shelter in stands of tall trees in elevated locations like ridgelines within range of the feeding resource. There is a relationship between roost sites and surface water sites (Environment Australia 1999; Forshaw 1981).

The Glossy black cockatoo usually forages close to the nest but is capable of travelling up to 20km away. It feeds on adult *Allocasuarina littoralis* and *A. torulosa* with individual trees believed to be selected on the basis of the nitrogen content of seeds. It will occasionally use alternative foods (Environment Australia 1999).

As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis was based on local expert knowledge and ranked the significance of various forms of disturbance for the Glossy black cockatoo, with the following results:

1st order disturbances	Clearing for agriculture Grazing and associated burning Urban development Logging that reduces age classes of eucalypts and *Allocasuarina*
3rd order disturbances	Cats climbing into nests Firewood collection

The proposed development of the Subject site will result in the loss of areas of forest containing Forest oak. This species is present in low numbers on the site in the central vegetated area.

Forest oak is a common species in dry sclerophyll forests in this part of the coast. Blackbutt Forest is the largest group in the Urunga Management Area of State Forests NSW. The group includes Forest Types 36 (moist Blackbutt) and 37 (dry Blackbutt). Approximately 70% of all sites in moist and dry locations within the Urunga Management Area have Forest oak as a dominant sub-canopy species (Tweedie *et al* 1995).

Nest sites for the Glossy black-cockatoo consist of hollows in the trunk, stump, spout or limb of eucalypts, living or dead (Higgins (Ed.) in press). The diameter of the hollow has been recorded as around 21 to 22.5cm (Higgins (Ed.) in press).

The proposed development will not result in the loss of potential nesting trees for this species. The loss of sub-mature eucalypts, particularly within the open space area proposed for clearing, represents a decrease in the future recruitment of nest trees.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

Green-thighed frog (*Litoria brevipalmata*)

Extent of the local population
The NPWS database contained three (3) records of this species within 10 kilometres of the subject site and six (6) sightings within the Coffs Harbour LGA.

The local population of this species would comprise of any individuals known to occur in the study area along with any individuals occurring in adjoining areas, contiguous or otherwise, that are known to, or that may utilise habitat in the study area.

Stages of the life-cycle affected by the proposed development
Green-thighed Frogs occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain. Breeding occurs following heavy rainfall from spring to autumn. The frogs are thought to forage in leaf-litter (OEH 2017).

The NSW Office of Environment and Heritage consider the following, direct and indirect impacts, as threats to the survival of the Green-thighed frog (OEH 2017):

- Changes to drainage patterns which reduce periodic local flooding;
- Damage to semi-permanent and ephemeral ponds and flood-prone vegetation;
- Clearing of habitat for development;
- Clearing of habitat for agriculture;
- Habitat disturbance through timber harvesting;
- Reduction in water quality through pasture fertilisation;

- Reduction in habitat and water quality as a result of grazing; and
- Reduction of leaf-litter and cover of fallen logs through burning for agricultural purposes.

The Proposed development will result in the minor loss of suitable habitat for this species, with the majority of suitable habitat to be retained within The Glades development site. The loss of vegetation within the Subject site may require offsets.

Likelihood of local extinction
The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species.

With the adoption of the recommended amelioration measures, it is considered that the proposed development is unlikely to result in the local extinction of this species.

Grey-headed flying fox

Extent of the local population
The NPWS database contained twenty-nine (29) records of this species within 10 kilometres of the Subject site.

The NPWS online database contained four (4) sightings of this species in the Moonee Beach Nature Reserve, and two-hundred and eighty-five (285) sightings in the Coffs Harbour LGA. This species was recorded on The Glades development site foraging in flowering Blackbutts.

Stages of the life-cycle affected by the proposed development
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis identified breeding and sheltering sites for the Grey-headed flying fox as consisting of mainly rainforest and moist riparian forest with a complex mosaic of rainforest, swamp and sclerophyll forest resources less than 40-50km from roost. There is high site fidelity with roosts often in riverine rainforest. The Grey-headed flying fox forages in subtropical rainforest with a mosaic of resources – rainforest fruit, nectar and pollen. The Grey-headed flying fox is less restricted to rainforest remnants than the Black flying fox.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Grey-headed flying fox, with the following results:

1st order disturbances	Clearing – habitat loss
2nd order disturbances	Direct disturbance to camps Drainage of swamps
3rd order disturbances	Powerlines Logging of Sclerophyll Management burns Shooting
4th order disturbances	Clearing resulting in fragmentation

	Wildfire
5th order disturbances	Disease – lyssavirus Apiary Barbed wire fences Weed invasion
6th order disturbances	Climate change

The proposed development will result in the minor loss of suitable forage habitat for this species. Suitable roosting habitat does not occur on site.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

Koala

Extent of the local population
The NPWS database contained seventy (70) records of this species within 10 kilometres of the Subject site.

The NPWS online database contained three (3) sightings of this species in the Moonee Beach Nature Reserve, and one thousand seven hundred and seventy-six (1776) sightings in the Coffs Harbour LGA.

Koala scats were found in vegetation to the north of the Subject site within The Glades development site, flanking Skinners Creek.

Stages of the life-cycle affected by the proposed development
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis identified feeding sites for Koalas in coastal forested environments (not woodland) as areas with stands with a high diversity of known food trees (three or more) including Tallowwood, Grey gum, Forest oak, Sydney blue gum, Swamp mahogany and Red gums. The Koala shelters in larger trees with big lateral branches (not necessarily food trees). The Koala disperses over any open habitat (including pasture and grassland) as long as scattered trees are present.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Koala, with the following results:

1st order disturbances	Habitat clearing
2nd order disturbances	Introduced predators – foxes and dogs
3rd order disturbances	Intensive logging that removes the critical tree size classes from the stand (may be frequent or single and intensive) Logging that fails to retain stems in the 30-80 DBH size class.

4th order disturbances	Wildfire
5th order disturbances	Road kills
6th order disturbances	Disease

Impacts on the Koala have been considered in **SECTION 4**. The proposed development will result in some minor loss and fragmentation of habitat for this species. There is the potential of injury or mortality from vehicle strike, or harassment by dogs.

Likelihood of local extinction
With the adoption of amelioration measures discussed in **SECTION 4**, the proposed development is unlikely to result in the local extinction of this species.

Large-footed myotis

Extent of the local population
The NPWS database contained seven (7) records of this species within 10 kilometres of the Subject site.

The NPWS online database contained no sightings of this species in the Moonee Beach Nature Reserve, and thirty-one (31) sightings in the Coffs Harbour LGA.

The Large-footed myotis was recorded in the Moonee Release Area by Clancy (1998) flora foraging over Cunningham's Creek to the west of The Glades development site. The Large-footed myotis was also recorded by JWA (2003) at Lot 122 DP 105 2566 Moonee Beach Road, approximately 1 km south-east of the site.

The Large-footed myotis was recorded near the dam on The Glades development site during 2017 survey.

Stages of the life-cycle affected by the proposed development
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis identified breeding and sheltering habitat for the Large-footed myotis as consisting of any forested riparian and adjacent vegetation around water bodies and coastal lakes and streams greater than first order streams. Breeding is in hollows, as well as under bridges and in caves. The Large-footed myotis forages in still water bodies with associated vegetation (tree line), and feeds on aquatic and other flying insects and small fish.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Large-footed myotis, with the following results:

1st order disturbances	Clearing – habitat loss (riparian vegetation) Clearing - fragmentation
2nd order disturbances	Use of chemicals Grazing Use of chemicals – mosquito control, pesticides

3rd order disturbances	Altered hydrology - sedimentation Altered hydrology - altered flow Bridge removal Eutrophication from grazing, agriculture and sewage Dams
4th order disturbances	Logging – loss of hollows Frequent burning
5th order disturbances	Recreational activities – fly fishing, boating Weeds
6th order disturbances	Fish (trout)

The proposed development is highly unlikely to affect forage habitat or decrease the foraging efficiency of Large-footed myotis occurring in the area.

There are no known roost sites (caves, tunnels) for the Large-footed myotis in the Subject site. It is unlikely that the local population of Large-footed myotis is dependent upon tree hollows within the development area for its continued survival. It is likely that the extent of the local population of Large-footed myotis has been underestimated due to the lack of targeted survey in the locality.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

Little bent-wing bat

Extent of the local population
The NPWS database contained twenty-seven (27) records of this species within 10 kilometres of the Subject site.

The NPWS online database contained one (1) sighting of this species in the Moonee Beach Nature Reserve, and one hundred and seventy (170) sightings in the Coffs Harbour LGA.

The Little bent-wing bat was recorded on the Subject site.
Stages of the life-cycle affected by the proposed development
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis identified breeding sites for Little bent-wing bat as consisting of limestone caves, where it usually occurs in association with the Common bent-wing bat. It congregates in high numbers in maternity roost (in 1000's). It also shelters in a range of artificial structures including culverts, drains, mines etc. The Little bent-wing bat forages on flying insects in forested areas, predominantly swamp forest, moist eucalypt forest, rainforest and some dry forests.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Little bent-wing bat, with the following results:

1st order disturbances	Clearing – habitat loss
2nd order disturbances	Disturbance to camps/caves by limestone mining (cave collapse, altered air flow, noise, dust etc) and recreational activities.
3rd order disturbances	Clearing – fragmentation Logging – loss of foraging habitat Frequent burning Altered hydrology/microclimate – old growth-regrowth
4th order disturbances	Grazing Wildfire Pesticides
5th order disturbances	Introduced predators

This species forages in a variety of habitats and is likely to forage in the Subject site at times. The proposed development will contribute toward the loss and fragmentation of habitat for this species and will result in a minor reduction in the availability of forage resources. Roosting habitat will not be affected.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

Little lorikeet (*Glossopsitta pusilla)*

Extent of the local population
The NPWS database contained twenty-nine (29) records of this species within 10 kilometres of the subject site and ninety-three (93) sightings within the Coffs Harbour LGA.

The local population of this species would comprise of any individuals known to occur in the study area along with any individuals occurring in adjoining areas, contiguous or otherwise, that are known to, or that may utilise habitat in the study area.

Stages of the life-cycle affected by the proposed development
The Little lorikeet forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophoras, Melaleucas and other tree species. Feeds mostly on nectar and pollen, occasionally on native fruits such as mistletoe, and only rarely in orchards. The species roosts in treetops, often distant from feeding areas. Nesting season extends from May to September. In years when flowering is prolific, Little Lorikeet pairs can breed twice, producing 3-4 young per attempt.

The NSW National Parks and Wildlife Service consider the following, direct and indirect impacts, as threats to the survival of the Little lorikeet (DEC 2005):

- extensive clearing of woodlands for agricultural purposes, resulting a loss in lorikeet food trees, as well as a decrease in survival and reproduction rates;
- loss of hollow bearing trees; and
- competition for resources with the introduced Honeybee.

The Proposed development will result in the minor loss of suitable forage habitat for this species, with the majority of suitable habitat to be retained within The Glades development site. The loss of vegetation within the Subject site may require offsets.

Likelihood of local extinction
The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species.

With the adoption of the recommended amelioration measures, it is considered that the proposed development is unlikely to result in the local extinction of this species.

Masked owl

Extent of the local population
The NPWS database contained six (6) records of this species within 10 kilometres of the Subject site.

The NPWS online database contained no sightings of this species in the Moonee Beach Nature Reserve, and one hundred and three (103) sightings in the Coffs Harbour LGA.

Stages of the life-cycle affected by the proposed development
The Masked owl feeds in sclerophyll forest with sparse, open understorey, particularly in the ecotone between wet and dry forest and non-forest habitat. It feeds on medium and small terrestrial mammals, some arboreal mammals and birds (Environment Australia 1999; Kavanagh & Murray 1996). Studies by Kavanagh & Murray (1996) suggest that the Masked owl may forage over a large area (1,000ha) containing a mosaic or relatively undisturbed and disturbed environments.

Nesting occurs at any time of year in deep hollows (usually vertical) in large, live trees (tall Eucalypts are favoured) or ledges in caves (Environment Australia 1999; Debus 1993). This owl shelters in hollows and in densely foliaged native and exotic understorey trees.
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis was based on local expert knowledge and ranked the significance of various forms of disturbance for the Masked owl, with the following results:

1st order disturbances	Clearing for agriculture
2nd order disturbances	Logging which increases structural density of forest which effects mid to ground layer and thus affects manoeuvrability
3rd order disturbances	Fire – high frequency
4th order disturbances	Clearing for urban development
5th order disturbances	Road-kills
6th order disturbances	Nest and roost site disturbance

This species forages over a wide area and may forage over the Subject site at times. The proposed development will contribute toward the loss and fragmentation of habitat for this species and will result in some reduction in the availability of prey.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

Osprey

Extent of the local population
The NPWS database contained twenty-eight (28) records of this species within 10 kilometres of the Subject site.

The NPWS online database contained four (4) sightings of this species in the Moonee Beach Nature Reserve, and two hundred and three (203) sightings in the Coffs Harbour LGA.

An active Osprey nest occured in 2004 on the northern boundary of the adjacent Lot 7, south of the subject site. However, this nest was not seen in the 2017 surveys. Ospreys are also known to nest to the south of Moonee township (Draft Moonee DCP, 2003).

Ospreys were recorded within the nest tree, and flying over the Subject site to forage over Moonee Creek.

Stages of the life-cycle affected by the proposed development
Ospreys forage for fish in fresh, brackish or saline waters of rivers, lakes, estuaries and inshore coastal waters (NPWS 2002; Marchant and Higgins 1993). A breeding pair requires a suitable foraging area with nesting sites nearby. The nest is a large bulky structure of dead sticks, often located in a tall dead tree or on artificial structures such as power transmission poles or towers. It is used year after year for as long as it lasts (NPWS 2002).

As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The RFA analysis was based on local expert knowledge and ranked the significance of various forms of disturbance for the Osprey, with the following results:

1st order disturbances	Drainage of wetlands Chemical pollutants Urban development Loss of nest sites Commercial fishing (removal of prey, especially mullet)

Potential impacts on the Osprey are considered in **SECTION 4** of this report. The Osprey nest in the adjacent property to the south was being utilised in previous surveys, however not seen in 2017, while the nest site recorded in the south-east of the Subject site appears to have collapsed. While there may be some disturbance to Ospreys during the construction period, this species is unlikely to be significantly affected by the proposed development.

Likelihood of local extinction
The proposed development has the potential to result in the disturbance of the potential nest sites by the resident pair of Ospreys. The proposed development is unlikely to result in the local extinction of this species.

Square-tailed kite

Extent of the local population
The NPWS database contained six (6) record of this species within 10 kilometres of the Subject site.

The NPWS online database contained one (1) sighting of this species in the Moonee Beach Nature Reserve, and thirty-eight (38) sightings in the Coffs Harbour LGA.

Stages of the life-cycle affected by the proposed development
Square-tailed kites are uncommon yet widespread. They inhabit dry woodland and open forest mainly in coastal or subcoastal districts, preferring vegetation along major rivers and belts of trees in urban or semi-urban areas for hunting (NPWS 2002; Marchant & Higgins 1993).

Breeding sites for the Square-tailed kite as consist of nests in tall trees with large branches in tall, open sclerophyll forest and woodland with or adjacent to areas of high densities of passerine birds (Environment Australia 1999). The Square-tailed kite forages on a high density of passerine birds, particularly honeyeaters. It will occasionally take lorikeets, quail, pipits as well as fledglings and nestlings, lizards and insects (Environment Australia 1999; Marchant & Higgins 1993).

As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis was based on local expert knowledge and ranked the significance of various forms of disturbance for the Square-tailed kite, with the following results:

1st order disturbances	Clearing for agriculture
2nd order disturbances	Grazing and associated burning Logging which increases the structural density through reducing age classes, decreased nectar production Intensive horticulture Nest site loss
3rd order disturbances	Urban development
4th order disturbances	Egg collecting

This species forages over a wide area and is likely to forage over the Subject site at times. The proposed development will contribute toward some loss and fragmentation of habitat for this species and will result in some reduction in the availability of prey.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

Squirrel glider

Extent of the local population
The NPWS database contained eight (8) records of this species within 10 kilometres of the Subject site.

The NPWS online database contained one (1) sighting of this species in the Moonee Beach Nature Reserve, and ninety-one (91) sightings in the Coffs Harbour LGA.

This species was recorded on the eastern margins and within scattered trees within grasslands on The Glades development site.

Stages of the life-cycle affected by the proposed development
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis identified breeding sites for Squirrel glider as tree hollows with a preference for small hollow entrances. A single study found that densities declined linearly when the abundance of trees with hollows fell below 6/ha (Smith, 1998). The preferred feeding habitat contains winter flowering eucalypts or banksias including Swamp mahogany, Spotted gum, Coast banksia and Swamp paperbark. Probable association with larger trees with high nectar flows. The Squirrel glider shelters in hollow bearing trees.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Squirrel glider, with the following results:

1st order disturbances	Habitat clearing
2nd order disturbances	High frequency burning
3rd order disturbances	Intensive logging that removes the critical tree size classes from the stand (may be frequent or single and intensive). Removal of large trees and hollows, includes firewood collection
4th order disturbances	Apiary – competition for hollows
5th order disturbances	Introduced predator – foxes, dogs and cats

The proposed development will result in the loss of eucalypts occurring within vegetated areas on the Subject site, and the subsequent fragmentation of habitat for this species. The future recruitment of tree hollows will also be affected as a result of the loss of sub-mature eucalypts on the Subject site. The majority of suitable habitat is to be retained within The Glades development site. However, the loss of vegetation within the Subject site may require offsets.

Likelihood of local extinction
With the adoption of amelioration measures recommended in **SECTION 4**, the proposed development is unlikely to result in the local extinction of this species.

Stephen's banded snake

Extent of the local population
The NPWS database contained six (6) records of this species within 10 kilometres of the Subject site.

The NPWS online database contained no sightings of this species in the Moonee Beach Nature Reserve, and twenty-seven (27) sightings in the Coffs Harbour LGA.

Clancy (1998) notes that the Stephen's banded snake has been recorded on several occasions in an area about 2-3km south-west of the Subject site.

Stages of the life-cycle affected by the proposed development
Stephen's banded snake inhabits dry and moist hardwood forest and rainforest in coastal and near coastal areas from southern Queensland to Gosford in New South Wales (NPWS 2002; Cogger 1996; Wilson and Knowles 1988). Key elements of the preferred habitat for this species are a dense understorey and canopy structure which are required for foraging and movement (Ehmann 1992).

Identified breeding and sheltering sites for Stephens' banded snake as consisting of nests in stags, strangler figs, creepers and vines, hollow bearing trees, decorticating bark, stumps, rock crevices and slabs and arboreal termitaria (Environment Australia 1999).

Prey items consist of small mammals (including bats) and frogs and lizards in riparian vegetation and water (frogs).

As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis was based on local expert knowledge and ranked the significance of various forms of disturbance for the Stephens' banded snake, with the following results:

1st order disturbances	Any fire Grazing and associated burning changes the structure of understorey and ground cover
2nd order disturbances	Predation by introduced species Clearing for urban development Logging –changing canopy structure Road-kills
3rd order disturbances	Clearing for agriculture Clearing – partial for grazing Weed invasion

The proposed development will not result in the loss of appropriate habitat for this species. However, any local population may be affected by predation from dogs and cats. The proposed development may result in a reduction in the prey base of this species due to a decrease in the diversity and abundance of prey species associated with fragmentation and loss of habitat.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

Wallum froglet (*Crinia tinnula*)

Extent of the local population
The OEH database contained two (2) records of this species within 10 kilometres of the subject site and seventy-eight (78) records in the Coffs Harbour LGA.

The local population of this species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area.

Stages of the life-cycle affected by the proposed development
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the north-east region. The analysis identified breeding habitat of this species as consisting of marshy or swampy areas with acidic, tannin stained water, typically associated with paper barks and tea trees. Breeding habitat is often, but not always, ephemeral. Eggs are laid in acid paper bark swamps. Tadpoles are free living and adults are terrestrial. The Wallum froglet forages around sedges and rushes adjacent to breeding habitat. This species is closely associated with the coastal zone and is found in altitudes up to 40m.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Wallum froglet, with the following results:

1st order disturbances	Habitat clearing Wetland swamp drainage for mosquito control Altered hydrology from earthworks
2nd order disturbances	Mining/quarrying
3rd order disturbances	Fish Pollution
4th order disturbances	Tea-tree harvesting

The proposed development will not reduce the potential habitat within the study area for this species.

Likelihood of local extinction

It is considered unlikely that the proposed development would lead to the extinction of any local population of this species.

Wallum sedge-frog (*Litoria olongburensis*)

Extent of the local population
The OEH database contained no records of this species within 10 kilometres of the subject site and no records in the Coffs Harbour LGA.

The local population of this species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area.

Stages of the life-cycle affected by the proposed development
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis identified breeding habitat for the Wallum sedge-frog as consisting of marshy or swampy wallum areas with emergent vegetation. Breeding habitat is often, but not always, ephemeral. Tadpoles are free living. The Wallum sedge-frog feeds adjacent to breeding habitat around emergent low vegetation, sedges and rushes and low foliage.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Wallum sedge-frog, with the following results:

1st order disturbances	Habitat clearing Wetland swamp drainage for mosquito control Altered hydrology etc earthworks
2nd order disturbances	Mining/quarrying, particularly sand mining
3rd order disturbances	Fish Pollution
4th order disturbances	Tea tree harvesting

The proposed development will not reduce the potential habitat within the study area for this species.

Likelihood of local extinction
It is considered unlikely that the proposed development would lead to the extinction of any local population of this species.

Yellow-bellied glider

Extent of the local population
The NPWS database contained thirty-four (34) records of this species within 10 kilometres of the Subject site.

The NPWS online database contained three-hundred and four (304) sightings of this species in the Coffs Harbour LGA.

Clancy (1998) also notes that the Yellow-bellied glider has been recorded in the north-west corner of The Glades development site.

Stages of the life-cycle affected by the proposed development
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis was based on local expert knowledge and identified breeding and sheltering sites for Yellow-bellied gliders as consisting of large hollow trees. It requires trees within gliding distance (on flat ground in tall forest >40m). In steep forest, glides may be much longer (up to 300m). Trees may be quite scattered. The Yellow-bellied glider forages in mature forests with high eucalypt species diversity, winter flowering eucalypts, smooth-barked eucalypts, and sap trees. Larger trees have higher nectar/sap yields.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Yellow-bellied glider, with the following results:

1st order disturbances	Intensive logging that removes the critical tree size classes from the stand (may be frequent or single and intensive). Logging that fails to retain a high proportion of large trees and hollows.
2nd order disturbances	Habitat clearing
3rd order disturbances	High frequency burning

The proposed development will result in the loss of some foraging resources for this species.

Likelihood of local extinction
It is considered unlikely that the proposed development will result in the local extinction of this species.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

Thirty-three (33) endangered populations have been identified under the *TSC Act*. The following endangered populations occur in north-eastern NSW:

- Emu population in the NSW North Coast Bioregion and Port Stephens LGA;
- Long-nosed potoroo population, Cobaki Lakes and Tweed Heads West;
- Low growing form of *Zieria smithii*, Diggers Head; and
- *Glycine clandestina* (Broad-leaf form) in the Nambucca LGA.

The proposed development will not affect any of these endangered populations.

(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, or

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.

Not Applicable.

(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, and

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, and

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 Subject site is considered to provide potential habitat for the Threatened species mentioned above. For the majority of these species however, all suitable habitats on the Subject site will be retained along the northern and eastern boundaries of The Glades development site. Threatened species with potential habitat within the proposed development area within the Subject site are:

- Brown treecreeper;
- Brush-tailed phascogale;
- Common blossom bat;
- Common planigale;

- Glossy black-cockatoo;
- Green-thighed frog;
- Grey-headed flying fox;
- Koala;
- Little bent-wing bat;
- Little lorikeet;
- Masked owl;
- Square-tailed kite;
- Squirrel glider; and
- Yellow-bellied glider.

No hollow-bearing trees will be removed within the Subject site which represents potential den sites for the Yellow-bellied glider, Squirrel glider, or nest sites for the Glossy black-cockatoo. Mature forest to be retained adjacent to the Subject site (i.e. within The Glades development site) comprises a high density of tree hollows. These habitat trees to be retained are considered more suitable as den/nest trees and are more likely to be occupied by these Threatened species should they occur within the study area.

Forage habitat for the Common blossom bat, Grey-headed flying-fox and Little lorikeet may be slightly reduced by the removal of Paperbarks and other flowering species from the development area. However, large areas of more suitable forage habitat will be retained.

Potential foraging and/or nesting habitat for the Brown treecreeper, Brush-tailed phascogale, Common planigale, Green-thighed frog, Little bent-winged bat, Masked owl and Square-tailed kite may be slightly reduced by the loss of habitat from the development area.

The removal of preferred Koala feed trees from the development area represents a reduction in forage resources for the Koala on the Subject site, however, more suitable forage habitat will be retained on the adjacent The Glades development site. It is further recommended that Koala trees be replanted in the north-west corner of The Glades site to consolidate Koala habitat.

Whilst the proposed development within the Subject site may reduce opportunities for dispersal across some areas of study area, it is worth noting that post-development (i.e. the approved The Glades development) corridor values would likely be restricted to stepping stone habitat for highly mobile and disturbance adapted species only. This is due to lack of connecting vegetation to the south, edge effects, roads, and the lack of connectivity to significant habitat areas. The retention of intact forest communities on The Glades site will ensure that dispersal opportunities will persist for fauna species within the study area.

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

Critical habitat areas listed under the Threatened Species Conservation Act (1995) currently consist of habitat for Gould's Petrel at Cabbage Tree Island, off the coast of Port

Stephens, Mitchell's rainforest snail in Stott's Island Nature Reserve, habitat for the Little penguin population in Sydney's North Harbour and habitat for the Wollemi Pine in Wollemi National Park within the Greater Blue Mountains World Heritage Area.

There will be no adverse effects on any critical habitat listed, in the Register of critical habitat in NSW, from the action proposed.

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

An Approved recovery plan exists for the Yellow-bellied glider which is considered a possible occurrence on the Subject site. The objectives of this recovery plan are:

- Co-ordinate the recovery of the Yellow-bellied glider in NSW;
- Encourage and assist in improving the protection and management of the Yellow-bellied glider and its habitat;
- Identify and monitor significant populations of this species;
- Facilitate strategic research into the ecology of the Yellow-bellied glider that is relevant to its conservation; and
- Increase community awareness of the Yellow-bellied glider and encourage community involvement in its conservation.

The Yellow-bellied glider has previously been recorded from The Glades site (Clancy 1998), but was not recorded during this assessment. However, it is considered that this species may occasionally forage over the Subject site. No den sites or feeding scars (sap trees) were located at the Subject site. It is considered that the proposed development is consistent with the objectives and actions of the Recovery Plan for the Yellow-bellied glider.

A Draft recovery plan exists for the Koala which is considered a possible occurrence on the Subject site. The objectives of this recovery plan are:

- To conserve Koalas in their existing habitat;
- To rehabilitate and restore Koala habitat and populations;
- To develop a better understanding of the conservation biology of Koalas;
- To ensure that the community has access to factual information about the distribution, conservation and management of Koalas at a national, state and local level;
- To manage captive, sick or injured Koalas and orphaned wild Koalas to ensure consistent and high standards of care; and
- To manage over-browsing to prevent both Koala starvation and ecosystem damage in discreet patches of habitat.

The proposed development will result in some minor loss and fragmentation of habitat for this species. Suitable habitat will be retained on the adjacent The Glades development site, however there is the potential of injury or mortality from vehicle strike, or harassment by dogs. A number of amelioration measures have been proposed to satisfy the

requirements of the CHCC Koala Plan of Management. It is considered that the proposed development is consistent with the objectives and actions of the Recovery Plan for the Koala.

A Draft recovery plan exists for the large forest owls (Powerful owl, Masked owl & Sooty owl) of which the Masked owl is considered a possible occurrence on the Subject site. The objectives of this recovery plan are to:

- To minimise further loss and fragmentation of habitat outside conservation reserves and State Forests by protection and fragmentation of significant owl habitat (including protection of individual nest sites);
- To minimise the impacts of development activities on large forest owls and their habitat outside conservation reserves and State forests;
- To assess the distribution and amount of high quality habitat for each owl species across public and private lands to get an estimate of the number and proportion of occupied territories of each species that are, and are not protected;
- To monitor trends in population parameters (numbers, distribution, territory fidelity and breeding success) across the range of the three species and across different land tenures and disturbance histories;
- To assess the implementation and effectiveness of forest management prescriptions designed to mitigate the impact of timber-harvesting operations on the three owl species and, (if necessary), to use this information to refine the prescriptions so that forestry activities on State forests are not resulting in adverse changes in species abundance and breeding success;
- To improve the recovery and management of the three large forest owls based on an improved understanding of key areas of their biology and recovery;
- To raise awareness of the conservation requirements of the three large forest owls among the broader community, to involve the community in owl conservation efforts and in so doing increase the information base about owl habitats and biology; and
- To coordinate the implementation of the recovery plan and continually seek to integrate actions in this plan with actions in other recovery plans or conservation initiatives.

Neither the Powerful owl, Masked owl, nor the Sooty owl were recorded from the Subject site. However, it is considered that the Masked owl may occasionally forage over the Subject site. No nest sites were located at the Subject site. It is considered that the proposed development is consistent with the objectives of the Recovery Plan for the large forest owls.

Two Approved Threat abatement plans (TAP) have been completed:

- Predation by the Plague Minnow
- Predation by the Red fox

The Plague Minnow has little relevance to the terrestrial fauna considered in this assessment. The occurrence of the Red fox constitutes a threat to ground nesting birds and

ground dwelling mammals. The Common planigale was recorded on site and may be predated upon by Red foxes. The goal of the Red fox TAB is to minimise the impact of foxes on biodiversity in Australia and its territories by:

- Protecting affected native species and ecological communities; and
- Preventing further species and ecological communities from becoming threatened.

The objectives of the Red fox TAB are to:

1. Prevent foxes occupying new areas in Australia and eradicate foxes from high-conservation-value 'islands';
2. Promote the maintenance and recovery of native species and ecological communities that are affected by fox predation;
3. Improve knowledge and understanding of fox impacts and interactions with other species and other ecological processes;
4. Improve the effectiveness, target specificity, integration and humaneness of control options for foxes; and
5. Increase awareness of all stakeholders of the objectives and actions of the TAP, and of the need to control and manage foxes.

It is considered that the proposed development is consistent with the objectives of the TAP for Threatened ground-dwelling species, such as the Common planigale, that may be present within the Subject site.

(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.

A "threatening process" means a process that threatens, or may have the capability to threaten, the survival or evolutionary development of a species, population or ecological community. Key Threatening Processes have been listed in Schedule 3 of the *TSC Act (1995)*.

Key Threatening Processes (Schedule 3):

- Invasion and establishment of exotic vines and scramblers;
- Invasion and establishment of the Cane toad, Bufo marinus;
- Invasion of the yellow crazy ant;
- Feral pigs;
- Competition and habitat destruction by feral goats;
- Entanglement in, or digestion of anthropogenic debris in marine and estuarine environments;
- Introduction of the large earth Bumble bee, *Bombus terrestris*;
- Removal of dead wood and dead trees;
- Death or injury to marine species following capture in shark control programs on ocean beaches;
- Invasion of native plant communities by exotic perennial grasses;

- Infection of frogs by amphibian chytrid, causing the disease chytrodiomycosis
- Competition from feral honeybees;
- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands;
- Clearing of native vegetation;
- Anthropogenic climate change;
- Removal of Bush rock;
- High frequency fire;
- Invasion by Bitou Bush (*Chrysanthemoides monilifera*);
- Loss and/or degradation of sites used for hilltopping by butterflies;
- Predation by the European red fox (*Vulpes vulpes*);
- Predation by the Feral cat (*Felis catus*);
- Predation by the Ship Rat (*Rattus rattus*) on Lord Howe Island;
- Predation by the Plague Minnow (*Gambusia holbrooki*);
- Infection of native plants by *Phytophthora cinnamomi*;
- Infection by Psittacine circoviral (beak and feather) disease affecting endangered psittacine species and populations;
- Importation of red imported fire ants into NSW; and
- Competition and grazing by the feral European rabbit.

The proposed development will contribute towards the clearing of native vegetation, a key threatening process listed on Schedule 3 of the *TSC Act (1995)*. The final determination of the NSW Scientific Committee notes that clearing of native vegetation is recognised as a major factor contributing to loss of biological diversity, with impacts such as: destruction of habitat; fragmentation of habitat; riparian zone degradation; increased greenhouse gas emissions; increased habitat for invasive species; loss of leaf litter layer; loss or disruption of ecological function (*e.g.* loss of populations of pollinators or seed dispersers) and changes to soil biota.

The amount of native vegetation to be cleared is discussed in Section 4. In total approximately 1.37 hectares of native vegetation will be lost from the Subject site. Amelioration measures have been recommended to minimise the loss of native vegetation on the Subject site.

The Proposed development will not increase the impact of any other key threatening processes.

On the basis of this assessment, it is considered that a Species Impact Statement (SIS) is not required.

Appendix 7 - Fauna Distribution Tables

Name	**Barred cuckoo shrike** (*Coracina lineata*)	
Status	Vulnerable – Schedule 2 TSC Act 1995.	
Geographical Distribution	This species occurs from Cape York Peninsula in Queensland to the Manning River district in NSW (Schodde and Tidemann 1986).	
Description	Medium sized (26-28cm) songbird, face is dark with black lores and yellow eyes. It is dark grey above with darker wings, breast to abdomen is white, strongly barred with black (Simpson and Day 1996).	
Habitat	Blakers et al (1984) note that this species inhabits rainforests and eucalypt forests including margins and regrowth, where it feeds on fruits and insects. A major habitat component is the presence of fruiting trees, particularly figs (*Ficus* sp.).	
Life Cycle Requirements	Forage	The Barred cuckoo shrike flies freely from one feeding tree to another but once settled the birds tend to be quiet and undemonstrative. Aside from rainforest fruits, this species has been reported also to feed on beetles, insect larvae and dragonflies (Shields 1993). Roosting is communal.
	Nesting	Nesting is between October and January, with a small nest of dry twigs and foliage usually built high in a tree (Shields 1993).
	Movements	The bird is often encountered alone or in pairs, but it also congregates in flocks at temporarily abundant food sources.
Conservation Reserves	Border Ranges, Mt. Warning, Nightcap National Parks. Iluka, Limeburners, Sea Acres Nature Reserves.	
Threatening Processes	This is mainly a tropical and subtropical species of lowland rainforest. This habitat has been subject to extensive clearing for residential and agricultural purposes.	
References	Blakers, M.; Davies, S.J.J.F.; and Reilly, P.N. (1984). The Atlas of Australian birds. RAOU and Melbourne University Press: Melbourne. Schodde, R. and Tidemann, S. (Eds) (1986) Readers Digest Complete Book of Australian Birds. Second Edition. Readers Digest Services, Sydney. Shields, J.M. (1993) Yellow-eyed cuckoo shrike *Coracina lineata*. In: Strahan, R (Ed). Cuckoos, Kingfisher and Nightbirds of Australia. Angus and Robertson, Sydney. Simpson, K. & Day, N (1996). Field Guide to the Birds of Australia. Viking: Penguin Books, Sydney.	

Name	**Black-necked stork** (*Xenorhynchus asiaticus)*	
Status	Endangered –Schedule 1 TSC Act (1995)	
Geographical Distribution	This species occurs sparsely throughout much of its northern and north-east Australian range. It is more common in the Coastal northern Territory and along northern and south eastern Queensland coast and plains. Breeding populations are found mainly in these zones.	
Description	An impressive very tall (1.29-1.37m) black and white bird with pipestem red legs: They have a heavy black bill, glossy green-black head and neck. The eye in males is black and in females yellow (Pizzey 1993).	
Habitat	The Black-necked stork inhabits riverine swamps, large permanent pools and coastal wetlands and estuaries. Fresh, brackish or saline water is used (SFNSW 1995). An abundant supply of frogs and fish is required, together with suitable roost and nest trees, usually overhanging rivers and swamps. Foraging occurs singly or in pairs. Critical habitat components for this species include their aquatic food base, water quality and availability of suitable nest and roost trees. The Black necked stork will therefore be sensitive to disturbance of these habitat components.	
Life Cycle Requirements	Foraging	This species forages in shallow water for small invertebrates, fish, amphibians, reptiles and possibly small mammals (Marchant and Higgins 1990). Once settled in specific localities, individual birds may become established for several years (Salmon 1965).
	Breeding	Breeding occurs from March to June with nests forming large stick platforms built in live or dead trees in secluded swamps.
	Movements	The Black-necked stork is an occasional breeding vagrant or transient in the locality. Elsewhere in Australia this species is widespread and moderately abundant as a breeding resident across the north of the continent. Many, if not all of the birds present in the locality may be transients overflowing from populations from the north, although there is no proof of this.
Conservation Reserves	Bundjalung, Broadwater and Yuraygir National Parks. Limeburners Creek Nature Reserve.	
Threatening Processes	The Black-necked stork is primarily threatened by the loss of suitable swamp habitats through draining of wetlands for agricultural and urban development; disturbance of feeding habitat by livestock grazing; contamination of water and food supplies by urban and agricultural nutrients and chemicals and the loss of roost and nest trees.	
References	Pizzey, G and Doyle (1993). A Field Guide to the Birds of Australia. Angus and Robertson. Salmon (1965). Distribution of the Jabiru in central and northern coastal NSW. *Emu*, **65:** 149-151. State Forests of NSW. (1995). Coffs Harbour Urunga Management Area - Environmental Impact Statement. Vol C, Proposed forestry operations - Schedule 12 Fauna. SFNSW, Northern Region.	

Name	**Brush-tailed phascogale** (*Phascogale tapoatafa*)	
Status	Endangered– Schedule 1 TSC Act (1995)	
Geographical Distribution	The species prefers open forest with sparse ground cover. The species was formerly distributed throughout the dry sclerophyll forest and woodlands of temperate and tropical Australia.	
Description	Head and body length is 181mm (approximately) for males. Uniform grizzled grey above, cream to white below. Large naked ears. Conspicuous black bottle-brush tail with hairs up to 55mm long.	
Habitat	The preferred habitat of this species is reported to be dry open forest and woodland containing box, stringybark and ironbark trees (Cuttle 1982, Trail and Coates 1993) but it has also been recorded from coastal forest in NE NSW containing Blackbutt and red bloodwood (Quin, cited in AMBS 1995).	
Life Cycle Requirements	Breeding	The requirement for hollow-bearing trees for nesting sites indicates that this species will require some component of old-growth within its habitat and therefore is likely to be sensitive to removal of this habitat component. This species occurs patchily and in low densities throughout its entire range.
	Foraging	This species is known to forage over the trunks and major limbs of trees, taking arthropods from the bark surface and in shallow bark crevices, and it is thought that they may also forage on logs (Trail and Coates 1993). Foraging takes place throughout the home range of this species rather than at particular sites (Soderquist 1995). The Phascogale forages as it travels, and all parts of the home range therefore represent forage habitat.
	Dispersal	Recent studies by Soderquist (1995) in Victoria have shown that both females and males occupy large home ranges (41ha and 106ha respectively). The home range of males was found to expand during the breeding season to an average length of 2.7km.
Conservation Reserves	Barrington Tops NP, Bundjalung NP, Dorrigo NP, Limeburners Ck. NR, Mt. Warning NP, New England NP, Washpool NP, Werrikimbe NP, Yuraygir NP.	
Threatening Processes	*P. tapoatafa* is sensitive to the loss of critical nest, shelter and feeding habitat such as tree hollows and suitable foraging substrate (especially fallen logs), and predation by feral carnivores such as foxes and cats (CHUMA - Supporting Document 4, 1995). Little is known about this species ecology but an overly frequent fire regime in drier forests is likely to be detrimental to the species through reduction in cover and increased exposure to predation (Smith *et al.*, 1994).	
References	Australian Museum Business Services (1995). Urbenville Management Area - Fauna Impact Statement Vol. D. State Forests of N.S.W., Pennant Hills. Cuttle, P (1982) Life history of the dasyurid marsupial *Phascogale tapoatafa* pp13-22. In Carnivorous Marsupials Ed by M. Archer, Royal Zoological Society of NSW, Sydney. Soderquist, T.R. (1995) Spatial organisation of the arboreal carnivorous marsupial *Phascogale tapoatafa*. Journal of Zoology, 237 pp 385-398.	

	Traill, B.J. and Coates, T.D. (1993). Field Observations on the Brush-tailed Phascogale (Phascogale tapoatafa) Marsupalia: Dasyuridae. *Australian Mammalogy*, 16: 61-65.

Name	**Common blossom bat** (*Syconycteris australis*)	
Status	Vulnerable –Schedule 2 TSC Act (1995).	
Geographical Distribution	This species occurs in eastern Queensland from Cape York south, with disjunct populations occurring south to the mid north coast of NSW around Taree. The southern limit distribution of the Common blossom bat in NSW is latitude 32°19'S at Booti Booti National Park, and may be a determent of climatic factors (Law 1994a).	
Description	The Common blossom bat is one of the smallest pteropids, about the size of a mouse. It has fawn to reddish fur that is very soft. The nostrils are raised above the surface of the muzzle and it has a long brush-like tongue (Strahan 1995).	
Habitat	The Queensland blossom bat is a nectarivore and takes nectar from species such as Banksia and Melaleuca in autumn and winter and from coastal Eucalypts in summer. The Bat prefers to roost in coastal Rainforest or other communities containing broad-leaved species where the canopy provides good protection from rain and wind (B Law, pers. comm).	
Life Cycle Requirements	Foraging	Foraging resources for the Common blossom bat species are produced in a number of habitats throughout coastal NSW and include heaths, paperbark swamps, coastal Eucalypt forest and sub-tropical rainforest. An essential requirement for the occurrence of the Queensland Blossom Bat is a diversity of habitats proximate to rainforest roost sites, so as to ensure a year round supply of nectar and pollen through sequential flowering of different species.
	Roosting	Individuals tend to roost solitarily, shifting roost sites within rainforest habitat depending on prevailing weather conditions.
	Movements	Commuting distances from these roosts to foraging areas are greater in spring and autumn (mean 1.4km) than in winter (mean 0.8km). Adults often change roosts each day, moving approximately 100m, while juveniles re-use roosts over longer periods (Law 1993).
Conservation Reserves	Broadwater, Broken Head, Bundjalung, Mt. Warning, Yuraygir National Parks. Iluka, Limeburners Creek Nature Reserves.	
Threatening Processes	The dominant threat to the critical habitat of this species in NSW is the extensive development of the coastal zone which disrupts the proximity of food supplies and roost sites.	
References	Law, B.S. (1993) "Roosting and Foraging Ecology of the Queensland Blossom Bat (*Syconycteris australis*) in north-eastern New South Wales: Flexibility in response to seasonal variation". Wildlife Research, 20: 419-431. Law, B.S. (1994a) "Climatic limitations of the southern distribution of the Common blossom bat (*Syconycteris australis*) in New South Wales." Aust. J. Ecology 19:366-374. Strahan R. (1995) "The Mammals of Australia". Reed Books, Chatswood.	

Name	**Glossy black cockatoo** (*Calyptorhynchus lathami)*	
Status	Vulnerable – Schedule 2 TSC Act (1995)	
Geographical Distribution	This species occurs from about the Clarke Range in Queensland to Gippsland and the Central Highlands of Victoria along the eastern seaboard. It occurs as far west as the Riverina and Pilliga Scrub (Blakers *et al* 1984).	
Description	This is the smallest of the Black cockatoos with a body length of about 48cm. Plumage I brownish black, with two panels in the tail: these panels are bright red in males, barred and shot with yellow in females. The bill is more bulbous than that of the Red-tailed black cockatoo (Simpson and Day 1996).	
Habitat	Found in coastal forests and open inland woodland in eastern Australia. The Glossy black-cockatoos distribution is limited to habitat which contains sufficient seed reserves of their three favoured species of food trees: *Allocasuarina littoralis, Allocasuarina torulosa* and *A. verticillata* (Forshaw, 1981) and suitable large hollow bearing trees for nesting.	
Life Cycle Requirements	Foraging	It is noticeable that birds appear to favour a certain tree, perhaps when seeds are at correct maturity and sweeter, or perhaps the tree is easily accessible (Clout 1989).
	Breeding	The cockatoos require large hollows in tall mature Eucalyptus for nesting (Forshaw 1981). Successful breeding of this species is dependent on cones having high seed-fill rates (% of viable seed per cone). Higher seed fill rate, often in excess of 80% appears to be influenced by geology, soil and moisture (Garnett 1997 *in press*).
	Movements	This cockatoo is mainly sedentary with pairs isolating themselves from groups to breed and then rejoin the main group with their young (Joseph, 1989). This species live in loose groups of 2 to 20 birds (Blakers *et al* 1984). Groups may disperse over wider areas during times of reduced she-oak seed occurrence within their normal range. There are no known barriers to the movement of this species.
Conservation Reserves	Barrington Tops, Border Ranges, Bundjalung, Dorrigo, Gibraltar Range, Guy Fawkes River, Hat Head, New England, Nymboida, Washpool, Werrikimbe, Woko and Yuraygir National Parks.	
Threatening Processes	The Glossy black cockatoo is threatened by any action that significantly reduces the quantity, quality or availability of the seed crop of the preferred *Allocasuarina* species, and/or results in the removal or destruction of potential nest sites.	

References	Blakers, M. Davies, S.J.J.F.; and Reilly, P.N. (1984). The Atlas of Australian birds. RAOU and Melbourne University Press: Melbourne. Clout, M.N. (1989). Foraging behaviour of Glossy Black Cockatoos. Aust Wild. Res. 16, 467-473. Forshaw, J.M (1981). Australian Parrots. Second (revised) Edition. Lansdowne Press, Melbourne. Joseph, L. (1989). The Glossy Black-Cockatoo in the South Mount Lofty Ranges. South Australian Ornithologists, 30: 202-204. Simpson, K. & Day, N (1996). Field Guide to the Birds of Australia. Viking: Penguin Books, Sydney.

Name	**Grey-headed Flying Fox** (*Pteropus poliocephalus)*	
Status	Vulnerable (Schedule 2 TSC Act (1995); Tidemann *et al.*, 1999	
Recovery Plan	Under the *Threatened Species Conservation Act* 1995, a Recovery Plan for the Grey-headed Flying Fox is required to be prepared by 2006.	
Geographical Distribution	Occurs along the east coast from Bundaberg in Queensland to Melbourne in Victoria (Eby, 2000a). The distribution of this species has contracted south, formerly ranging north to Rockhampton (Eby, 2000a). This species may range to the western slopes of the Great Dividing Range in northern NSW (Eby, 1991). At any one time the majority of animals only occupy a small proportion of this entire range.	
Description	The Grey-headed Flying Fox has dark grey fur on the body, lighter grey fur on the head and a russet collar encircling the neck. This species can be distinguished from other flying-fox species by leg fur which extends to the ankle. Wing membranes are black and the wingspan can be up to one metre with a head and body length 23-30cm and weight of 600-1000g. (Tidemann, 1995 and Eby, 1995)	
Habitat	The Grey-headed Flying Fox inhabits "sub – tropical and temperate rainforests, tall sclerophyll forest and woodlands, heaths and swamps" (Eby, 1995). Urban gardens and cultivated fruit crops also provide habitat for this species.	
Life Cycle Requirements	Breeding/ nesting	Mating occurs annually with mating commencing in January, the majority to a single young.
	Foraging	The nectar and pollen of native trees, in particular *Eucalyptus, Melaleuca* and *Banksia* (Eby, 2000a), and fruits of rainforest trees and vines. This species is an important pollinator and seed-disperser of native trees.
	Movements	The Grey-headed Flying Fox migrate in response to food availability, sometimes travelling hundreds of kilometres. In addition, during periods when native food is limited, during periods when native food is limited, they disperse from colonial roosts, often foraging in cultivated gardens and fruit crops. This species occasionally inflicts severe crop damage during periods of native food shortage. (Ratcliffe, 1932; Eby, 1991; Parry-Jones & Augee, 1992). This results in large fluctuations of the numbers of this species in NSW from as few as 20% of the total population in winter up to around 75% of the total population in summer (Eby, 2000a).
Conservation Reserves	In NSW, Grey-headed Flying Fox have been recorded in numerous conservation reserves along the east coast, and the tablelands and eastern slopes of the Great Dividing Range.	
Threatening Processes	Destruction and fragmentation of roosting and foraging habitat pose significant threats to this species in NSW. Unregulated shooting, electrocution on power lines, persecution due to poor understanding of diseases they may carry and competition and hybridisation with the Black Flying-fox (*Pteropus alecto*).	

References	Eby, P. 1991. Seasonal movements of Grey-headed Flying-foxes, *Pteropus poliocephalus* (Chiroptera: Pteropodidae). From two maternity camps in northern New South Wales. *Wildlife Research* 18:547-559. Eby, P. 1995. The biology and management of flying-foxes in NSW; Species management report number 18 Llewellyn, L. (ed). NPWS, Hurstville. Eby, P. 2000a. The results of four synchronous assessments of relative distribution and abundance of Grey-headed Flying-fox *Pteropus poliocephalus*. In *Proceedings of a Workshop to Assess the Status of the Grey-headed Flying-fox in New South Wales*. Richards, G. (ed). http://batcall.csu.edu.au/abs/ghff/ghffproceedings.pdf Eby, P. 2000b. A case for listing Grey-headed Flying-fox *Pteropus poliocephalus* as threatened in NSW under IUCN creiterion A2. In *Proceedings of a Workshop to Assess the Status of the Grey-headed Flying-fox in New South Wales*. Richards, G. (ed). http://batcall.csu.edu.au/abs/ghff/ghffproceedings.pdf Parry-Jones, K.A. and Augee, ML. 1992. Movements of Grey-headed Flying Foxes (*Pteropus poliocephalus*) to and from a colony site on the central coast of New South Wales. *Wildlife Research* 19:331-340. Ratcliffe, F.N. 1932. Notes on the fruit bats (*Pteropus spp*.) of Australia. *Journal of Animal Ecology* 1:32-57. Tidemann, C.R., Eby P., Parry-Jones, K.A. and Vardon, M. 1999. Grey-headed Flying-fox. In *The Action Plan for Australian Bats*. Duncan, A., Baker, G.B. and Montgomery, N. (eds.). Environment Australia, Canberra.

Name	**Koala** (*Phascolarctos cinereus*)	
Status	Vulnerable – Schedule 2 TSC Act (1995)	
Geographical Distribution	The Koala has a broad distribution in eastern Australia, extending from South Australia through to north Queensland (Lee and Martin 1988). Reed *et al* (1990) noted that the distribution of the Koala in NSW was sparse on the south coast but there was a concentration of sightings on the north coast, northern tablelands and western slopes.	
Description	The Koala is an arboreal marsupial with woolly, pale to dark grey fur on the back, lighter on the underside. The tail is vestigial. Animals from the northern part of the range are smaller than those from the south (Martin and Handasyde 1995)	
Habitat	Koalas primarily inhabit Eucalypt woodlands and open forest and occasionally grazing lands and residential developments, although the later obviously do not constitute optimal habitat. Home ranges can vary from 1ha to 67ha depending on the resource availability (MKES 1994).	
Life Cycle Requirements	Breeding	Breeding occurs in summer. Females become sexually active at two years and produce one young each year after a gestation period of about 35 days. Weaning occurs at 12 months and at 18 months dispersal may occur. Females breed to more than 14 years of age (Martin and Handasyde 1995)
	Foraging	Schedule 2 of State Environmental Planning Policy No. 44 (SEPP 44) - Koala Habitat Protection, supplies a list of ten (10) Koala Feed Tree Species, noting that "almost all occurrences of Koalas in NSW have been associated with the presence of one or more of these species." The nominated species are; Forest red gum (*Eucalyptus tereticornis*), Tallowwood (*E. microcorys*), Grey gum (*E. punctata*), Ribbon gum (*E. viminalis*), River red gum (*E. camaldulensis*), Broad - leaved scribbly gum (*E. haemastoma*), Scribbly gum (*E. signata*), White box (*E. albens*), Bimple box (*E. populnea*) and Swamp mahogany (*E. robusta*). Department of Planning: 1995).
	Movements	The Koala is solitary. Home range size is related to the density of occurrence of large trees, preferred feed trees and population density. Homer range can vary from several hectares to 15ha in area (Mitchell 1990).
Conservation Reserves	Billinudgel NR, Bongil Bongil NP, Border Ranges NP, Broadwater NP, Broken Head NR, Brunswick Heads NR, Bundjalung NP, Chaelundi NR, Cudgen NR, Dorrigo NP, Iluka NR, Koreelah NP, Mallanganee NP, Mebbin NP, Mt. Warning NP, Nightcap NP, Richmond Range NP, Stotts Island NR, Toloom NP, Toonumbar NP, Ukerebagh NR and Wilson NR. In NSW, Koalas have been recorded in numerous conservation reserves along the east coast and the slopes and tablelands of the Great Dividing Range (NPWS 1999).	

Threatening Processes	The most serious threat to the koala is the removal of food trees (Braithwaite 1993). The optimal habitat of this species has been mainly cleared for agriculture and forestry activities.
References	Lee A.K. and Martin R.W. 1988. The Koala a Natural History. New South Wales University Press, Kensington. Reed P.C., Lunney D. and Walker P. 1990. A 1986-1987 survey of the koala *Phascolarctos cinereus* (Goldfuss) in New South Wales and an ecological interpretation of its distribution, in A.K. Lee, K.A. Handasyde and G.D. Sanson (Eds). Biology of the Koala. pp 55-74. Surrey Beatty and Sons, Sydney. Martin R.W. and Handasyde K.A. 1995. Koala *Phascolarctos cinereus* (Goldfuss, 1817), in R. Strahan (Ed). The Mammals of Australia. pp 195-198. Reed Books, Chatswood. Mitchell P. 1990. The home ranges and social activity of koalas – a quantitative analysis, in A.K. Lee, K.A. Handasyde and G.D. Sanson (Eds). Biology of the Koala. pp 171-187. Surrey Beatty & Sons, Sydney.

Name	**Large-footed myotis** (*Myotis macropus*)	
Status	Vulnerable – Schedule 2 TSC Act (1995)	
Geographical Distribution	This species is widely but sparsely distributed in eastern and northern Australia in coastal and sub-coastal regions. This species has been redefined in a recent taxonomic revision to include two similar species in eastern Australia. *Myotis macropus* is relatively common in riparian habitat in the study region.	
Description	The species is normally grey-brown above, paler below, but the fur gets more ginger as the bats get older. The feet are exceptionally large. Head and body length is 52-56mm (Richards 1995b).	
Habitat	This species roosts in tunnels and caves, and prefers riparian habitat over 500m in length Hall and Richards (1979). It generally requires forested waterways with nearby roosting opportunities. The most significant foraging habitats for this species are streams, creeks, rivers, lagoons, lakes and other waterbodies and their banks.	
Life Cycle Requirements	Breeding/ Roosting	The Large-footed myotis has been recorded roosting in caves, mines, tunnels, bridges, buildings and dense foliage in tropical areas. Males establish territories within the colony and monopolise a cluster of females during the breeding season (Strahan 1995). This species goes into torpor during winter and utilises caves during this period which are separate from maternity caves (SFNSW 1995).
	Foraging	This species forages by making feeding passes over the surface of water bodies for small aquatic insects, including water boatmen and mayflies Vestjens and Hall (1977). It seldom occurs far from waterbodies which range from rainforest streams to large reservoirs and even brackish water (Richards 1991c).
	Movements	This species is now known to travel significant distances from roost sites in caves to forage areas. Bats from a colony at Samford near Brisbane have been observed to fly each night to feed on a Lake 10km away (Richards *pers. comm*. 1998).
Conservation Reserves	Border Ranges, Bundjalung, Nightcap, Nymboida National Parks.	
Threatening Processes	State wide threats to this species include toxic accumulation of agricultural chemicals (such as pesticides and herbicides) in body fat used during winter torpor (Dunsmore *et al* 1974), predation at roost sites from foxes (Dwyer 1964), and destruction and modification of foraging habitat.	

References	Richards, G.C. (1995). Large-footed myotis *Myotis macropus* (Morsfield 1824). In: Strahan, R. (Ed). Mammals of Australia. The Australian Museum and Reed Books Sydney Richards (1991) Yellow bellied sheath-tail bat In: Strahan, R. (Ed). Mammals of Australia. The Australian Museum and Reed Books Sydney, p.315 Hall, L.S. and Richards, G.C (1979) "Bats of Eastern Australia" Booklet No. 12. Queensland Museum, Brisbane. Strahan R. (1995) "The Mammals of Australia". Reed Books, Chatswood. Dunsmore, J.D., Hall, L.S. & Kottek, K.H. (1974). "DDT in the Bent-winged Bat in Australia". Search 5: 110-111. State Forests of NSW. (1995) "Coffs Harbour Urunga Management Area – Environmental Impact Statement. Vol C, Proposed forestry operations - Schedule 12 Fauna." SFNSW, Northern Region. Dwyer, P.D. (1964). "Fox Predation on Cave Bats". Australian Journal of Science 26: 397-98. Vestjens, W.J.M. and Hall, L.S (1977). Stomach contents of forty two species of bat from the Australasian region. Australian Wildlife Research, 4: 25-35.

Name	**Little bent-wing bat** (*Miniopterus australis*)	
Status	Vulnerable –Schedule 2 TSC Act (1995).	
Geographical Distribution	Regionally, this species is widely distributed with records from coastal districts to the Great dividing range. This species becomes increasingly coastal in the southern part of its range in eastern Australia. In north eastern NSW it occurs from the Macleay River watershed to the Hunter River. Nationally this species occurs along the coastal plains and adjacent ranges from Cape York to north east NSW and around the Hunter Valley (Strahan 1992).	
Description	This bat is chocolate brown on the upper surface, with paler fur on the underside. It is similar to M. schreibersii but tends to have lighter and more subtle shades of colour and can be distinguished by smaller size and lighter weight (Dwyer 1995b).	
Habitat	The Little bentwing bat is generally found in forested areas, particularly well timbered habitats, where it forages below and above the tree canopy (Dwyer 1995b).	
Life Cycle Requirements	Foraging	Dwyer (1991) identifies this species as a sub-canopy forager, however Strahan (1992) notes that the Little Bent-wing Bat feeds above the forest canopy in wet and dry open forest, catching insects on the wing.
	Roosting	This species roosts in caves, old mines, stormwater channels and buildings. Roost sites tend to be located adjacent to large areas of dense vegetation.
	Movements	It is known to migrate over large distances to maternity sites, apparently using different roosts for different seasonal needs (Dwyer 1991).
Conservation Reserves	Border Ranges, Broadwater, Broken Head, Bundjalung, New England, Mt. Warning, Yuraygir National Parks, Iluka and Tyagarah Nature Reserves.	
Threatening Processes	State wide threats to this species include disturbance of maternity and winter roost sites from human visitation, destruction of roost sites in caves and mine tunnels, toxic accumulation of agricultural chemicals (such as pesticides and herbicides) in body fat used during winter torpor (Dunsmore *et al* 1974), predation at roost sties from foxes (Dwyer 1964), and destruction and modification of foraging habitat, which is assumed to be forested areas and wetlands.	
References	Dunsmore, J.D., Hall, L.S. & Kottek, K.H. (1974). DDT in the Bent-winged Bat in Australia. Search 5: 110-111. Dwyer, P.D. (1995b) Little bent-wing bat (Miniopterus australis). In The Australian Museum Complete book of Australian Mammals. R. Strahan (ed). Surrey Beatty and Sons, Sydney. Dwyer, P.D (1991b) Little bent-wing bat (Miniopterus australis). In The Australian Museum Complete book of Australian Mammals. R. Strahan (ed). Angus and Robertson, Sydney. Pp. 338-339. Dwyer, P.D. (1964). Fox Predation on Cave Bats. Australian Journal of Science 26: 397-98. Strahan R. (1992) Encyclopedia of Australian Animals: Mammals. Angus and Robertson Publishers, Sydney.	

Name	**Masked Owl** (*Tyto novaehollandiae*)

Status	Vulnerable – Schedule 2 TSC Act (1995)	
Geographical Distribution	Closely resembles the Barn owl from which it is not easily distinguished visually. Distinguishing characteristics are fully feathered legs as opposed to the sparsely feathered legs of the Barn owl.	
Description	The Masked owl occurs along all of coastal and sub coastal Australia except for a small section of the Western Australian coastline.	
Habitat	The southern subspecies novaehollandiae occurs from Cooktown in north-eastern Queensland, around the southern coast of Australia to the Pilbara in Western Australia (Schodde and Mason 1980). Although it occurs mainly on the coast, records also occur from the Nullabor Plain and up to 1000km inland along watercourses (Garnett 1992).	
Life Cycle Requirements	Forage	The preferred foraging areas of this species appear to be in open forests with a very sparse or grassy ground cover near creeks or small drainage lines, and near the ecotones between forest and natural or man made clearings (Kavanagh and Murray 1996). The diet of the Masked owl in disturbed environments has been observed to consist mainly of introduced species of small terrestrial mammals, particularly *Rattus rattus*, although birds have also been taken (Kavanagh and Murray 1996). In more intact forest, this species has been observed to feed most frequently on the Bush rat (*Rattus fuscipes*), Brown antechinus (*Antechinus stuartii*) and Dusky antechinus (*Antechinus swainsonii*) (Kavanagh 1996).
	Nesting	Nesting occurs at any time of the year with nests in deep vertical tree hollows (tall Eucalypts are favoured) or ledges in caves. Nests are prepared by the male and used for successive years. Masked owls roost during the day inside large Eucalypt hollows or among dense foliage and in caves (Debus 1993).
	Movements	This owl can range over an area of at least 200-300 hectares (and may range up to 3 km from any detection point). Recent studies by Kavanagh and Murray (1996) suggest that the Masked Owl may forage over a much larger area (over 1000ha) that may contain a mosaic of relatively undisturbed and disturbed environments.
Conservation Reserves	Barrington Tops, Border Ranges, Bundjalung, Dorrigo, Gibraltar, Guy Fawkes, Nightcap, Werrikimbe and Yuraygir National Parks. Limeburners Creek Nature Reserve.	
Threatening Processes	Threats to this species include loss of habitat and vehicle strike.	
References	Debus, S.J.S. (1993). The mainland Masked Owl *Tyto novaehollandiae* A Review. *Aust. Bird Watcher,* 15, 168-191. Garnett, S (1992). Threatened and Extinct Birds of Australia. RAOU Report 82. Kavanagh, R.P. (1996). The Breeding biology and Diet of the Masked owl *Tyto novaehollandiae* Near Eden, New South Wales. EMU, 96, pp 158-165 Kavanagh, R.P. and Murray, M. (1996). Home range, Habitat and Behaviour of the Masked Owl *Tyto novaehllandiae* near Newcastle, New South Wales. Emu, 96. Pp250-257 Schodde, R and Mason, I.J. (1980) Nocturnal Birds. Lansdowne Editions, Melbourne.	

Name	**Osprey** (*Pandion haliaetus*)	
Status	Vulnerable – Schedule 2 TSC Act (1995)	
Geographical Distribution	Most of the Australian coastline in suitable but limited habitat (Marchant and Higgins 1993).	
Description	Dark brown above with a mainly white head, neck and underside. A distinctive bold black stripe passes through the eye. A variable dusky breast band may be present. Length is 50 to 60cm, wingspan 145-170cm (Marchant and Higgins 1993).	
Habitat	Ospreys require adequate supplies of fish, expanses of open water, tall trees for use as feeding bases, nest sites and vantage points. The preferred habitats are coastal lakes, rivers, estuaries, oceans and beaches. Offshore islands are utilised, and this species may range inland along large rivers, particularly in the northern part of the country. Extensive sheets of clear open water, fresh, brackish or saline are needed for fishing.	
Life Cycle Requirements	Breeding/ nesting	This species breeds mainly on coasts and islands; nesting near the ocean or other large waterbodies for fishing, in open position for access and visibility, and in site protected from predators be height or surrounding water; often in a prominent position on rocky headlands, stacks, cliffs, palm trees, or in tall dead trees or on artificial platforms (Marchant and Higgins 1993).
	Foraging	Ospreys are specialist predators of live fish, taking prey often by submergence to a depth of one metre.
	Movements	The Osprey is mainly a sedentary species but forages over a wide area during the non breeding season. It remains faithful to nest sites and nest-site territories over successive years (Marchant and Higgins 1993).
Conservation Reserves	Broadwater, Broken Head, Bundjalung, Hat Head, Yuraygir National Parks, Limeburners and Iluka Nature Reserves.	
Threatening Processes	The main threats to the survival of this species are the loss of suitable feeding, nesting and roosting habitat and disturbance of nest sites by humans.	
References	Marchant, S. and Higgins, P.J. (eds) (1993) Handbook of Australian, New Zealand and Antarctic birds. Vol. 2 Raptors to Lapwings. Oxford University Press, Melbourne.	

Name	**Square-tailed kite** (*Lophoictinia isura)*	
Status	Vulnerable – Schedule 2 TSC Act (1995)	
Geographical Distribution	This species is widespread in its distribution throughout Australia but is uncommon in the arid shrublands and grasslands of central Australia (Debus and Czechura 1989).	
Description	The Square-tailed kite closely resembles several other hawks in appearance. The tail is long and broad with angular corners and shadowy grey and black bars below. At rest the wingtips extend past the tail. Other features include: pale, dark streaked head, slight crest, rufous dark-streaked body, blackish back, fawn mark on shoulder.	
Habitat	Habitat utilised is open forests and woodlands, particularly those on fertile soils and with abundant passerines. This species may range into open habitats nearby but not extensive treeless regions (Marchant and Higgins 1993).	
Life Cycle Requirements	Forage	The Square-tailed kite predates mainly on the fledglings and nestlings of passerines, lizards and insects. Kites usually forage singly among forests and woodlands at or just above the canopy.
	Nesting	Breeding occurs in Spring. Nests are built high in trees, typically on a large horizontal bough of a Eucalypt and 12 to 26m from the ground. Two or three eggs are laid, these hatch in 37 to 42 days and fledging takes 8 to 10 weeks (Marchant and Higgins 1993).
	Movements	The species is migratory through much of it's range and it is a spring/summer breeding migrant in the south-east, east and south-west of Australia (Marchant and Higgins 1993).
Conservation Reserves	Bundjalung and Gibraltar Range National Parks.	
Threatening Processes	Habitat destruction is the main threat to the survival of the Square-tailed kite, as at least half of the area of open dry eucalypt forest and woodland in southern and eastern Australia has been cleared for settlement or agriculture.	
References	Debus, S.J.S and Czechura, G.V. (1988). The Square-tailed Kite *Lophoictinia isura*: a review. Australian Birdwatcher, 13, 81-97. Marchant, S. and Higgins, P.J. (eds) (1993) Handbook of Australian, New Zealand and Antarctic birds. Vol. 2 Raptors to Lapwings. Oxford University Press, Melbourne.	

Name	**Squirrel glider** (*Petaurus norfolcensis*)	
Status	Vulnerable –Schedule 2 TSC Act (1995).	
Geographical Distribution	The range of the Squirrel glider has, in the past, been considered to lie to west of the Great Dividing Range and extend from western Victoria to northern Queensland (Strahan 1995). However recent records would tend to suggest that the Squirrel glider is also present in suitable habitat on the coastal lowlands of NSW and Queensland.	
Description	The Squirrel glider is similar to the Sugar glider but has a longer and more pointed face, longer and narrower ears and bushier tail and the facial markings often more distinct (Suckling 1995)..	
Habitat	The Squirrel glider occupies wet and dry sclerophyll forests (Smith & Winter 1984) with open dry sclerophyll forests regarded as optimum habitat (Tyndale-Biscoe & Calaby 1975). Although Davey (1984) has found Squirrel gliders in rainforest, it is unlikely that they occur extensively in this habitat type.	
Life Cycle Requirements	Foraging	Critical habitat consists of mixed stands of Eucalypts which invariably include gum barked species and high proportion of winter nectar producing trees. Mixed species Eucalypt forests may provide a more reliable year round food resource than do less diverse forests. This may attribute to the greater availability of microhabitats for invertebrates and to the availability of nectar for a greater part of the year.
	Nesting	Dens or hollows in trees are another critical habitat component and Squirrel gliders require several hollow trees within a home range. Dens are communal and are occupied by 2-9 adults (Quin 1993).
	Movements	In Victoria (Traill & Coates 1993) have estimated the home range of the Squirrel glider to be 13 hectares with an average density of 0.4 individuals/hectare. The Squirrel glider generally has a higher density than the Sugar glider and as a result where the two occur together the Squirrel glider is usually the more common (Suckling 1984).
Conservation Reserves	Border Ranges, Bundjalung, Mt. Warning, new England, Washpool, Werrikimbe, Yuraygir National Parks. Limeburners Creek Nature Reserve.	
Threatening Processes	Threats to Squirrel glider populations are likely to include: clearing of habitat *which* provides critical habitat components, particularly older Eucalypt stands which provide a large number of hollow bearing trees. Domestic animals, particularly cats are a major threat. Squirrel glider kills have been observed where motor vehicles pass through or near habitat (based on AKF 1995).	
References	Davey, S.M. (1984). Habitat preferences of arboreal marsupials within coastal forests in Southern NSW. In: Smith, A.P. and Hume, I.D. (Eds.) *Possums and Gliders*. Surrey Beatty and Sons, Chipping Norton, Sydney, pp. 509-516 Tyndale-Biscoe, C,H and Calaby, J.H. (1975) Eucalypt forests as refuges for wildlife. Australian Forestry 38, 117-133.	

	Quin, D.G. (1993). Socio-ecology of the Squirrel Glider and the Sugar Glider. PhD Thesis, University of New England, Armidale. Strahan R. (1995). The Mammals of Australia. Reed Books, Chatswood. Suckling, G.C. (1984). Population ecology of the sugar glider, *Petaurus breviceps*, in a system of fragmented habitats. *Aust. Wild. Res.* 11: 49-75.Traill, B.J. and Coates, T.D. (1993). Field Observations on the Brush-tailed Phascogale (*Phascogale tapoatafa*) Marsupalia: Dasyuridae. *Australian Mammalogy*, 16: 61-65.

Name	**Stephens' banded snake** (*Hoplocephalus stephensii*)	
Status	Vulnerable – Schedule 2 TSC Act (1995)	
Geographical Distribution	On the coast and Great Dividing Range from Gosford in NSW to Kroombit Tops is southern Queensland (Wilson and Knowles 1988).	
Description	A medium sized (65cm) nocturnal semi-arboreal snake. The dorsal surface is usually brownish to yellowish and can have the colour pattern of broad dark cross bands, but is may lack this pattern entirely. The head is black with a brown or creamy patch either side of the nape. The lips are barred with black and cream (Cogger 1994).	
Habitat	Stephens' banded snake inhabits dry and moist hardwood forest and rainforest in coastal and near coastal areas (Cogger 1992; Wilson and Knowles 1988). It also occurs in rocky outcrops, particularly those comprising exfoliated granite (Wilson and Knowles 1988; Ehmann 1992) and occasionally sandstone in the southern parts of its range (Wells *et al* 1988). The key elements of the preferred habitat for Stephens' banded snake are a dense understorey and canopy structure which are required for foraging and movement.	
Life Cycle Requirements	Forage	Hollows, tree scars and loose bark in mature or senescent trees, and to a lesser extent large hollow logs, are required for foraging. It feeds in the canopy as well as on the ground. Prey is lizards and small mammals, including bats, that occur in the tree canopy or in its roost site in trees (Ehmann 1992).
	Breeding	Breeding habitat is analogous with sheltering habitat. Females appear to reproduce every two years, producing a litter of 3 to 8 young in December to February.
	Shelter	Hollows, tree scars and loose bark in mature or senescent trees, and to a lesser extent large hollow logs, are required for sheltering sites.
	Dispersal	Not known.
Conservation Reserves	Mt. Warning, Dorrigo, Nymboida, Gibraltar Range and Border Ranges National Parks	
Threatening Processes	Stephens' banded snake is threatened by habitat loss brought about by logging and Clearing Rainforest, Dry hardwood forest and Moist hardwood forest.	
References	Cogger, H. (1992). Reptiles and Amphibians of Australia. Reed International Books. Cogger, H. (1994) Reptiles and Amphibians of Australia. Reed International Books. Ehmann H., (1992). Encyclopaedia of Australian Animals. Reptiles. Angus and Robertson 495pp. Wells, R.W., Wellington, C.R. & Williams D.J (1988) Notes on Stephens' Banded Snake *Hoplocephalus stephensii* Krefft, 1869. The Australian Herpetologist No. 512. Wilson, S.K. and Knowles, D.G. (1988) Australia's reptiles: A photographic Guide to the terrestrial Reptiles of Australia. Collins, Sydney.	

Name	**Wallum froglet** (*Crinia tinnula*)

Status	Vulnerable – Schedule 2 TSC Act (1995)	
Geographical Distribution	Strictly coastal from Tin Can Bay in Queensland to Wyong in NSW. Distribution along this strip is not continuous.	
Description	Similar in most respects to the Common Eastern froglet (*Crinia signifera*) from which it differs in having a median line of white dots on the throat, a more pointed snout and a distinctive call.	
Habitat	In NSW this species is most often recorded from coastal heath sites and Paperbark swamps. In Queensland this species is associated with Paperbark swamps on coastal alluvial sands (Straughan and Main 1966)	
Life Cycle Requirements	Breeding	Breeding occurs in ephemeral sites such as larger puddles in heath or puddles in watercourses and creek-lines (White 1995). Breeding also occurs on the periphery of permanent wetlands and drains (J. Richard pers. obs.)
	Foraging	The Wallum froglet appears to feed on small arthropods in sedges and grasses around the fringes of wetland or wet heathland sites (AMBS 1995).
	Dispersal	The Wallum froglet will disperse into highly disturbed habitats such as grasslands during flood events (J. Richard pers. obs).
Conservation Reserves	Broadwater NP, Bundjalung NP, Yuraygir NP, Myall Lakes NP, Tyagarah NR, Broken Head NR.	
Threatening Processes	The Wallum froglet is threatened by the loss of coastal wetland and wet heath habitats, and declines in the quality of water entering such habitats.	
References	Australian Museum Business Services (1995). Urbenville Management Area - Fauna Impact Statement Vol. D. State Forests of N.S.W., Pennant Hills. Straughan, I.R. and Main, A.R. (1966). Speciation and polymorphism in the genus Crinia (*Anura Leptodactylidae*) in Queensland. Proceedings of the Royal Society of Queensland, 78, 11-28. White (1995) *Crinia tinnula* distribution extension. Frogcall. Newsletter of the NSW Frog and Tadpole Study Group.	

Name	**Yellow-bellied glider** (*Petaurus australis)*	
Status	Vulnerable – Schedule 2 TSC Act (1995)	
Recover Plan	NSW National Parks and Wildlife Service (2003). Recovery Plan for the Yellow-bellioed Glider (*Petaurus australis*). NSW National Parks and Wildlife Service, Hurstville.	
Geographical Distribution	The Yellow-bellied glider has a patchy distribution along the east coast and adjacent ranges of Australia from south-eastern South Australia to North Queensland. The southern subspecies *P. australis australis* occurs along the east coast of Australia to central Queensland and the northern subspecies *P.a. reginae* occurs in two small populations in North Queensland (Russell 1995).	
Description	Grey fur above, whitish to orange fur underneath and large bare ears. Individuals have a gliding membrane that extends from the wrists to the ankles. The head and body is much longer than that of the Sugar or Squirrel glider but shorter than in the Greater glider. Tail is fluffy and about one and a half times the length of its body and relatively much longer than in other gliders. Males and females are similar in appearance.	
Habitat	Preferred habitats are productive, tall open sclerophyll forests where mature trees provide shelter and nesting hollows and yearround food resources are available from a mixture of eucalypt species (Goldingay & Kavanagh 1991; Tanton 1994; Craig 1985).	
Life Cycle Requirements	Breeding	A single young is born between May and September, with the variation likely to reflect the abundance of food resources (Goldingay & Kavanagh 1991). The yound remains in the pouch for up to 100 days after which time it is left in the nest while the mother forages. After leaving the pouch, the young is suckled for up to 60 days (Russell 1995).
	Foraging	Primarily made up of eucalypt nectar, eucalypt sap, honeydew, manna and invertebrates found under decorticating bark and pollen (Goldingay & Kavanagh 1991). Incises the bark of eucalypts to obtain sugar-rich sap.
	Dispersal	Homerange between 30 and 65 ha (Goldingay & Kavanagh 1991) usually occurs in densities of 0.05-0.14 individuals per ha (Russell 1995). This is a gregarious species and lives in family groups of between 3 (in southern parts of its range) and 6 (in the north).
Conservation Reserves	Yellow-bellied glider occurs in various conservation reserves along the east coast and adjacent inland areas in NSW (NPWS 1999).	
Threatening Processes	The loss and fragmentation of habitat through clearing and the activities associated with clearing is a threat as the logging of oldgrowth elements removes the number of hollow bearing trees available for nesting. Inappropriate fires regimes reduces the availability of food resources and isolates populations making them vulnerable. Predation by feral carnivores such as foxes and cats is also a threat.	

References	Craig, S.A. 1985. Social organization, reproduction and feeding behaviour of a population of Yellow-bellied Glider *Petaurus australis* (Marsupalia: Petauridae). *Australian Wildlife Research* 12:1-18. Goldingay, R.L. and Kavanagh, R.P. 1991. The Yellow-bellied Glider: a review of its ecology, and management considerations, in D. Lunney (Ed.) Conservation of Australia's Forest Fauna. Royal Zoological Society of NSW, Mosman. Russell, R. 1995. Yellow-bellied Glider *Petaurus australis* Shaw 1791, in R. Strahan (Ed.) The Mammals of Australia. Reed Books, Chatswood. Tanton, M.T.T. 1994. Fauna Impact Statement. Proposed Forestry operations in the Eden Management Area. Environmental Impact Statement. Vol. B: Appendix 1. State Forests of NSW, Sydney.